

California High-Speed Train Project



TECHNICAL MEMORANDUM

Capital Cost Estimating Methodology for the 15% Design Level TM 1.1.19

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System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memoranda. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the System Level technical and integration review by any Subsystem must be approved by the Engineering Manager.

System Level Technical Reviews by Subsystem:

Systems:	<u>Signed document on file</u> Richard Schmedes	<u>30 Jun 09</u> Date
Infrastructure:	<u>Signed document on file</u> John Chirco	<u>7 July 09</u> Date
Operations:	<u>Signed document on file</u> Paul Mosier	<u>7 July 09</u> Date
Maintenance:	<u>Signed document on file</u> Paul Mosier	<u>7 July 09</u> Date
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ABSTRACT

This technical memorandum describes the Capital Cost Estimating Methodology (CCEM) for the California High Speed Train Project (CHSTP) and provides guidance for preparing and presenting estimated capital costs for the project's 15% Design level. It is expected that a uniform methodology for the preparation of capital costs will promote the development of complete and consistent cost information for the high-speed train alignment and facilities in each of the project's geographic sections.

This document describes the roles and responsibilities for preparing capital cost estimates, defines the estimating tasks, and outlines the procedures and standards that will be used to prepare the capital cost estimates. The methodology for estimating the project's capital costs is required to determine the fiscal requirements for the project and provide necessary information for the cost-effectiveness analysis, project financial planning and implementation.

1.0 INTRODUCTION

1.1 PURPOSE OF TECHNICAL MEMORANDUM

The purpose of this technical memorandum is to provide guidance for the preparation of reliable and accurate capital cost estimates for the 15% Design level.

This memo describes the preparation of a program wide Capital Cost Estimating Methodology (CCEM) for the California High-Speed Train Project (CHSTP). With its size, complexity, phased design, and number of participants, it is important that the CCEM is flexible enough to be applied at each point in the project development process to appropriately support the tracking, monitoring and control of cost changes through each if the program's design and implementation phases. This document addresses only the capital cost estimating requirements for the 15% Design level. Additional guidelines will be developed for the preparation of capital cost estimates for subsequent phases of the high-speed rail project.

1.2 STATEMENT OF TECHNICAL ISSUE

The guidance in this technical memorandum is intended to address the preparation of a program cost estimate, including construction, acquisition of right-of-way, engineering and management and related costs that may arise during execution of the project.

The CCEM is intended to provide guidelines for accurately and consistently estimating the costs of capital infrastructure and systems for the 15% Design level. It will also provide a framework for defining the scope and technical basis for the estimates, the roles and responsibilities for specific estimating tasks among the project participations, and the structure, organization, and format for reporting capital costs.

1.3 GENERAL INFORMATION

1.3.1 Definition of Terms

Technical terms, acronyms, or other cost estimating terminology specifically used for capital cost estimating purposes, unless otherwise indicated, will follow the standard definition of terms published by the Association for the Advancement of Cost Engineering (AACE) International in their Recommend Practice No. 10S-90 – Cost Engineering Terminology.

The following acronyms used in this document have specific connotations with regard to California High Speed Train system.

Acronyms

AACE	Association for the Advancement of Cost Engineering
CCEM	Capital Cost Estimating Methodology
Authority	California High-Speed Rail Authority
CHSTP	California High-Speed Train Project
ENR	Engineering News Record
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
LCCA	Life Cycle Cost Analysis
O&M	Operating and Maintenance
PMT	Program Management Team
RC	Regional Consultant(s)
SCC	Standard Cost Categories
TM	Technical Memorandum
WBS	Work Breakdown Structure

1.3.2 Units

The California High-Speed Train Project is based on U.S. Customary Units consistent with guidelines prepared by the California Department of Transportation and defined by the National Institute of Standards and Technology (NIST). U.S. Customary Units are officially used in the United States, and are also known in the US as “English” or “Imperial” units. In order to avoid confusion, all formal references to units of measure shall be made in terms of U.S. Customary Units.

Guidance for units of measure terminology, values, and conversions can be found in the Caltrans Metric Program Transitional Plan, Appendice B U.S. Customary General Primer (<http://www.dot.ca.gov/hq/oppd/metric/TransitionPlan/Appendice-B-US-Customary-General-Primer.pdf>). Caltrans Metric Program Transitional Plan, Appendice B can also be found as an attachment to the CHSTP Mapping and Survey Technical Memorandum.

2.0 DESIGN STANDARDS AND GUIDELINES

2.1 CAPITAL COST ESTIMATING METHODOLOGIES

Estimating methodologies are not static and must be flexible enough to adjust to the needs of the project's stage in the development process. The development process is described by the overall level of engineering design associated with the major development stages defined for the CHSTP:

Development Stage	Engineering Design Completion			
Programmatic EIR/S	0-5%			
Project EIR/S	0-10%			
15% Design Level		10-15%		
30% Design Level			15-30%	
Design-Build				30-100%
	0	15%	30%	90% 100%

Each development stage is represented by a range of engineering design completion and influenced by ongoing updates to the ridership demand forecast and associated revisions to estimated system capacity, service design and operating plans. Because of this variability, the appropriate estimating methods or procedures at a given milestone will be based on the actual levels of project engineering and scope definition present at that time. Because the program will be designed in multiple segments, the level of engineering design completed for major high-speed train system elements will be at different levels at any point in time. The goal of using established estimating methodologies is to assure that project estimates are prepared in a consistent and uniform manner, organized and standardized in methods, and formatted in order to facilitate estimate review and reporting.

2.2 POLICY CONSIDERATIONS

2.2.1 Estimating Format

A consistent format is required for the reporting, estimating, and managing of the project's capital costs. This document recommends using standard cost categories (SCC) similar to those developed by the Federal Transit Authority (FTA) in order to facilitate the tracking, evaluation, and control of changes over the life of the high-speed train project. FTA's cost categories will be modified as appropriate for the CHSTP. Preparation of capital costs in SCC format will be required throughout the preliminary design.

2.2.2 Estimating Software

In order to provide for uniformity between numerous corridors and Regional Consultants as well as a consistent platform to allow for anticipated reporting and analysis requirements of the program wide cost estimates, a commercially available database software system will be used for the program-level compilation and reporting tasks performed by the PMT. Regional Consultants have the option of preparing quantity and cost information using any appropriate software for the estimating tasks that are their responsibility. Regional Consultants will be required to present summary quantities in Microsoft Excel. Standard Excel templates will be developed for tasks such as quantity takeoffs and provided to all project participants.

3.0 ASSESSMENT AND ANALYSIS

3.1 ROLES AND RESPONSIBILITIES

Project participants will work on different and/or multiple high-speed train corridors and will be working at varying stages of project development concurrently. Recognizing that the development of capital cost estimates involves the execution and coordination of a number of estimating tasks, one of the critical issues is the assigning of roles and responsibilities for these tasks.

The primary project participants that have a role in the Capital Cost Estimating Program are:

- California High-Speed Rail Authority (Authority)
- Program Management Team (PMT)
- Regional Consultants (RC)

Table 3-1 identifies the areas of responsibility for each estimating task, by participant, for the project's 15% Design level.

Table 3-1 Roles and Responsibilities for 15% Design

Task Estimating Task		15% Design Level		
		Authority	PMT	RC
1	Work Breakdown Structure (WBS)	R	P	-
2	Unit Prices	R	P	R
3	Quantity Takeoffs	-	-	P / R
4	Construction Cost Estimate	R	P	R
5	Property Takes and Easement Qty	-	R	P
6	Right-of-Way Cost Estimate	R	R	P
7	Rolling Stock Procurement Estimate	R	P	-
8	Program Implementation Add-ons	R	P	-
9	Program Wide Cost Estimate	R	P	-
10	Estimate Validation	R	P	P

Legend: **P** = Perform Work **R** = Review Work

3.2 ESTIMATING TASKS

3.2.1 Task 1 - Work Breakdown Structure (WBS)

This task involves the development of the Work Breakdown Structure (WBS) that will be applied to cost estimating and cost reporting. The WBS for estimating will include a coding system that will be used for estimating elements such as unit prices, quantities, labor, materials, etc. The WBS for reporting includes the development of a coding system that allows the cost estimates to be sorted and presented by elements such as geographic region, political or municipal boundaries, construction package, schedule activity, and similar project elements.

The WBS for capital cost estimates for the 15% Design level is based upon the CHSTP Standard Cost Categories. The WBS, inclusive of the standard cost categories, is presented in Appendix A. The CHSTP Standard Cost Categories are based on those developed for the Federal Transit Administration (FTA). These established categories were developed for new rail transit projects and are well-known to estimating practitioners. As a reference, source information on the current FTA guidelines can be found at:

Federal Transit Administration – Technical Guidelines Section

http://www.fta.dot.gov/printer_friendly/planning_environment_2580.html

3.2.2 Task 2 – Unit Prices

This task involves the development of construction unit prices for each of the construction activities that will be identified and quantified from the design documents in accordance with Section 3.5 Cost Estimate Pricing Methods for 15% Design. The development of individual or composite unit prices will be accomplished through the use of historical bid data and by unit cost analysis, as appropriate, using labor, equipment and material rates. Unit prices will be expressed in current year dollars and will be adjusted to reflect any regional variations typically seen in the state.

The PMT will prepare a list of unit cost elements and the units of measure to be estimated for 15% Design level. Appendix B presents the list of cost elements for the 15% Design Level. In addition, the PMT will prepare the units of measure and unit prices for the 15% Design Level. If required, an adjustment of unit prices to reflect specific, geographic information, conditions and configurations will be performed by the PMT in conjunction with the Regional Consultants.

3.2.3 Task 3 – Quantity Takeoffs

This task involves preparing estimated quantities, either by direct measurement and calculation of construction elements that are shown in design drawings, electronically calculated for CADD files or established as an allowance quantity based on professional experience and judgment.

No specific methodology will be prescribed for estimating quantities for the 15% Design level. Regional Consultants shall identify and use the appropriate source and methodology used for quantity take-offs. The intent is to leave a reviewable trail for quantities to be checked or spot-checked by others.

The PMT will develop a template with the 15% Design unit cost items and units of measure that the Regional Consultants will use to record and transmit estimated quantities. Regional Consultants will prepare the Basis of Estimate in accordance with Section 3.4.1, as well as prepare and transmit final quantities in the Unit Cost Summary template prepared by the PMT.

3.2.4 Task 4 - Construction Cost Estimate (including Contingency)

This task involves the assembly and calculation of cost estimates for construction related activities using data developed in Tasks 1-3 and procedures described in Section 3.4 Preparation of 15% Cost Estimates, Section 3.5.4 Base Year and Escalation, and Section 3.5.5 Program Implementation, along with the application of appropriate contingencies as presented in Section 3.5.3 Contingency. The PMT will establish baseline contingencies for major cost categories for the 15% Design level, as presented in Table 3-2. Regional Consultant's may adjust contingency values, if appropriate, based on information about each of the project's geographic segments. The analysis and selection of appropriate contingencies will be informed by CHSTP risk assessment and risk management practices. The PMT will prepare program-level cost estimates based on the contingency values that are agreed upon by the PMT and Regional Consultants.

3.2.5 Task 5 – Property Takes and Easement Quantities

This task involves preparing estimated quantities of impacted properties, either permanent takes or temporary easements, which result from construction, operation, and maintenance of proposed high-speed train alignment alternatives. The identification of property related impacts that need to be quantified must be performed in coordination with the methodology that will be used to develop the right-of-way cost estimates described in Task 6 – Right-of-Way Cost Estimates.

Regional Consultants will be responsible for preparing quantity estimates for property takes and easements.

3.2.6 Task 6 – Right-of-Way Cost Estimate (including Contingency)

This task involves applying professional experience and judgment in the area of property valuation, business damages, and legal and administrative issues as they relate to the estimation of right-of-way costs. The means and methods used to develop these cost estimates will have a direct effect on Task 5 and on how property impacts are identified and quantified.

Regional Consultants will determine appropriate methodologies for determining, quantifying, and estimating real property costs. Regional Consultants will estimate costs to acquire right-of-way and property interests required for the construction, operation, and maintenance of the high-speed train system.

3.2.7 Task 7 – Rolling Stock Procurement Estimate

This task involves estimating the costs associated with the procurement of rolling stock, including both revenue and non-revenue vehicles. Cost estimates for this task will be dependent on the vehicle technology that is ultimately selected.

The PMT will prepare the rolling stock procurement estimate.

3.2.8 Task 8 – Program Implementation Add-ons

This task involves establishing percentage add-on allowances for project related professional services for items such as preliminary and final engineering, project and construction management, agency program management, project insurance, commissioning and testing, and project start-up costs. These allowances will be computed by applying percentage factors to the total estimated construction cost (Task 4), excluding right-of-way and rolling stock costs since the total cost for these two items will include the management and administration costs associated with these activities.

The PMT will prepare the professional service categories and percentage factors.

3.2.9 Task 9 – Assemble Program Wide Cost Estimate

This task involves compiling and maintaining a program wide cost estimate by combining construction costs (Task 4), right-of-way costs (Task 6), rolling stock procurement costs (Task 7), and applying professional services costs (Task 8) to produce an estimate of the overall CHSTP program.

The PMT will prepare the program wide capital cost estimate based on quantities that are prepared by the Regional Consultants.

3.2.10 Task 10 – Estimate Validation

Following preparation of the 15% Design level estimates, cost estimates will advance through a validation process as outlined in Section 3.5.6 Estimate Validation. This task will assemble subject matter experts in the areas of engineering, construction, and estimating to perform an independent review of the scope, assumptions and basis used to prepare the cost estimate. This process will provide a thorough vetting of each cost estimate before it is finalized.

In collaboration, the PMT and Regional Consultants will validate the 15% Design level cost estimates.

3.3 ESTIMATING METHODOLOGY AND STANDARDS

Multiple designers working concurrently on the project's multiple geographic segments requires that common design basis, criteria and standards; engineering assumptions; design guidance; and directive drawings are used to develop high-speed train alternatives and cost estimate quantities used in preparing the cost estimates. The following are guidelines and standards to be used in preparing the 15% Design level cost estimates.

3.3.1 Design Guidelines and Standards

CHSTP estimates shall be based on design guidelines defined in Technical Memoranda that have been issued or are under development. Criteria, guidelines and assumptions used to identify construction activities in capital cost estimates shall be in accordance with all approved technical memoranda and design guidance documents.

3.3.2 Software

Software for developing and preparing program capital cost estimates include standard spreadsheet programs, such as Microsoft Excel, or commercially produced database estimating programs.

No specific software is prescribed for the estimating quantities for the 15% Design level. However, Regional Consultants shall prepare quantity and transmit summary quantities in a Unit Cost Summary

template. This will provide uniformity between high-speed line segments performed by the Regional Consultants as well as provide a platform to allow for consistent input into program-level estimates. Standard Unit Cost Summary templates will be developed by the PMT for tasks such as quantity takeoffs and provided to Regional Consultants.

The PMT shall compile and prepare the overall program cost estimates using a commercially available database program that will allow for the anticipated reporting and analysis needs of the program-wide cost estimates. The database software will be used primarily as a tool to compile quantities, apply unit prices, contingencies and for reporting.

3.3.3 Coordination with Project Control Functions

There are a number of project controls disciplines that are typically associated with capital cost estimating that must be considered during the development of the CCEM. These include construction scheduling, cost and change control, and risk management.

Regional Consultants shall be responsible for the coordination between the project control functions, including preparation of cost-loaded schedules, etc. for their respective segments.

3.4 PREPARATION OF 15% COST ESTIMATE QUANTITIES

The following information shall be included in the 15% Design level cost estimate quantities shall be prepared by the Regional Consultants for each project segment:

- Letter of transmittal
- Basis of estimate
- Estimate reconciliation (if previous estimate exists)
- Estimate summary
- Details of estimate
- Quantity takeoff summary

A description of the information to be included is summarized in the following section.

3.4.1 Basis of Estimate

The Basis of Estimate provides specific information related to the estimate and shall provide the following information:

- Scope of Estimate – a brief written description of what the estimate covers.
- Drawings – references the engineering drawings or sketches on which the estimate is based. Drawing set titles or description and publication date shall be listed.
- Specifications - the specification (if any) on which the estimate is based.
- Estimate Format – a description of the format on which the estimate was based.
- Quantities - indicates how quantities were developed and calculated as well as any limitations.
- Construction Schedule - indicates start and finish dates and sequence of major phases of work if pertinent to the estimate.
- Cost Exclusions - a list of any items not included in the estimate that may become a Project expense.
- Estimate Discussion/Comments - identifies any items that can affect either cost or schedule and that have not been covered in any of the above paragraphs. It also lists observations, recommendations, or unusual features of the project, from the estimator's perspective.

Preparation of the Basis of Estimate is the responsibility of the Regional Consultants.

3.4.2 Estimate Reconciliation

Reconciliations will be made between current cost estimates and previous cost estimates. The goal of reconciliation is to identify and document significant changes that have occurred since the preparation of the prior capital cost estimate. Significant changes shall be identified in the reconciliation under one of three categories that best reflects the cause for the change: Quantity, Unit Price, or Scope. These changes shall be referenced to specific line items in the estimate and shall include a brief written description of the change.

The PMT will prepare the 15% Design level capital cost estimate reconciliation with the programmatic capital cost estimate based on input from the Regional Consultants. The 15% cost estimate will serve as the baseline cost for subsequent design phases.

3.5 COST ESTIMATE PRICING METHODS FOR 15% DESIGN

The PMT will develop unit prices based on common methods used for estimating unit prices, including:

- Historical bid prices
- Analysis of production rates, labor and equipment rates, and material costs for each construction activity.

These methods may be used either individually or in combination. For the 15% Design level, when limited engineering details are available, the historical bid price method will typically be used.

3.5.1 Historical Bid Price Method

Historical bid prices will typically be used to develop costs for common construction elements. When using this method, the time of bid and conditions of the historical project used for pricing shall be taken into account and factors applied as needed:

- Adjust bid prices where the bid date is older than 12 months from the current date by using an appropriate escalation factor
- Adjust bid prices to reflect conditions of the project, such as type of terrain, geographical location, soil, traffic and other related factors. For location factor adjustments, the City Cost Index as published by RS Means will be used.

Sources for historical bid prices that will be used may come from local, regional, statewide and national levels, as well as from international high-speed rail projects with unique high-speed elements. Historical unit prices that are used for the CHSTP will be verified for appropriateness and documented as to their source as well as any adjustments for site, escalation or location factors.

3.5.2 Unit Price Analysis Method

The unit price analysis method will typically be used to develop costs for complex construction elements such as tunneling and underground structures. This method allows for unit prices to be developed based on current local construction and market conditions, such as changes which might affect productivity or the cost of labor or materials. The following steps are required in order to develop a unit price using this method:

- Analyze the proposed construction conditions
- Estimate production rates
- Compile a list of materials
- Obtain materials prices using local available sources
- Determine labor and equipment rates
- Calculate direct unit price using the above factors
- Add allowances for contractor overhead and profit to arrive at a in place unit price

The following sources will be used to obtain basic cost data that is input into the database estimating program in order to develop any needed construction unit prices:

- Labor Rates – Federal Davis-Bacon Wage Determination and/or California Department of Industrial Relations Prevailing Wage Determinations.
- Equipment Rates – RS Means and/or Corp of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VII.
- Material Prices - Material and supply prices for locally available material will be obtained from local supplier quotes, if possible. Secondary sources of material cost data may be taken from RS Means, Engineering News-Report (ENR) or other published resource.

3.5.3 Contingency

Contingency, in the statistical sense, is the estimated percentage by which a calculated value may differ from its true or final value and is typically included in an estimate as an allowance for the level of engineering design completion or to address imperfections in the estimating methods used at the various project development stages. Contingency is typically added to a particular item or group of items by the use of percentage multipliers. Contingency is generally greatest for the early stage of project development and decreases with advancement in the level of engineering design. During the preliminary design of the high-speed train project, the limited level of design information that is available requires the use of contingency allowances that are allocated against specific construction or procurement cost categories. The percentage selected for a given cost category are generally based on professional judgment and experience relative to the historical cost variability typically seen for work within a particular cost category. For the purposes of this estimating program, contingency will be assigned into two major categories – allocated and unallocated.

Allocated contingency will be added based on an assessment of the quality of design information available for individual items of work and will typically fall in a range of 10% to 35%. The exact percentage selected for each cost category is based on professional judgment and experience related to the cost variability typically seen for items of work within a particular cost category. The percentages shown in Table 3-2 are values that will normally be used; however, slightly higher or lower values may be used if a project-specific condition warrants.

Unallocated contingency is typically included to address uncertainties that are more global in nature like schedule delays, changes in contracting environment, or other such issues that are not associated with individual construction activities.

Table 3-2 Allocated Contingency Percentages by Cost Category

Cost Category No.	Description	Allocated Contingency Percentage
10	Guideway and Track Elements	
	Guideway Elements (except underground)	25
	Guideway Elements (underground)	35
	Track Elements	20
20	Stations, Stops, Terminals, Intermodals	20
30	Support Facilities: Yards, Shops, Admin Buildings	20
40	Sitework & Special Conditions	
	Demolition, Clearing, Earthwork	25
	Site Utilities, Utility Relocation	30
	Hazardous materials, contaminated soil removal/mitigation, ground water treatments	30
	Environmental mitigation, e.g. wetlands, historic /archaeological, parks	30
	Site structures including retaining walls, sound walls	25
	Pedestrian / bike access and accommodation, landscaping	25
	Automobile, bus, van access including roads, parking lots	25
50	Systems	20
60	Right-of-Way, Land, Existing Improvements	50
70	Vehicles	10

3.5.4 Base Year and Escalation

Estimates will be prepared in Base Year dollars with the Base Year defined as the current calendar year. Unit costs will be updated annually or as required. For cost estimates with a base year that is older than the current calendar by one or more years, actual historical construction cost index values can be used to calculate the escalation rate to be applied to bring a cost from the period in question to the present. A cost estimate prepared in the current base year cost will be projected into a future calendar year by using a cost escalation factor.

There are a wide variety of published construction cost indexes and economic forecasting publications, from both governmental as well as private sources. These indexes are normally calculated using a set of defined construction or procurement commodities that the sponsoring group determines to be representative of the market sector that they are trying to monitor and predict. Some indexes track the in-place constructed cost for a set of commodities that include material, labor and equipment costs plus contractor's overhead and profit. Other indexes may only track certain material prices, labor costs, or the cost of goods and services sold. Another aspect of these indexes that can affect their usefulness is whether they are calculated using regional or national market information.

The CHSTP will consider a number of sources of information including Caltrans Highway Construction Index, California Department of Finance Economic Forecasts, and US Bureau of Labor Statistics Producer Price Index for highway construction, and construction economics data published by *Engineering News-Record* (ENR).

3.5.5 Program Implementation Costs

Program Implementation costs are included to represent the costs of engineering, project and construction management, contract administration, insurance, permits and fees, training/start-up/testing and any force account work. These add-on costs will be calculated as a percentage of construction costs only (excluding vehicle procurement and right-of-way costs) and are itemized below the construction cost subtotal. The percentages are applied individually and not cumulatively. Program Implementation costs for the 15% Design level are established based on the CHSTP 2008 Business Plan, which estimated these costs at 15% of the construction costs (including contingencies but excluding Right of Way cost). :

	<u>15% Design</u>
Program Management	3.5%
Preliminary Engineering / Environmental Assessment	2.5%
Final Design (estimated as part of construction cost)	4.5%
Construction Management	4.0%
Agency Costs	0.5%
Total	15.0%

3.5.6 Estimate Validation

A formal estimate validation meeting will be scheduled to include a select group of project participant's representing the Authority, PMT, Regional Consultants and potentially outside subject matter experts. The purpose of this meeting will be to provide an opportunity to discuss and confirm the design, construction and estimating inputs and assumptions used to prepare the estimate. All changes and adjustments that are accepted at this meeting will then be incorporated before the final estimate submittal. Estimates will be considered a draft until they receive a final review and approval by Authority staff. Authority approval is required prior to the release of any estimate information to anyone other than a project participant.

4.0 SUMMARY AND RECOMMENDATIONS

Recommended methodologies for preparing the 15% Design level capital cost estimate are presented in Section 6.0.

5.0 SOURCE INFORMATION AND REFERENCES

1. Capital Cost Estimating Program Manual – Charlotte Area Transit System (February 2006)
2. Federal Transit Agency - Standard Cost Categories
3. California High-Speed Train Project - 2008 Business Plan
4. International Association for the Advancement of Cost Engineering (AACE) - Recommended Practice No. 10S-90 – Cost Engineering Terminology
5. Association for the Advancement of Cost Estimating. International Practice No. 17R-97. Cost Estimate Classification System. TCM Framework: 7.3 – Cost Estimate and Budgeting. 2003.

6.0 DESIGN MANUAL CRITERIA

6.1 ROLES AND RESPONSIBILITIES

Project participants will work on different and/or multiple high-speed train corridors and will be working at varying stages of project development concurrently. Recognizing that the development of capital cost estimates involves the execution and coordination of a number of estimating tasks, one of the critical issues is the assigning of roles and responsibilities for these tasks.

The primary project participants that have a role in the Capital Cost Estimating Program are:

- California High-Speed Rail Authority (Authority)
- Program Management Team (PMT)
- Regional Consultants (RC)

Table 6-1 identifies the areas of responsibility for each estimating task, by participant, for the project's 15% Design level.

Table 6-1 Roles and Responsibilities for 15% Design Level

Task Estimating Task		15% Design Level		
		Authority	PMT	RC
1	Work Breakdown Structure (WBS)	R	P	-
2	Unit Prices	R	P	R
3	Quantity Takeoffs	-	-	P / R
4	Construction Cost Estimate	R	P	R
5	Property Takes and Easement Qty	-	R	P
6	Right-of-Way Cost Estimate	R	R	P
7	Rolling Stock Procurement Estimate	R	P	-
8	Program Implementation Add-ons	R	P	-
9	Program Wide Cost Estimate	R	P	-
10	Estimate Validation	R	P	P

Legend: **P** = Perform Work **R** = Review Work

6.2 ESTIMATING TASKS

6.2.1 Task 1 - Work Breakdown Structure (WBS)

This task involves the development of the Work Breakdown Structure (WBS) that will be applied to cost estimating and cost reporting. The WBS for estimating will include a coding system that will be used for estimating elements such as unit prices, quantities, labor, materials, etc. The WBS for reporting includes the development of a coding system that allows the cost estimates to be sorted and presented by elements such as geographic region, political or municipal boundaries, construction package, schedule activity, and similar project elements.

The WBS for capital cost estimates for the 15% Design level is based upon the CHSTP Standard Cost Categories. The WBS, inclusive of the standard cost categories, is presented in Appendix A. The CHSTP Standard Cost Categories are based on those developed for the Federal Transit Administration (FTA). These established categories were developed for new rail transit projects and are well-known to estimating practitioners. As a reference, source information on the current FTA guidelines can be found at:

Federal Transit Administration – Technical Guidelines Section

http://www.fta.dot.gov/printer_friendly/planning_environment_2580.html

6.2.2 Task 2 – Unit Prices

This task involves the development of construction unit prices for each of the construction activities that will be identified and quantified from the design documents in accordance with Section 3.5 Cost Estimate Pricing Methods for 15% Design. The development of individual or composite unit prices will be accomplished through the use of historical bid data and by unit cost analysis, as appropriate, using labor, equipment and material rates. All unit prices will be expressed in current year dollars and will be adjusted to reflect any regional variations typically seen in the state.

The PMT will prepare a list of unit cost elements and the units of measure to be estimated for 15% Design level. Appendix B presents the list of cost elements for the 15% Design Level. In addition, the PMT will prepare the units of measure and unit prices for the 15% Design Level. If required, an adjustment of unit prices to reflect specific, geographic information, conditions and configurations will be performed by the PMT in conjunction with the Regional Consultants.

6.2.3 Task 3 – Quantity Takeoffs

This task involves preparing estimated quantities, either by direct measurement and calculation of construction elements that are shown in design drawings, electronically calculated for CADD files or established as an allowance quantity based on professional experience and judgment.

No specific methodology will be prescribed for estimating quantities for the 15% Design level. Regional Consultants shall identify and use appropriate source and methodology used for quantity take-offs. The intent is to leave a reviewable trail for quantities to be checked or spot-checked by others.

The PMT will develop a template with the 15% unit cost items and units of measure that the Regional Consultants will use to record and transmit estimated quantities. Regional Consultants will prepare the Basis of Estimate in accordance with Section 6.4.1, as well as prepare and transmit final quantities in the Unit Cost Summary template prepared by the PMT.

6.2.4 Task 4 - Construction Cost Estimate (including Contingency)

This task involves the assembly and calculation of cost estimates for construction related activities using data developed in Tasks 1-3 and procedures described in Section 6.4 Preparation of 15% Cost Estimates, Section 6.5.4 Base Year and Escalation, and Section 6.5.5 Program Implementation, along with the application of appropriate contingencies as presented in Section 6.5.3 Contingency. The PMT will establish baseline contingencies for major cost categories for the 15% Design level, as presented in Table 6-2. Regional Consultants may adjust contingency values, if appropriate, based on information about each of the project's geographic segments. The analysis and selection of appropriate contingencies will be informed by CHSTP risk assessment and risk management practices. The PMT will prepare program-level cost estimates based on the contingency values that are agreed upon by the PMT and Regional Consultants.

6.2.5 Task 5 – Property Takes and Easement Quantities

This task involves preparing estimated quantities of impacted properties, either permanent takes or temporary easements, which result from construction, operation, and maintenance of proposed high-speed train alignment alternatives. The identification of property related impacts that need to be quantified must be performed in coordination with the methodology that will be used to develop the right-of-way cost estimates described in Task 6 – Right-of-Way Cost Estimates.

Regional Consultants will be responsible for preparing quantity estimates for property takes and easements.

6.2.6 Task 6 – Right-of-Way Cost Estimate (including Contingency)

This task involves applying professional experience and judgment in the area of property valuation, business damages, and legal and administrative issues as they relate to the estimation of right-of-way costs. The means and methods used to develop these cost estimates will have a direct effect on Task 5 and on how property impacts are identified and quantified.

Regional Consultants will determine appropriate methodologies for determining, quantifying, and estimating real property costs. Regional Consultants will estimate costs to acquire right-of-way and property interests required for the construction, operation, and maintenance of the high-speed train system.

6.2.7 Task 7 – Rolling Stock Procurement Estimate

This task involves estimating the costs associated with the procurement of rolling stock, including both revenue and non-revenue vehicles. Cost estimates for this task will be dependent on the vehicle technology that is ultimately selected.

The PMT will prepare the rolling stock procurement estimate.

6.2.8 Task 8 – Program Implementation Add-ons

This task involves establishing percentage add-on allowances for project related professional services for items such as preliminary and final engineering, project and construction management, agency program management, project insurance, commissioning and testing, and project start-up costs. These allowances will be computed by applying percentage factors to the total estimated construction cost (Task 4), excluding right-of-way and rolling stock costs since the total cost for these two items will include the management and administration costs associated with these activities.

The PMT will prepare the professional service categories and percentage factors.

6.2.9 Task 9 – Assemble Program Wide Cost Estimate

This task involves compiling and maintaining a program wide cost estimate by combining construction costs (Task 4), right-of-way costs (Task 6), rolling stock procurement costs (Task 7), and applying professional services costs (Task 8) to produce an estimate of the overall CHSTP program.

The PMT will prepare the program wide capital cost estimate based on quantities that are prepared by the Regional Consultants.

6.2.10 Task 10 – Estimate Validation

Following preparation of the 15% Design level estimates, cost estimates will advance through a validation process as outlined in Section 6.5.6 Estimate Validation. This task will assemble subject matter experts in the areas of engineering, construction, and estimating to perform an independent review of the scope, assumptions and basis used to prepare the cost estimate. This process will provide a thorough vetting of each cost estimate before it is finalized.

In collaboration, the PMT and Regional Consultants will validate the 15% Design level cost estimates.

6.3 ESTIMATING METHODOLOGY AND STANDARDS

Multiple designers working concurrently on the project's multiple geographic segments requires that common design basis, criteria and standards; engineering assumptions; design guidance; and directive drawings are used to develop high-speed train alternatives and cost estimate quantities used in preparing the cost estimates. The following are guidelines and standards to be used in preparing the 15% Design level cost estimates.

6.3.1 Design Guidelines and Standards

CHSTP estimates shall be based on design guidelines defined in Technical Memoranda that have been issued or are under development. Criteria, guidelines and assumptions used to identify construction activities in capital cost estimates shall be in accordance with all approved technical memoranda and design guidance documents.

6.3.2 Software

Software for developing and preparing program capital cost estimates include standard spreadsheet programs, such as Microsoft Excel, or commercially produced database estimating programs.

No specific software is prescribed for the estimating quantities for the 15% Design level. Regional Consultants shall prepare and transmit summary quantities in a Unit Cost Summary template. This will

provide uniformity between high-speed rail segments performed by the Regional Consultants as well as provide a platform to allow for consistent input into program-level estimates. A Unit Cost Summary template will be developed by the PMT for tasks such as quantity takeoffs and provided to Regional Consultants.

The PMT shall compile and prepare the overall program cost estimates using a commercially available database program that will allow for the anticipated reporting and analysis needs of the program-wide cost estimates. The database software will be used primarily as a tool to compile quantities, apply unit prices, contingencies and for reporting.

6.3.3 Coordination with Project Control Functions

There are a number of project controls disciplines that are typically associated with capital cost estimating that must be considered during the development of the CCEM. These include construction scheduling, cost and change control, and risk management.

Regional Consultants are responsible for the coordination between the project control functions, including preparation of cost-loaded schedules, etc. for their respective sections.

6.4 PREPARATION OF 15% COST ESTIMATE QUANTITIES

The following information shall be included in the 15% Design level cost estimate quantities shall be prepared by the Regional Consultants for each project segment:

- Letter of transmittal
- Basis of estimate
- Estimate reconciliation (if previous estimate exists)
- Estimate summary
- Details of estimate
- Quantity takeoff summary

A description of the information to be included is summarized in the following section.

6.4.1 Basis of Estimate

The Basis of Estimate provides specific information related to the estimate and shall provide the following information:

- Scope of Estimate – a brief written description of what the estimate covers.
- Drawings – references the engineering drawings or sketches on which the estimate is based. Drawing set titles or description and publication date shall be listed.
- Specifications - the specification (if any) on which the estimate is based.
- Estimate Format – a description of the format on which the estimate was based.
- Quantities - indicates how quantities were developed and calculated as well as any limitations.
- Construction Schedule - indicates start and finish dates and sequence of major phases of work if pertinent to the estimate.
- Cost Exclusions - a list of any items not included in the estimate that may become a Project expense.
- Estimate Discussion/Comments - identifies any items that can affect either cost or schedule and that have not been covered in any of the above paragraphs. It also lists observations, recommendations, or unusual features of the project, from the estimator's perspective.

Preparation of the Basis of Estimate is the responsibility of the Regional Consultants.

6.4.2 Estimate Reconciliation

Reconciliations shall be made between current cost estimates and previous cost estimates. The goal of reconciliation is to identify and document significant changes that have occurred since the preparation of the prior capital cost estimate. Significant changes shall be identified in the reconciliation under one of three categories that best reflects the cause for the change: Quantity, Unit Price, or Scope. These changes shall be referenced to specific line items in the estimate and shall include a brief written description of the change.

The PMT will prepare the 15% Design level capital cost estimate reconciliation with the programmatic capital cost estimate based on input from the Regional Consultants. The 15% cost estimate will serve as the baseline cost for subsequent design phases.

6.5 COST ESTIMATE PRICING METHODS FOR 15% DESIGN

The PMT will develop unit prices based on common methods used for estimating unit prices, including:

- Historical bid prices
- Analysis of production rates, labor and equipment rates, and material costs for each construction activity.

These methods may be used either individually or in combination. For the 15% Design level, when limited engineering details are available, the historical bid price method will typically be used.

6.5.1 Historical Bid Price Method

Historical bid prices will typically be used to develop costs for common construction elements. When using this method, the time of bid and conditions of the historical project used for pricing shall be taken into account and factors applied as needed:

- Adjust bid prices where the bid date is older than 12 months from the current date by using an appropriate escalation factor
- Adjust bid prices to reflect conditions of the project, such as type of terrain, geographical location, soil, traffic and other related factors. For location factor adjustments, the City Cost Index as published by RS Means will be used.

Sources for historical bid prices that will be used may come from local, regional, statewide and national levels, as well as from international high-speed rail projects with unique high-speed elements. Historical unit prices that are used for the CHSTP will be verified for appropriateness and documented as to their source as well as any adjustments for site, escalation or location factors.

6.5.2 Unit Price Analysis Method

The unit price analysis method will typically be used to develop costs for complex construction elements such as tunneling and underground structures. This method allows for unit prices to be developed based on current local construction and market conditions, such as changes which might affect productivity or the cost of labor or materials. The following steps are required in order to develop a unit price using this method:

- Analyze the proposed construction conditions
- Estimate production rates
- Compile a list of materials
- Obtain materials prices using local available sources
- Determine labor and equipment rates
- Calculate direct unit price using the above factors
- Add allowances for contractor overhead and profit to arrive at a in place unit price

The following sources will be used to obtain basic cost data that is input into the database estimating program in order to develop any needed construction unit prices:

- Labor Rates – Federal Davis-Bacon Wage Determination and/or California Department of Industrial Relations Prevailing Wage Determinations.
- Equipment Rates – RS Means and/or Corp of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VII.
- Material Prices - Material and supply prices for locally available material will be obtained from local supplier quotes, if possible. Secondary sources of material cost data may be taken from RS Means, Engineering News-Report (ENR) or other published resource.

6.5.3 Contingency

Contingency, in the statistical sense, is the estimated percentage by which a calculated value may differ from its true or final value and is typically included in an estimate as an allowance for the level of engineering design completion or to address imperfections in the estimating methods used at the various project development stages. Contingency is typically added to a particular item or group of items by the use of percentage multipliers. Contingency is generally greatest for the early stage of project development and decreases with advancement in the level of engineering design. During the preliminary design of the high-speed train project, the limited level of design information that is available requires the use of contingency allowances that are allocated against specific construction or procurement cost categories. The percentage selected for a given cost category are generally based on professional judgment and experience relative to the historical cost variability typically seen for work within a particular cost category. For the purposes of this estimating program, contingency will be assigned into two major categories – allocated and unallocated.

Allocated contingency will be added based on an assessment of the quality of design information available for individual items of work and will typically fall in a range of 10% to 35%. The exact percentage selected for each cost category is based on professional judgment and experience related to the cost variability typically seen for items of work within a particular cost category. The percentages shown in Table 6-2 are values that will normally be used; however, slightly higher or lower values may be used if a project-specific condition warrants.

Unallocated contingency is typically included to address uncertainties that are more global in nature like schedule delays, changes in contracting environment, or other such issues that are not associated with individual construction activities.

Table 6-2 Allocated Contingency Percentages by Cost Category

Cost Category No.	Description	Allocated Contingency Percentage
10	Guideway and Track Elements	
	Guideway Elements (except underground)	25
	Guideway Elements (underground)	35
	Track Elements	20
20	Stations, Stops, Terminals, Intermodals	20
30	Support Facilities: Yards, Shops, Admin Buildings	20
40	Sitework & Special Conditions	
	Demolition, Clearing, Earthwork	25
	Site Utilities, Utility Relocation	30
	Hazardous materials, contaminated soil removal/mitigation, ground water treatments	30
	Environmental mitigation, e.g. wetlands, historic /archaeological, parks	30
	Site structures including retaining walls, sound walls	25
	Pedestrian / bike access and accommodation, landscaping	25
	Automobile, bus, van access including roads, parking lots	25
50	Systems	20
60	Right-of-way, Land, Existing Improvements	50
70	Vehicles	10

6.5.4 Base Year and Escalation

Estimates will be prepared in Base Year dollars with the Base Year defined as the current calendar year. Unit costs will be updated annually or as required. For cost estimates with a base year that is

older than the current calendar by one or more years, actual historical construction cost index values can be used to calculate the escalation rate to be applied to bring a cost from the period in question to the present. A cost estimate prepared in the current base year cost will be projected into a future calendar year by using a cost escalation factor.

There are a wide variety of published construction cost indexes and economic forecasting publications, from both governmental as well as private sources. These indices are normally calculated using a set of defined construction or procurement commodities that the sponsoring group determines to be representative of the market sector that they are trying to monitor and predict. Some indices track the in-place constructed cost for a set of commodities that include material, labor and equipment costs plus contractor's overhead and profit. Other indices may only track certain material prices, labor costs, or the cost of goods and services sold. Another aspect of these indices that can affect their usefulness is whether they are calculated using regional or national market information.

The CHSTP will consider a number of sources of information including Caltrans Highway Construction Index, California Department of Finance Economic Forecasts, and US Bureau of Labor Statistics Producer Price Index for highway construction, and construction economics data published by *Engineering News-Record* (ENR).

6.5.5 Program Implementation Costs

Professional services cost add-ons are included to represent the costs of engineering, project and construction management, contract administration, insurance, permits and fees, training/start-up/testing and any force account work. These add-on costs will be calculated as a percentage of construction costs only (excluding vehicle procurement and right-of-way costs) will be developed by the PMT.

6.5.6 Estimate Validation

A formal estimate validation meeting will be scheduled to include a select group of project participant's representing the Authority, PMT, Regional Consultants and potentially outside subject matter experts. The purpose of this meeting will be to provide an opportunity to discuss and confirm the design, construction and estimating inputs and assumptions used to prepare the estimate. All changes and adjustments that are accepted at this meeting will then be incorporated before the final estimate submittal. All estimates will be considered a draft until they receive a final review and approval by Authority staff. Authority approval is required prior to the release of any estimate to anyone other than a project participant.

APPENDIX A WORK BREAKDOWN STRUCTURE (WBS)

WORK BREAKDOWN STRUCTURE

APPENDIX A - WORK BREAKDOWN STRUCTURE
CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Work Breakdown Structure

Jul-09

WBS Level	Description	Element
0	Program Level	15% Estimate 30% Estimate
1	Regions	San Francisco to San Jose San Jose to Central Valley Wye Merced to Bakersfield Bakersfield to Palmdale Palmdale to Los Angeles Los Angeles to Orange Los Angeles to San Diego Merced to Sacramento
2	Owner Assigned	TBD
3	Standard Cost Category	10.00 GUIDEWAY & TRACK ELEMENTS 10.01 Guideway: At-grade exclusive HSR right-of-way 10.03 Guideway: At-grade in shared rail corridor 10.04 Guideway: Aerial structure 10.05 Guideway: Built-up fill 10.06 Guideway: Underground cut & cover 10.07 Guideway: Underground TBM twin, single bore tunnel 10.08 Guideway: Retained cut or fill 10.09 Track: Direct fixation 10.11 Track: Ballasted 10.12 Track: Special (switches, turnouts) 10.13 Track: Vibration and noise dampening 20.00 STATIONS, STOPS, TERMINALS, INTERMODAL 20.01 At-grade station, stop, shelter, mall, terminal, platform 20.02 Aerial station, stop, shelter, mall, terminal, platform 20.03 Underground station, stop, shelter, mall, terminal, platform 20.04 Other stations, landings, terminals: Intermodal 20.05 Joint development 20.06 Automobile parking multi-story structure 20.07 Elevators, escalators 30.00 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS 30.01 Administration Building: Office, sales, storage, revenue counting 30.02 Light Maintenance Facility 30.03 Heavy Maintenance Facility 30.04 Maintenance of Way Building 30.05 Yard and Yard Track

WBS Level	Description	Element
		40.00 SITEWORK & SPECIAL CONDITIONS 40.01 Demolition, Clearing, Earthwork 40.02 Site Utilities, Utility Relocation 40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments 40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks 40.05 Site structures including retaining walls, sound walls 40.06 Pedestrian / bike access and accommodation, landscaping 40.07 Automobile, bus, van accessways including roads, parking lots 40.08 Temporary Facilities and other indirect costs during construction 50.00 SYSTEMS 50.01 Train control and signals 50.02 Traffic signals and crossing protection 50.03 Traction power supply: substations 50.04 Traction power distribution: catenary 50.05 Communications 50.06 Fare collection system and equipment 50.07 Central Control 60.00 ROW, LAND, EXISTING IMPROVEMENTS 60.01 Purchase or lease of real estate 60.02 Relocation of existing households and businesses 70.00 VEHICLES 70.01 Light Rail 70.02 Heavy Rail 70.03 Commuter Rail 70.04 Bus 70.05 Other 70.06 Non-revenue vehicles 70.07 Spare parts 80.00 PROFESSIONAL SERVICES 80.01 Preliminary Engineering 80.02 Final Design 80.03 Project Management for Design and Construction 80.04 Construction Administration & Management 80.05 Professional Liability and other Non-Construction Insurance 80.06 Legal; Permits; Review Fees by other agencies, cities, etc. 80.07 Surveys, Testing, Investigation, Inspection 80.08 Start up 90.00 UNALLOCATED CONTINGENCY 100.00 FINANCE CHARGES
4	Unit Price Elements	See Appendix B

APPENDIX B UNIT COST CATEGORIES

UNIT COST CATEGORIES

APPENDIX B - STANDARD COST CATEGORIES
CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Unit Price Elements

1-Jul-2009

Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
10	GUIDEWAY & TRACK ELEMENTS		
10.01	Guideway: At-grade exclusive right-of-way		This cost includes wayside protection.
AG20	At-Grade Single Slab Track	RF	
AG21	At-Grade Single Ballasted	RF	
AG30	At-Grade Double Slab Track (__ ft. track spacing)	RF	
AG31	At-Grade Double Ballasted (__ ft. track spacing)	RF	
10.02	Guideway: At-grade semi-exclusive (allows cross-traffic) (Not Used)		
10.03	Guideway: At-grade (Not Used)		
10.04	Guideway: Aerial structure		
BR02	Bridge Structure, Double track	RF	This cost element includes: Clearing & Grubbing Allowance, Level 1; Steel Sheet Pile; Structural Excavation; Structural Backfill; Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Parapet; CIPC, Aerial Deck Slab; CIPC, Plinth; Precast Prestressed I Beams; Metal Pipe and Cable Railing; Elastomeric Bearing Pads; Corrosion Control, Aerial; Ductbank, Aerial Guideway; Mobilization Allowance; General Condition Allowance
EL22	Precast Segmental Box Girder (Avg. Pier 20' Ht.)	RF	This cost element includes: Clearing & Grubbing Allowance, Level 2; Drilled Shaft, 120" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Aerial Pier; CIPC, Aerial Pier Cap; CIPC, Plinth; Precast Segmental Box Girder, Double; Metal Pipe and Cable Railing; Disk Bearing, (300 Kip); Corrosion Control, Aerial; Ductbank, Aerial Guideway; Mobilization Allowance; General Condition Allowance
EL23	Precast Segmental Box Girder (Avg. Pier 30' Ht.)	RF	
EL24	Precast Segmental Box Girder (Avg. Pier 40' Ht.)	RF	
EL25	Precast Segmental Box Girder (Avg. Pier 50' Ht.)	RF	
EL26	Precast Segmental Box Girder (Avg. Pier 60' Ht.)	RF	
EL27	Precast Segmental Box Girder (Avg. Pier 70' Ht.)	RF	
EL28	Precast Segmental Box Girder (Avg. Pier 80' Ht.)	RF	
EL43	Precast Segmental Box Girder, Long Span (Avg. Pier 30' Ht.)	RF	
EL44	Precast Segmental Box Girder, Long Span (Avg. Pier 40' Ht.)	RF	
EL45	Precast Segmental Box Girder, Long Span (Avg. Pier 50' Ht.)	RF	
EL46	Precast Segmental Box Girder, Long Span (Avg. Pier 60' Ht.)	RF	
EL47	Precast Segmental Box Girder, Long Span (Avg. Pier 70' Ht.)	RF	
EL50	Special Structure for Waterway Crossing - Primary, Long Span (Avg. Pier __ft. Ht.)	RF	This cost element includes: Drilled Shaft, 144" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Aerial Pier; CIPC, Aerial Pier Cap; CIPC, Plinth; Special Structure for Span> 300'; Metal Pipe and Cable Railing; Disk Bearing, (400 Kip); Corrosion Control, Aerial; Ductbank, Aerial Guideway; Mobilization Allowance; General Condition Allowance
10.05	Guideway: Built-up fill		
BF20	At-Grade Single Ballasted on Embankment (__ft. Avg. Fill Ht.)	RF	
BF30	At-Grade Double Ballasted on Embankment (__ft. Avg. Fill Ht.)	RF	

APPENDIX B - STANDARD COST CATEGORIES
 CALIFORNIA HIGH SPEED TRAIN PROJECT
 15% Design Level Estimate
 Unit Price Elements

1-Jul-2009

Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
	Guideway: Cut At-Grade Single Track At-Grade Double Track		
10.06	Guideway: Underground cut & cover		This cost includes labor, equipment, and mobilization costs. It also includes excavation support, excavation bracing, excavation, structural backfill, and structure cost. Excavation includes removing the material from within the supported area and disposing of that amount of material not used for backfill or unsuitable for use. Structural back-fill includes obtaining sufficient, acceptable material for use, and the placing and compacting of that material. Cost excludes traffic control, street relocation or utility relocation.
CC03	Cut and Cover Box - Single (Avg. 35' Depth)	RF	This cost element includes: Dewatering Allowance; Soldier Pile & Lagging; Finish Grading; Cut & Cover Excavation; Cut & Cover Backfill; Erosion Control Allowance; Composite Drainage Board; Trackway Drainage, Tunnel; Service/Safety Walkway; Reinforcing Steel; CIPC, C&C Slab on Grade; CIPC, C&C Exterior Walls, Formed 1 Side; CIPC, C&C Roof Slab; CIPC, Plinth; Sheet Waterproofing; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance
CC13	Cut and Cover Box - Double (Avg. 35' Depth)	RF	
CC14	Cut and Cover Box - Double (Avg. 45' Depth)	RF	
CC15	Cut and Cover Box - Double (Avg. 55' Depth)	RF	
CC16	Cut and Cover Box - Double (Avg. 65' Depth)	RF	
CC17	Cut and Cover Box - Double (Avg. 75' Depth)	RF	
CC23	Cut and Cover Box - Crossover (Avg. 35' Depth)	RF	This cost element includes: Dewatering Allowance; Soldier Pile & Lagging; Finish Grading; Cut & Cover Excavation; Cut & Cover Backfill; Erosion Control Allowance; Composite Drainage Board; Trackway Drainage, Tunnel; Service/Safety Walkway; Reinforcing Steel; CIPC, C&C Slab on Grade; CIPC, C&C Exterior Walls, Formed 1 Side; CIPC, C&C Interior Walls; CIPC, C&C Roof Slab; CIPC, Plinth; Sheet Waterproofing; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance
10.07	Guideway: Underground tunnel		The costs for tunnel boring machine (TBM) and drill and blast (D&B) tunnels include all structural work, full lining and grouting, ventilation systems, special drainage, etc. This cost excludes the track, signaling or traction power systems.
TL01	TBM Tunnel - Single Bore/Single Track (33'-6" I.D.)	RF	This cost element includes: Tunnel Excavation & Support, TBM; Contact Grouting; CIPC, Tunnel; Precast Tunnel Lining Segments; Tunnel Construction Instrumentation; Temporary Air, Water, Ventilation; Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, Plinth; Safety Railing; Signage, Guideway Allowance; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance
TL05	TBM Tunnel - Twin Bore/Double Track (33'-6" I.D.)	RF	This cost element includes: Tunnel Excavation & Support, TBM; Contact Grouting; CIPC, Tunnel; Precast Tunnel Lining Segments; Crosspassage; Tunnel Construction Instrumentation; Temporary Air, Water, Ventilation; Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, Plinth; Safety Railing; Signage, Guideway Allowance; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance
	TBM Tunnel - Twin Single Track (<6 miles) TBM Tunnel - Twin Single Track w/ 3rd Tube (>6 miles)		
TL15	D&B Tunnel - Twin Single Bore/Twin Single Track (<6 miles)	RF	This cost element includes: Tunnel Excavation, Drill & Blast; Shotcrete, Tunnels; Lattice Girders; Rock Dowels; CIPC, Tunnel; Crosspassage; Tunnel Construction Instrumentation; Temporary Air, Water, Ventilation; Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, Plinth; Safety Railing; Signage, Guideway Allowance; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance

**APPENDIX B - STANDARD COST CATEGORIES
CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Unit Price Elements**

1-Jul-2009

Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
TL20	D&B Tunnel - Double Track	RF	These cost elements include: Tunnel Excavation, Drill & Blast; Shotcrete, Tunnels; Lattice Girders; Rock Dowels; CIPC, Tunnel; Tunnel Construction Instrumentation; Temporary Air, Water, Ventilation Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, Plinth; Safety Railing; Signage, Guideway Allowance; Ductbank, Tunnel Guideway; Mobilization Allowance; General Condition Allowance
TL30	Seismic Chamber (D&B/Mined)	EA	
	Double Track Mined (Soft Soil)		
ME03	Mechanical & Electrical for Tunnels (Single Bore)	RF	These cost elements include: Fire Protection Piping, Tunnel; Subsurface Ventilation (Allowance); Lighting, Underground Guideway; Mobilization Allowance; General Condition Allowance
ME05	Mechanical & Electrical for Tunnels (Twin Bore)	RF	
VS01	Fan / Vent Shaft Equipment	EA	This cost element includes: Ventilation Equipment (Allowance); Mobilization Allowance; General Condition Allowance
VS05	Fan / Vent Shaft (18' O.D.)	VF	This cost element includes: Shaft Excavation & Support, Rock; Contact Grouting; CIPC, Shaft; Temporary Air, Water, Ventilation; Reinforcing Steel; CIPC, Miscellaneous Structures; Structural Steel, Misc.; Sheet Waterproofing; Fire Protection Piping, Tunnel; Lighting, Underground Guideway; Mobilization Allowance; General Condition Allowance
ES05	Emergency Access Shaft (24' O.D.)	VF	This cost element includes: Shaft Excavation & Support, Rock; Contact Grouting; CIPC, Shaft; Temporary Air, Water, Ventilation; Reinforcing S; Mobilization Allowance; General Condition Allowance; CIPC, Miscellaneous Structures; Structural Steel, Misc.; Metal Pipe and Cable Railing; Sheet Waterproofing; Fire Protection Piping, Tunnel; Lighting, Underground Guideway; Mobilization Allowance; General Condition Allowance
PS01	Pumping Station	EA	This cost element includes: Pumping Station (Tunnel / Cut & Cover); Mobilization Allowance; General Condition Allowance
10.08	Guideway: Retained cut or fill		This cost includes Wayside Protection.
RC01	Retained Cut - One Side (Avg. 10' Depth)	RF	
RC02	Retained Cut - One Side (Avg. 20' Depth)	RF	
RC03	Retained Cut - One Side (Avg. 30' Depth)	RF	
RC11	Retained Cut - Two Side (Avg. 10' Depth)	RF	These cost elements include: Clearing & Grubbing Allowance, Level 2; Soldier Pile & Lagging; Rough Grading; Finish Grading; Cut & Cover Excavation; Mud Slab; Erosion Control Allowance; Trackway Drainage, Paved Area; 6 ft. Chain Link Fence, Wall Mounted; Reinforcing Steel; CIPC, C&C Slab on Grade; CIPC, C&C Exterior Walls, Formed 1 Side; CIPC, Plinth; Architectural Treatment, Retaining Wall; Signage, Guideway Allowance; Corrosion Control, At-Grade; Ductbank, At Grade Guideway; Mobilization Allowance; General Condition Allowance
RC12	Retained Cut - Two Side (Avg. 20' Depth)	RF	
RC13	Retained Cut - Two Side (Avg. 30' Depth)	RF	
RF21	Retained Fill - One Side (Avg. 10' Height)	RF	These cost elements include: Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Embankment; Structural Excavation; Structural Backfill; Mud Slab; Erosion Control Allowance; Trackway Drainage, Ballasted; 6 ft. Chain Link Fence, Wall Mounted; Reinforced Earth Walls (MSE); Reinforcing Steel; CIPC, Beams; Subballast; Corrosion Control, At-Grade; Ductbank, At Grade Guideway; Mobilization Allowance; General Condition Allowance
RF22	Retained Fill - One Side (Avg. 20' Height)	RF	
RF23	Retained Fill - One Side (Avg. 30' Height)	RF	
RF31	Retained Fill - Two Sides (Avg. 10' Height)	RF	
RF32	Retained Fill - Two Sides (Avg. 20' Height)	RF	
RF33	Retained Fill - Two Sides (Avg. 30' Height)	RF	

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
CF21	Retained Cut & Fill (Avg. ___ft. Height)	RF	
10.09	Track: Direct fixation		
TK01	Direct Fixation - Single Track	RF	This cost element includes: Girder Rails; DF Fasteners; Special Trackwork; Welding; Other Track Material; Concrete Base Slabs; Infill (Second Pour) Concrete; Dynamic Envelop Delineation
TK02	Direct Fixation - Double Track	RF	
10.10	Track: Embedded (Not Used)		
10.11	Track: Ballasted		
TK31	Ballasted - Single Track	RF	This cost element includes: Concrete Ties; Rails; Special Trackwork; Welding; Other Track Materials; Turnouts & Crossovers; Combined System Ducts; Concrete Base Slabs; Grade Crossing (Precast or Rubber); Dynamic Envelop Delineation
TK32	Ballasted - Double Track	RF	
10.12	Track: Special (switches, turnouts)		
SP01	Terminal - Bumping Posts	EA	
	Freight Single Track - At-Grade	RF	
	Freight Double Track - At-Grade	RF	
SP20	Turnout (60 MPH)	EA	
	Turnout (110 MPH)		
	Turnout (145 MPH)		
SP21	Crossover (___ MPH)	EA	
	Station Track	LF	

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
20	STATIONS, TERMINALS, INTERMODAL		Passenger station cost includes cost of passenger platform, circulation, lighting, security measures and all auxiliary spaces including intermodal connection areas. Spaces are provided within the station for ticket sales, passenger information, station administration, baggage handling, and commercial space for newsstands, small restaurants, etc. Cost excludes cost of traction power, Overhead Catenary System OCS, signal and communication. It excludes track and track structure.
20.01	At-grade station, shelter, terminal, platform		This cost excludes right of way.
ST01	Intermediate Passenger Station (Station Name)	LS	These cost elements include: Site Clearing; Earthwork; Paving and Surfacing; Piped Utilities; Site Structural Work; Station Electrical Work; Traction Power; Station Platform; Station Building & Access to Platforms; Fare Collection. These costs elements exclude Parking Facilities.
ST10	Terminal Passenger Station (Station Name)	LS	
20.02	Aerial station, shelter, terminal, platform		
ST21	Intermediate Passenger Station (Station Name)	LS	These cost elements include: Site Clearing; Earthwork; Paving and Surfacing; Piped Utilities; Site Structural Work; Station Electrical Work; Traction Power; Station Platform; Station Building & Access to Platforms; Fare Collection. These costs elements exclude Parking Facilities.
ST30	Terminal Passenger Station (Station Name)	LS	
20.03	Underground station, shelter, terminal, platform		
ST41	Intermediate Passenger Station (Station Name)	LS	These cost elements include: Site Clearing; Earthwork; Paving and Surfacing; Piped Utilities; Site Structural Work; Station Electrical Work; Traction Power; Station Platform; Station Building & Access to Platforms; Fare Collection. These costs elements exclude Parking Facilities.
ST50	Terminal Passenger Station (Station Name)	LS	
20.04	Other stations, landings, terminals: Intermodal, ferry, trolley, etc. (Not Used)		
20.06	Automobile parking multi-story structure		Parking includes all facility costs associated with the construction of parking structures and at grade parking lots including right of way.
SF20	Parking - Structure (Above Ground) Parking - At-Grade Parking - Structure (Below Ground)	Space	
20.07	Elevators, escalators (Include as part of other facilities) (Not Used)		

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
30	SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS		Support facilities cost includes all costs associated with support maintenance facilities, including facilities. In addition to civil work and structural work, it includes trackwork, traction power, OCS, signal, communication, and maintenance equipment costs. It excludes right of way.
30.01	Administration Building: Office, sales, storage, revenue counting (Include in Maintenance Facility)		
	Maintenance Facility - Level I: In-Service Monitoring Maintenance Facility - Level II: Examinations Maintenance Facility - Level III: Periodic Inspections Maintenance Facility - Level IV: Overhauls Maintenance Facility - Level V: Accident Repairs and Modifications	LS LS LS LS LS	These cost element include: Site Clearing; Earthwork; Paving & Surfacing; Piped Utilities; Site Improvements; Track work; Yard Electrical Work; Traction Power; Train Control; Service and Inspection Facility Incl. Electrical & Mechanical Work; Maintenance Shop Equipment, Tools and Supplies; Car Wash; Mobilization and Indirect Field Cost. These cost elements exclude: Environmental Mitigation
30.04	Storage or Maintenance of Way Building (Include in Maintenance Facility)		
	Storage Facility - Overnight Layup Storage Facility - Periodic Inspection Storage Facility - Heavy Maintenance		These cost elements include: Site Clearing; Earthwork; Paving & Surfacing; Piped Utilities; Site Improvements; Track work; Yard Electrical Work; Traction Power; Train Control; Service and Inspection Facility Incl. Electrical & Mechanical Work; Maintenance Shop Equipment, Tools and Supplies; Mobilization and Indirect Field Cost. These cost elements exclude: Environmental Mitigation
30.05 YT01	Yard and Yard Track Yard & Storage Track	TF	
30.06	Central Control Operations Center	EA	
40	SITWORK & SPECIAL CONDITIONS		
	Earthwork		This cost excludes earthwork incidental to the construction of a structure such as the excavation for a bridge foundation.
	Clearing and Grubbing / Site Preparation - Undeveloped Total Cut Total Fill Borrow Spoil		This includes the costs for clearing and grubbing (which cover the removal of unsuitable surface debris, and removal of vegetation), grading (which is the movement of dirt around the site to prepare the surface for construction), and work done to make the site usable after the demolition of existing structures.
	Security Fencing (Both Sides of R/W)		All at-grade sections, trench sections, cut and fill sections, tunnel portals, maintenance areas, and any other areas where tracks are accessible to public would be fully fenced.
	Special Drainage Facilities (5% of Earthwork Cost)		This cost includes culverts and other structures needed for track and cross drainage purposes only, including track underdrains if needed. This does not include the cost of bridges or bridge drainage costs.

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Element ID	COST ELEMENTS	Base year for unit cost UOM	COST ELEMENT DESCRIPTION
40.01 DM01 DM05 DM06 DM10 DM30 DM40 DM80 DM85	Demolition, Clearing, Earthwork Demolition Allow. - Existing Bridge Structure Demolition Allow. - Existing Building, Moderate Structure Demolition Allow. - Existing Building, Major Structure Demolition Allow. - Existing Station Structure Demolition Allow. - Existing Site w/Buildings Demolition Allow. - Curb Demolition Allow. - Guideway Demolition Allow. - Pavement	SF SF SF SF SF SF SF SF	
	Rail Relocation		This cost includes the cost of track relocations (temporary or permanent) or track removal required to place high-speed train track into existing rail corridors, including all construction work needed to relocate or remove the railroad, including earthwork, trackwork, etc.
	Single Track Relocation (Temporary) Single Track Relocation (Permanent) Single Track Removal		
40.02	Site Utilities, Utility Relocation		For the 15% design it is assumed that all utilities within the CHSTP impacted by construction of the trackway and facilities will be relocated, regardless of whether the relocation is to the utility original location (protected in place) or to a new location. The Utility Relocation cost includes: removal of the existing utility lines, pipes and valves, excavation of underground utilities, and reconstruction of the utility line/pipe at the new location.
UM01 UM02 UM03 UM04 UM05 UM06	Utility Modifications Allow. - Rural Utility Modifications Allow. - Suburban - Light Utility Modifications Allow. - Suburban - Heavy Utility Modifications Allow. - Urban - Light Utility Modifications Allow. - Urban - Medium Utility Modifications Allow. - Urban - Heavy Wet Utilities Water Lines (Pipes) < 6" Water Line Relocation 6" to 12" Water Line Relocation > 12" to 24" Water Line Relocation > 24" to 36" Water Line Relocation > 36" to 60" Water Line Relocation > 60" Water Line Relocation Oil and/or Gas Lines (Pipes) < 6" Oil and/or Gas Line Relocation 6" to 12" Oil and/or Gas Line Relocation > 12" to 24" Oil and/or Gas Line Relocation > 24" to 36" Oil and/or Gas Line Relocation > 36" Oil and/or Gas Line Relocation	RF RF RF RF RF RF LF LF LF LF LF LF LF LF LF LF LF	

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
SW01	Sound Walls	SF	
	Intrusion Protection Barrier (6' Height)	RF	
	Intrusion Protection Barrier (12' Height)	RF	
40.06	Pedestrian / bike access and accommodation, landscaping		
PA01	Station Pedestrian Bridge	LF	
PA05	Station Pedestrian Access Cut & Cover Box	LF	
PA10	Station Pedestrian Access - Plaza	SF	
PA20	Station Pedestrian Vertical Access, to 25ft.	EA	
LS02	Landscaping Allow. - Site	SF	
LS10	Landscaping Allow. - Guideway	RF	This cost includes areas alongside the tracks within the high-speed train right-of-way. Plantings in station areas are included under passenger stations. The landscaping along the route includes the seeding of cut slopes and embankments. Site preparation and landscaping costs would only be applied to areas of new right-of-way for the alignment, including bypass alignments and corridor widening.
40.07	Automobile, bus, van accessways including roads, parking lots		
RM01	Roadway Modifications Allow. - Full Intersection	EA	
RM02	Roadway Modifications Allow. - Half Intersection	EA	
RM40	Roadway Reconstruction Allow. - Curb & Sidewalk	RF	
RM80	Roadway Modifications Allow. - AC Paving	SF	
RM81	Roadway Modifications Allow. - Conc. Paving	SF	
RM82	Roadway Modifications Allow. - AC Paving (incl. Curb & Sidewalk)	SF	
RM83	Roadway Modifications Allow. - Mill and Resurface	SF	
40.08	Temporary Facilities and other indirect costs during construction		
40.09	Grade Separations		The costs include all costs necessary to complete the construction of the grade separations, such as earthwork, traffic handling, drainage, etc.
RX02	Roadway Overcrossing HSR - 2 lane retained fill roadway over 2 tracks	EA	These cost elements include: Retained Fill Section (Assume 600' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Embankment; Structural Excavation; Structural Backfill; Erosion Control Allowance; Pavement Drainage, Allowance;
RX04	Roadway Overcrossing HSR - 4 lane retained fill roadway over 2 tracks	EA	Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Reinforced Earth Walls (MSE); Concrete Barrier Wall; Bridge Section (Assume 70' span) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Parapet; CIPC, Aerial Deck Slab; Precast Prestressed I Beams; Elastomeric Bearing Pads
RX06	Roadway Overcrossing HSR - 6 lane retained fill roadway over 2 tracks	EA	Mobilization Allowance; General Condition Allowance
RX12	Roadway Overcrossing HSR - 2 lane retained fill roadway over 4 tracks	EA	These cost elements include: Retained Fill Section (Assume 600' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Embankment; Structural Excavation; Structural Backfill; Erosion Control Allowance; Pavement Drainage, Allowance;

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
RX14	Roadway Overcrossing HSR - 4 lane retained fill roadway over 4 tracks	EA	Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Reinforced Earth Walls (MSE); Concrete Barrier Wall; Bridge Section (Assume 100' span) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Parapet; CIPC, Aerial Deck Slab; Precast Prestressed I Beams; Elastomeric Bearing Pads Mobilization Allowance; General Condition Allowance
RX16	Roadway Overcrossing HSR - 6 lane retained fill roadway over 4 tracks	EA	
RX22	Roadway Overcrossing HSR - 2 lane embankment roadway over 2 tracks	EA	This cost element includes: Embankment Section (Assume 500' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Embankment; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Bridge Section (Assume 3-100' span) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Parapet; CIPC, Aerial Pier; CIPC, Aerial Pier Cap; CIPC, Aerial Deck Slab; Precast Prestressed I Beams; Elastomeric Bearing Pads <u>Mobilization Allowance; General Condition Allowance</u>
RX24	Roadway Overcrossing HSR - 4 lane embankment roadway over 2 tracks	EA	These cost elements include: Embankment Section (Assume 500' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Embankment; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Concrete Barrier Wall; Bridge Section (Assume 3-100' span) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Parapet; CIPC, Aerial Pier; CIPC, Aerial Pier Cap; CIPC, Aerial Deck Slab; Precast Prestressed I Beams; Elastomeric Bearing Pads Mobilization Allowance; General Condition Allowance
RX26	Roadway Overcrossing HSR - 6 lane embankment roadway over 2 tracks	EA	
RX42	Roadway Undercrossing HSR - 2 lane retained cut roadway under 2 tracks	EA	These cost elements include: Retained Cut Section (Assume 600' on each side of box) - Clearing & Grubbing Allowance, Level 1; Soldier Pile & Lagging; Rough Grading; Finish Grading; Cut & Cover Excavation; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Reinforcing Steel; CIPC, C&C Exterior Walls, Formed 1 Side; Architectural Treatment, Retaining Wall; Box Section (Assume 120' length) - Dewatering Allowance; Soldier Pile & Lagging; Cut & Cover Excavation; Cut & Cover Backfill; Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, C&C Slab on Grade; CIPC, C&C Exterior Walls, Formed 1 Side; CIPC, C&C Roof Slab; Sheet Waterproofing Mobilization Allowance; General Condition Allowance
RX44	Roadway Undercrossing HSR - 4 lane retained cut roadway under 2 tracks	EA	
RX46	Roadway Undercrossing HSR - 6 lane retained cut roadway under 2 tracks	EA	
RX52	Roadway Undercrossing HSR - 2 lane retained cut roadway under 4 tracks	EA	These cost elements include: Retained Cut Section (Assume 600' on each side of box) - Clearing & Grubbing Allowance, Level 1; Soldier Pile & Lagging; Rough Grading; Finish Grading; Cut & Cover Excavation; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Reinforcing Steel; CIPC, C&C Exterior Walls, Formed 1 Side; Architectural Treatment, Retaining Wall; Box Section (Assume 150' length) - Dewatering Allowance; Soldier Pile & Lagging; Cut & Cover Excavation; Cut & Cover Backfill; Trackway Drainage, Tunnel; Reinforcing Steel; CIPC, C&C Slab on Grade; CIPC, C&C Exterior Walls, Formed 1 Side; CIPC, C&C Roof Slab; Sheet Waterproofing Mobilization Allowance; General Condition Allowance
RX54	Roadway Undercrossing HSR - 4 lane retained cut roadway under 4 tracks	EA	
RX56	Roadway Undercrossing HSR - 6 lane retained cut roadway under 4 tracks	EA	

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RX62	Roadway Undercrossing HSR - 2 lane roadway under 2 tracks on bridge	EA	This cost element includes: Excavated Cut Section (Assume 600' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Excavation w/haul; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Concrete Curb and Gutter; Concrete Sidewalk; HSR Bridge over Roadway Section (Assume 50' W & 60' L) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Aerial Deck Slab; CIPC, Plinth; Precast Prestressed I Beams; Metal Pipe and Cable Railing; Elastomeric Bearing Pads Mobilization Allowance; General Condition Allowance
RX64	Roadway Undercrossing HSR - 4 lane roadway under 2 tracks on bridge	EA	This cost element includes: Excavated Cut Section (Assume 600' on each side of bridge) - Clearing & Grubbing Allowance, Level 1; Rough Grading; Finish Grading; Excavation w/haul; Erosion Control Allowance; Pavement Drainage, Allowance; Aggregate Base; Asphalt Concrete Pavement; Misc. Signing and Striping, Roadway Median; Concrete Curb and Gutter; Concrete Sidewalk; HSR Bridge over Roadway Section (Assume 50' W & 80' L) - Drilled Shaft, 36" Dia.; Trackway Drainage, Aerial; Reinforcing Steel; CIPC, Footings; CIPC, Walls; CIPC, Aerial Deck Slab; CIPC, Plinth; Precast Prestressed I Beams; Metal Pipe and Cable Railing; Elastomeric Bearing Pads Mobilization Allowance; General Condition Allowance
SS01 SS02 SS03 SF02 SF05	Streetscaping Allow. - Light Streetscaping Allow. - Moderate Station Site Facilities - Surface Parking Station Site Facilities - Bus / Shuttle Bays	SF SF SF Space Space	
50	SYSTEMS		
50.01	Train control and signals		
TC	Positive Train Control Location	EA	PTC Wayside Location. This cost includes equipment house/cabinet, foundation or mounting support, grounding, all interior panels, racks, terminations, conduits. It also includes PTC field equipment, interface to communication system units, power from utility or other, batteries, conduits, cables, antenna, transmitter, receiver, etc.
	Positive Train Control On-Board	EA	PTC On-board train equipment. This cost includes processors, display, sensors, radio, antenna, etc. This cost is to be estimated once for each train to be operating in system
	Interlocking	EA	Full universal interlocking. This cost includes control house, <i>track switches unless estimated elsewhere</i> , signals or other switch indication, train detection circuit, cables, ductbank or conduit
	Conventional Signal Circuit	EA	Open territory underlying signal and broken rail detection circuitry. This cost includes cabinet/case, transmit/receive equipment, cables, conduits, batteries, racks, utility house power or other, impedance bonds, track bonds, track wires, etc.
	Yard Signal Circuit	EA	Maintenance siding and yard signaling. This cost includes track circuit, signals, cases, power supply local control system/tower, track bonds, impedance bonds, <i>switches - if not estimated elsewhere, etc.</i>

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Element ID	COST ELEMENTS	Base year for unit cost	COST ELEMENT DESCRIPTION
		UOM	
	Other (both systems) - Testing and Commissioning and start up support	LS	
	Other (both systems) - Spare parts and Test Equipment	LS	
	Other (both systems) - Operation and Maintenance Training	LS	
50.02	Traffic signals and crossing protection		This cost includes the cost of wayside, on-board and central control software and hardware for the overall signaling system. The VHS technologies operate either on the basis of moving block technology with automatic train protection (ATP) or automatic train control (ATC) and automatic train operation (ATO).
50.03	Traction power supply: substations		This cost includes all costs of the substations, including site preparation; foundations; cable trenches; fencing; electrical equipment (transformers, breakers, switches, etc.); and the cost of transmission lines from the local utility source to the substations.
TPS	Traction Power Substation - Traction Power Transformer, 60 MVA	EA	
	Traction Power Substation - Substation Switchgear/Control Building	EA	This cost includes breakers, relays, control cable, local utility/house power supply, etc.
	Traction Power Substation - 115 kV Disconnect Switch & Stand	EA	
	Traction Power Substation - 115 kV 2-Pole Circuit Breaker & Stand	EA	
	Traction Power Substation - 115 kV Auxiliary Equipment	EA	This cost includes metering, monitoring, surge protection, buswork, insulators, and supports
	Traction Power Substation - 25kV Equipment	EA	This cost includes disconnect switches, feeder taps, feeder cables, underground cables, buswork, auxiliary transformer, PTs, etc.
	Traction Power Substation - Substation structures	LS	This cost includes support steel, strain gantries, tap structure, feeder gantries, lightning masts, etc.
	Traction Power Substation - Substation civil base	LS	This cost includes foundations, duct banks, cable basement, oil containment pit, cable trough, fire walls, etc.
	Traction Power Substation - Site work	LS	This cost includes clearing, leveling, grubbing, fencing, ground grid, stone base, access road, landscaping, screening, utility relocation, etc.
SWS	Traction Power Switching Station - Autotransformer, 10 MVA	EA	
	Traction Power Switching Station - SWS-1 Switchgear/Control House	EA	This cost includes with breakers, relays, control cable, local utility/house power supply, etc.
	Traction Power Switching Station - 25kV Equipment	EA	This cost includes disconnect switches, feeder taps, feeder cables, underground cables, buswork, auxiliary transformer, PTs, etc.
	Traction Power Switching Station - Station structures	LS	This cost includes support steel, strain gantries, tap structure, and feeder gantries
	Traction Power Switching Station - Station civil base	LS	This cost includes foundations, duct banks, cable basement, oil containment pit, cable trough, fire walls, etc.
	Traction Power Switching Station - Site work	LS	This cost includes clearing, leveling, grubbing, fencing, ground grid, stone base, access road, landscaping, screening, utility relocation, etc.
PS	Traction Power Paralleling Station - Autotransformer, 10 MVA	EA	
	Traction Power Paralleling Station - PS Switchgear/Control House	EA	This cost includes breakers, relays, control cable, local utility/house power supply, etc.
	Traction Power Paralleling Station - 25kV Equipment	EA	This cost includes disconnect switches, feeder taps, feeder cables, underground cables, buswork, auxiliary transformer, PTs, etc.
	Traction Power Paralleling Station - Station structures	LS	This cost includes support steel, strain gantries, tap structure, and feeder gantries
	Traction Power Paralleling Station - Station civil base	LS	This cost includes foundations, duct banks, cable basement, oil containment pit, cable trough, fire walls, etc.
	Traction Power Paralleling Station - Site work	LS	This cost includes clearing, leveling, grubbing, fencing, ground grid, stone base, access road, landscaping, screening, utility relocation, etc.

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UI	Traction Power Utility Interface - 115kV/230kV connection	LS	This cost includes special or additional transmission line or ductbank construction to get transmission power to substation site. Also additional step down facility if connection above 115kV as assumed above
	Traction Power Utility Interface - Utility Relocation	LS	This cost includes aerial or underground relocation for facility construction
SCADA	Traction Power SCADA System - Wayside switch control	EA	This cost includes control house, cables, duct banks, field control PLC/RTU, local utility house power supply, etc.
	Traction Power SCADA System - SCADA Office end hardware and software	LS	This cost is to be estimated only once for section with train control center
OTHER	Other Traction Power Equipment - Property	LS	This cost includes real estate for facilities, access roads, easements temporary and permanent
	Other Traction Power Equipment - Spare TES Equipment	LS	
	Other Traction Power Equipment - Integrated Testing Support	LS	
	Other Traction Power Equipment - Training	LS	
50.04	Traction power distribution: catenary		This cost includes the catenary poles and foundations; catenary wires and supports; tensioning devices; feeder wires and static wires; disconnect switches and other appurtenances.
OCS-1	Overhead Contact System - Foundations - Standard	EA	This cost relates to single side pole for single cantilever
OCS-2	Overhead Contact System - Foundations - Non Standard	EA	This cost includes Head span, Portal, Two-track cantilever, counter weight, anchor, etc
	Overhead Contact System - Poles - Standard	EA	This cost includes single cantilever type and back to back cantilever type
	Overhead Contact System - Poles - Non-Standard	EA	This cost includes multi-track type, counterweight type, fixed end type, etc
	Overhead Contact System - Pole Attachments - Anchor/Guy Assembly	EA	This cost includes fixed end, midpoint anchor, and down guy
	Overhead Contact System - Pole Attachments - Counterweight Assembly	EA	
	Overhead Contact System - Wire Supports - Cantilever Assembly	EA	This cost includes tubes, steady arm, insulators, clamps, etc
	Overhead Contact System - Wire Supports - Tunnel / Overhead Bridge support assembly	EA	This cost includes drilled attachment, insulator, bracket, clamp etc
	Overhead Contact System - Wire Supports - Head Span Assembly	EA	This cost includes span wires, insulators, steady arm, etc
	Overhead Contact System - Wire Supports - Portal Beam	EA	This cost includes drop pipes, strut brace, insulator etc
	Overhead Contact System - Wire Supports - Feeder wire support assembly	EA	This cost includes brace, steel support, insulator, bracket), etc
	Overhead Contact System - Wires - Catenary	LF	This cost includes messenger, contact wire, hangers, jumpers, etc
	Overhead Contact System - Wires - Static and Feeder Wire	LF	This cost includes terminations, supports, etc
	Overhead Contact System - Sectionalizing/Section Breaks - Disconnect Switch	EA	This cost includes insulator, air break assembly, etc
	Overhead Contact System - Sectionalizing/Section Breaks - Phase Break Assembly	EA	
	Overhead Contact System - Protection Elements - Barriers and Screens	# panels	This cost includes panel, hardware, bonds, etc) for overbridges, signals, adjacent structures, etc
	Overhead Contact System - Protection Elements - Grounding and bonding	LF	This cost includes counterpoise, ground rods, mats, etc.) of lineside metal, fences, platforms, etc.
	Overhead Contact System - Other - Testing and Measurement	LF	
	Overhead Contact System - Other - Mobilization	LS	
	Overhead Contact System - Other - Test Pit/Pot hole	EA	
	Overhead Contact System - Operation & Maintenance Manuals	LS	
	Overhead Contact System - OCS Training	LS	
	Overhead Contact System - OCS Spare Parts	LS	
	Overhead Contact System - OCS Special Tools	LS	

APPENDIX B - STANDARD COST CATEGORIES
 CALIFORNIA HIGH SPEED TRAIN PROJECT
 15% Design Level Estimate
 Unit Price Elements

1-Jul-2009

Element ID	COST ELEMENTS	Base year for unit cost UOM	COST ELEMENT DESCRIPTION
50.05	Communications		This cost includes a high capacity, redundant, secure fiber optic backbone, which connects the central control facility with vital infrastructure monitoring and control systems as well as nonvital functions. Communication connection points will be provided for SCADA, train control, operations, maintenance and emergency functions as well as, phone and fax capabilities (enroute); closed circuit television; public information systems; public address systems; and other monitoring and detection devices needed for a safe and efficient operating system.
	Fiber Optic System - Multimode fiber optic cable Fiber Route - Ductbank/Conduit Node Location - Node Splice House/Case Access Location - Access Splice Case Network Equipment - Network Management Intermediate Control Equipment Network Equipment - Network Management Equipment - Control Center Voice Radio System - Equipment Location Voice Radio System - Onboard Radio Voice Radio System - Operations and Maintenance radio equipment Other (both systems) - Testing and Commissioning and start up support Other (both systems) - Spare parts and Test Equipment Other (both systems) - Operation and Maintenance Training	CLF CLF EA EA EA EA EA EA LS LS LS	This cost includes all routing of main trunk cable including redundant paths, cross connections, etc. This cost includes ductbank, conduit pipes, manholes, pull boxes, splice boxes, etc. for main routing of fiber along tracks This cost includes building/cabinet, foundation, grounding, all interior distribution panels for splicing & termination, racks, batteries, and local utility power or other, conduits to track, etc. This cost includes cabinet, foundation or mounting hardware, grounding, all interior panels, racks, terminations, conduits, etc. This cost includes redundant RTU hardware and software to manage data, etc. This cost is to be estimated once for section containing Central Control Facility This cost includes house/cabinet, power supply from utility or other, batteries, racks, radio equipment transmit/receive antenna, etc. This cost includes train-borne transmit and receive equipment. This cost is to be estimated once for number of trains to be running on system This cost includes handheld units, MoW, MoE, Operations base stations and portable units. This cost is to be estimated once for total maintenance and operations of system
60	ROW, LAND, EXISTING IMPROVEMENTS		This cost includes all costs associated with the purchase of land, and/or easement rights, including relocation assistance and demolition costs. Property values and acquisition costs include those for title searches, appraisals, legal fees, title insurance, surveys, and various other processes.
	Permanent Acquisition Temporary Easement Other	LS LS LS	
70	VEHICLES		This cost includes costs for trainsets including an inventory of small parts estimated to be needed for regular maintenance.
70.01	HSR Vehicles (TBD)	EA	

APPENDIX C HIGH-SPEED TRAINS STATIONS AND FACILITIES

HIGH-SPEED TRAIN STATIONS AND FACILITIES

CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Intermediate Station

Station Name

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
	Station Name (Segment # - Urban/Suburban/Rural, At Grade/Aerial)					
1	Site Clearing					
	Site Clearing	ACRE			\$0	
	Site Demolition	ACRE			\$0	
						\$0
2	Earthwork					
	Grading Site- Cut & Fill	CY			\$0	
						\$0
3	Paving & Surfacing					
						\$0
4	Utilities					
						\$0
5	Site Structural Work					
	At Grade					
	Aerial Structure	ACRE			\$0	
						\$0
6	Station Track / Siding					
	Ballasted Track Incl. Ballast and subballast	LF				
	Direct Fixation	LF			\$0	
	Turnouts, 110 mph W. Conc. Ties	EA			\$0	
						\$0
7	Station Electrical Work					
	CCTV & Security System					
	Communication System					
	Lighting - Included in Item 10					
						\$0
8	Traction Power					
	(Included in Systems Estimate)					\$0
9	Train Control					
	(Included in Systems Estimate)					\$0
10	Station Platform					
	Platforms:					
	Foundation- Pier Caissons	SF			\$0	
	Pier Caps	SF			\$0	
	Platform Slab	SF			\$0	
	Platform Warning Edge & Rubbing Edge	FT			\$0	
	Platform Finish Work- excluded					
	Canopy- Str. Steel	SF			\$0	
	Canopy Roof Metal Deck, Roofing, Gutter, Etc.	SF			\$0	
	Station Lighting	SF			\$0	
	Signage	platform			\$0	
	Platform Furnishing	platform			\$0	
	Windscreen Shelter - 4 ea. Per Platform	EA			\$0	
						\$0
11	Station Building & Access to Platforms					
	Passenger Terminal (Size of Foot Print)	SF			\$0	
	Ticketing (Enclosed)	SF			\$0	
						\$0
	Sub-Total					\$0
	Mobilization & Indirect Field Cost		15%			\$0
	Subtotal- Construction Cost- Base (year dollars)					\$0
	Contingencies					
	Escalation to Midpoint of Construction - not included					
	Right of way Acquisition - excluded					
	Subtotal- Construction Cost (year dollars)					
	Total Estimated Project Cost					

CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Terminal Station

Station Name

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
	Inspection Platform Behind Passenger Platform					
1	Site Clearing					
	Site Clearing	ACRE			\$0	
	Site Demolition	ACRE			\$0	
						\$0
2	Earthwork					
	Grading Site - Cut & Fill	CY			\$0	
						\$0
3	Paving & Surfacing					
						\$0
4	Piped Utilities					
						\$0
5	Site Structural Work					
	At Grade					
	Aerial Structure	ACRE			\$0	
						\$0
6	Track work					
	Direct Fixation	FT			\$0	
	Turnouts, No. 26.5 W. Conc. Ties	EA			\$0	
	Crossover, No. 26.5 w. Conc. Ties	EA			\$0	
	Turnouts, No. 32.7 W. Conc. Ties	EA			\$0	
	Crossover, No. 32.7 w. Conc. Ties	EA			\$0	
	Turnouts, No. 40.5 W. Conc. Ties	EA			\$0	
	Crossover, No. 40.5 w. Conc. Ties	EA			\$0	
	Turnouts, No. 50 W. Conc. Ties	EA			\$0	
	Crossover, No. 50 w. Conc. Ties	EA			\$0	
	Bumping Posts	EA			\$0	
	Heavy Duty Rubber Grade Crossing					\$0
						\$0
7	Station Electrical Work					
	CCTV & Security System- excluded					
	Communication System-excluded					
	Lighting- See Item 10					
						\$0
8	Traction Power					
	(Included in Overall Estimate)					\$0
9	Train Control					
	(Included in Overall Estimate)					\$0
10	Station Platform					
	Platforms:					
	Foundation- Pier Caissons	SF			\$0	
	Pier Caps	SF			\$0	
	Platform Slab	SF			\$0	
	Platform Warning Edge & Rubbing Edge	FT			\$0	
	Platform Finish Work- excluded					
	Canopy- Str. Steel	SF			\$0	
	Canopy Roof Metal Deck, Roofing, Gutter, Etc.	SF			\$0	
	Station Lighting	SF			\$0	
	Signage	platform			\$0	
	Platform Furnishing	platform			\$0	
	Windscreen Shelter- 4 ea. Per Platform	EA			\$0	
						\$0
11	Station Building & Access to Platforms					
	Passenger Terminal (Size of Foot Print)	SF			\$0	
	Ticketing (Enclosed)	SF			\$0	
						\$0
	Sub-Total					\$0
	Mobilization & Indirect Field Cost		15%			\$0
	Subtotal- Construction Cost- Base (year dollars)					\$0
	Contingencies					
	Escalation to Midpoint of Construction - not included					
	Right of way Acquisition - excluded					
	Subtotal- Construction Cost (year dollars)					
	Total Estimated Project Cost					

CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Storage Yard & Light Maintenance Facility

Facility Location

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
1	Site Clearing					
	Site Clearing	ACRE			\$0	
	Site Demolition	ACRE			\$0	
						\$0
2	Earthwork					
	Grading Site- Cut & Fill	CY			\$0	
						\$0
3	Paving & Surfacing					
	Driveway / Service Road	SF			\$0	
	Paved Area/Parking Spaces	SF			\$0	
	Maint. Path	FT			\$0	
						\$0
4	Piped Utilities					
	Drainage & Sanitary- track drainage	FT			\$0	
	Drainage & Sanitary- sewer system- allow	FT			\$0	
	Connection to Exist. Lines	Allow			\$0	
	Sanitary Pump Station	EA			\$0	
	Oil/ Water Separator	EA			\$0	
	Exist. Utility Lines Relocation/Protection	ACRE			\$0	
	Water Distribution- allow	Allow			\$0	
						\$0
5	Site Improvements					
	Alum. Chain Link Fence	FT			\$0	
	Signs	Allow			\$0	
	Landscaping	Allow			\$0	
						\$0
6	Track work					
	Ballasted Track Incl. Ballast and subballast	FT			\$0	
	Turnouts, no. 15 with Conc. Ties	EA			\$0	
	Diamond Crossover, no. 15 with Conc. Ties	EA			\$0	
	Heavy Duty Rubber Grade Crossing	Allow			\$0	
						\$0
7	Yard Electrical Work					
	Site Lighting, Distribution, High Mast Poles	EA			\$0	
	Electrical service to yard -- 480v	Allow			\$0	
	CCTV & Security System	Allow			\$0	
	Communication System	Allow			\$0	
						\$0
8	Traction Power					
	Double Ended SS	EA			\$0	
	OCS Incl. Hardware, Poles & Foundation	FT			\$0	
						\$0
9	Train Control					
	Yard Train Control	Allow			\$0	
						\$0
10	Service and Inspection Facility Incl. Electrical & Mechanical Work					
	Service & Inspection Facility	SF			\$0	
	Inspection Pit	FT			\$0	
	Inspection Pit Rail Support	FT			\$0	
	Car Wash Building	SF			\$0	
	Wheel Repair Facility	SF			\$0	
						\$0
11a	Maintenance Shop Equipment, Tools and Supplies-					
	Storage Equipment	LS			\$0	
	Shop Equipment	LS			\$0	
	Shop Work Station	LS			\$0	
	Cleaning Equipment	LS			\$0	
	Car Component Repair & Test Equipment	LS			\$0	
	Wheel Truing Machine	EA			\$0	
	Welding Equipment	LS			\$0	
	Battery Equipment	LS			\$0	
	Prefab. Storage Buildings	LS			\$0	
	Traveling Manlifts	LS			\$0	
	Material Lift	LS			\$0	
	Bridge Crane - 3ton Capacity	EA			\$0	
	Jib Cranes- Various Capacity	EA			\$0	
	Forklifts	EA			\$0	
	Tools & Supplies	Allow			\$0	

CALIFORNIA HIGH SPEED TRAIN PROJECT
 15% Design Level Estimate
 Storage Yard & Light Maintenance Facility

Facility Location

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
11c	Car Wash					
	Storage	LS			\$0	
	Central Vacuum Cleaning system	LS			\$0	
	Steam Cleaner Pressure Washer	LS			\$0	
	Car Wash Equipment Installation & Plumbing	LS			\$0	
						\$0
	Environmental Mitigation					
	Excluded					
						\$0
	Sub-Total					\$0
	Mobilization & Indirect Field Cost		15%			\$0
	Subtotal- Construction Cost- Base (year dollars)					\$0
	Contingencies					
	Escalation to Midpoint of Construction - not included					
	Right of way Acquisition - excluded					
	Subtotal- Construction Cost (year dollars)					
	Total Estimated Project Cost					

CALIFORNIA HIGH SPEED TRAIN PROJECT
15% Design Level Estimate
Storage Yard & Main Repair Facility

Facility Location

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
1	Site Clearing					
	Site Clearing	ACRE			\$0	
	Site Demolition	ACRE			\$0	
						\$0
2	Earthwork					
	Grading Site- Cut & Fill	CY			\$0	
	Silt Fence	FT			\$0	
						\$0
3	Paving & Surfacing					
	Driveway / Service Road	SF			\$0	
	Paved Area/Parking Spaces -Allow	SF			\$0	
						\$0
4	Piped Utilities					
	Drainage & Sanitary- track drainage	SF			\$0	
	Drainage & Sanitary- sewer system- allow	SF			\$0	
	Connection to Exist. Lines	Allow			\$0	
	Sanitary Pump Station	EA			\$0	
	Oil/ Water Separator	EA			\$0	
	Exist. Utility Lines Relocation/Protection	ACRE			\$0	
	Water Distribution- allow	Allow			\$0	
						\$0
5	Site Improvements					
	Alum. Chain Link Fence	FT			\$0	
	Signs	Allow			\$0	
	Landscaping	Allow			\$0	
						\$0
6	Track work					
	Ballasted Track Incl. Ballast and subballast	FT			\$0	
	Turnouts, no. 15 with Conc. Ties	EA			\$0	
	Diamond Crossover, no. 15 with Conc. Ties	EA			\$0	
	Heavy Duty Rubber Grade Crossing	Allow			\$0	
						\$0
7	Yard Electrical Work					
	Site Lighting, Distribution, High Mast Poles	EA			\$0	
	Electrical service to yard -- 480v	Allow			\$0	
	CCTV & Security System	Allow			\$0	
	Communication System	Allow			\$0	
						\$0
8	Traction Power					
	Substation	EA			\$0	
	OCS Incl. Hardware, Poles & Foundation	FT			\$0	
						\$0
9	Train Control					
	Yard Train Control	Allow			\$0	
						\$0
10	Service and Inspection Facility Incl. Electrical & Mechanical Work					
	Service & Inspection Facility	SF			\$0	
	Inspection Pit	FT			\$0	
	Wheel Truer	SF			\$0	
	Wheel Shop	SF			\$0	
	Material Inventory & Distribution	SF			\$0	
	Running Repair & Truck Shop	SF			\$0	
	Heavy Repair, Support Shop & Overhaul	SF			\$0	
						\$0
11a	Maintenance Shop Equipment, Tools and Supplies-					
	Storage Equipment	LS			\$0	
	Dock Lifts	LS			\$0	
	Rail Car Spray Booth	LS			\$0	
	Shop Work Station	LS			\$0	
	Shop Equipment	LS			\$0	
	Sheet Metal Equipment	LS			\$0	
	Cleaning Equipment	LS			\$0	
	Steam Cleaner Pressure Washer	LS			\$0	
	Car Component Repair & Test Equipment	LS			\$0	
	Wheel Truing Machine	EA			\$0	
	Welding Equipment	LS			\$0	
	Battery Equipment	LS			\$0	
	Prefab. Storage Buildings	LS			\$0	
	Traveling Manlifts	LS			\$0	
	Material Lift	LS			\$0	
	Car Hoist System	LS			\$0	

CALIFORNIA HIGH SPEED TRAIN PROJECT
 15% Design Level Estimate
 Storage Yard & Main Repair Facility

Facility Location

Item No.	DESCRIPTION	UNIT	UNIT COST (year\$)	QUANTITY	Estimated Cost	Category Total Cost
	Potable car Hoist System	LS			\$0	
	Truck Repair Hoist	LS			\$0	
	Jacking Carriage	EA			\$0	
	Bridge Crane - 3 ton Capacity	EA			\$0	
	Bridge Crane - 10 ton Capacity	EA			\$0	
	Monorails	EA			\$0	
	Jib Cranes- Various Capacity	EA			\$0	
	Turntables	EA			\$0	
	Forklifts	EA			\$0	
	Tools & Supplies	Allow			\$0	
						\$0
	Environmental Mitigation					
	Excluded					
						\$0
	Sub-Total					\$0
	Mobilization & Indirect Field Cost		15%			\$0
	Subtotal- Construction Cost- Base (year dollars)					\$0
	Contingencies					
	Escalation to Midpoint of Construction - not included					
	Right of way Acquisition - excluded					
	Subtotal- Construction Cost (year dollars)					
	Total Estimated Project Cost					