

# California High-Speed Train Project



## TECHNICAL MEMORANDUM

### 15% Design Scope Guidelines TM 0.1

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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 memorandums. 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:

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## ABSTRACT

The California High-Speed Train Project (CHSTP) is proposed as a high-speed steel wheel on steel rail train system that provides service throughout the state of California with end terminals in Sacramento, San Francisco, Fresno, Bakersfield, Los Angeles, Anaheim, and San Diego. At this time, the CHSTP is entering the project-level environmental assessment stage. In order to facilitate this process, the CHSTP has been divided into sections where specific engineering and environmental technical studies are being prepared by separate Regional Consultant teams.

This technical memorandum presents design guidance for a minimum level of engineering (referred to as 15% Design) required to support the project-specific EIR/EIS process. It further defines design elements, development level, and engineering outputs with the objective of providing a consistent approach in developing preliminary engineering documents across all teams of the CHSR program while ensuring compliance with applicable state and federal regulations as well as project specific Design Criteria.

## 1.0 INTRODUCTION

### 1.1 Purpose of Technical Memorandum

The California High-Speed Train (HST) program is entering the project-level environmental review phase. The HST system is being divided into project sections for environmental clearance and implementation. The purpose of this technical memorandum is to ensure consistency of the California High Speed Train Project (CHSTP) engineering studies by defining a minimum level of engineering design needed to support the project-level environmental process and to support more detailed construction cost estimates.

## 2.0 DEFINITION OF TECHNICAL TOPIC

This memorandum defines the scope for the engineering effort required to prepare a 15% Design for sections of the CHSTP. It identifies the design elements to be addressed, the level of design effort, and the engineering outputs as part of the project's conceptual design in support of the project-level environmental review. The following parameters were used to develop the 15% Design scope:

- Engineering Subsystems – 15% Design will define requirements for the five subsystems (Infrastructure, Systems, Rolling Stock, Operations, and Maintenance) necessary to design a safe and reliable operating high-speed railway that meets applicable regulatory requirements and achieves CHSTP performance requirements. Additional information regarding the CHSTP objectives can be found in the Basis of Design Report.
- Design Consistency -- 15% Design will conform to the Basis of Design, applicable codes of practice, design guidelines, design practices adopted as part of the program environmental review, and criteria prepared for the CHSTP operational and performance requirements.
- Regulatory and Performance -- 15% Design will comply with Federal Railroad Administration (FRA) railroad safety and California Public Utility Commission (CPUC) regulations except where requirements are otherwise defined specifically for CHSTP operations. Exceptions to regulatory and performance requirements will be identified, documented, and submitted for FRA consideration.
- Construction Cost -- Completion of 15% Design is expected to result in sufficient information consisting of unit costs, quantities, construction staging, and implementation information to allow for preparation of construction cost estimates accurate enough to support a maximum 25% cost contingency.
- Review and Acceptance -- 15% Design will comply with applicable AREMA design standards and with FRA regulations and guidelines. 15% Design deliverables and supporting data will be transmitted to FRA for review, comment, and acceptance as to the applicable environmental, design, operational, and safety requirements. Concurrent review will be performed by state agencies and affected railroad owners and operators.

As each section of the HST system has unique characteristics, it is important to note that the Regional Consultant teams are responsible for confirming whether additional engineering beyond the minimum requirements defined in this document is needed to address specific project issues, to support the Project EIR/EIS or other applicable local laws and regulations, and to generate the construction cost estimate.

## **3.0 ASSESSMENT / ANALYSIS**

### **3.1 ASSESSMENT**

#### **3.1.1 Analysis / Approach**

The engineering requirements for the 15% Design were initially established in collaboration with the Regional Consultant engineering managers at a June 2007 Engineering Managers Meeting held in Los Angeles. The requirements were reviewed and revised to incorporate the design requirements for engineering of transit projects prepared under the guidance provided by the Federal Transit Agency (FTA).

As part of the development of the 15% Design scope, these engineering requirements were also reviewed with the following persons:

- Don Emerson, Former FTA Deputy Administrator and author of the white paper "What is PE?" that was prepared for the FTA and describes what occurs during preliminary engineering for FTA New Starts projects.
- Internal reviews and assessments were performed by the Infrastructure Manager for the CHSTP Engineering Management Team and by the Environmental Manager for the CHSTP Program Management Team in November 2007.

#### **3.1.2 Applicability**

The guidelines in this technical memorandum are applicable to all Regional Consultants preparing engineering for sections of the CHSTP.

## **4.0 SUMMARY AND RECOMMENDATIONS**

### **4.1 GENERAL**

The recommendations are included in Table 1.

## **5.0 SOURCE INFORMATION AND REFERENCES**

### **5.1 GENERAL**

- "What is PE?", A white paper describing what occurs during Preliminary Engineering for New Starts, Feb 2003, Donald J. Emerson
- 13 June 2007, Engineering Managers Meeting, Los Angeles, CA
- 11 July 2007, Meeting and review with Donald J. Emerson, Former FTA Deputy Administrator

## **6.0 DESIGN MANUAL CRITERIA**

### **6.1 INFORMATION FOR INCLUSION IN DESIGN MANUAL**

The guidance in this technical memorandum is not intended to be a part of the CHSTP Design Manual. The purpose of the CHSTP Design Manual is to define and document appropriate design criteria for the CHSTP. The purpose of this technical memorandum is to define a minimum level of engineering design required to develop a design for environmental assessment and generate a new construction cost estimate.

**Table 1. 15% Design Scope Guidelines**

TABLE 1	15% Design Scope	Engineering Output
<b>General</b>	<p>Engineering design to support a project-level EIR/EIS, provide a more detailed construction cost estimate, and conform to all requirements and commitments included in decision documents (FRA ROD, Authority resolution, CEQA findings and MMRP, the Final Statewide Programmatic EIR/EIS for the California High-Speed Train Project and the Bay Area to Central Valley Program EIR/EIS).</p> <p>These are minimum requirements. Additional detailed studies are to be completed where necessary.</p>	<ul style="list-style-type: none"> <li>- Limits of disturbance for each project alternative</li> <li>- Design and technical documentation prepared to support regulatory agency approvals</li> <li>- Required agreements identified</li> <li>- Major cost elements identified</li> <li>- Risk assessment completed and reflected in construction costs for each alternative</li> </ul>
<b>Infrastructure</b>	<b>15% Design Scope</b>	<b>Engineering Output</b>
<b>Alignment (Plan and Profile)</b>	<ul style="list-style-type: none"> <li>- Update alignment with available off-the-shelf (i.e., Intermap) planimetric and terrain mapping (3-foot vertical accuracy)</li> <li>- Alignment drawings at a scale appropriate to the context. Drawing scale is to be                             <ul style="list-style-type: none"> <li>▪ 1"=200' scale for undeveloped areas</li> <li>▪ 1"=200' in developed areas</li> <li>▪ 1"=100' in constrained urban areas</li> <li>▪ 1"=50' for stations and special study areas) on rectified aerial photo base</li> </ul> <p>These are recommended scales and are to be confirmed with the Environmental Manager and Regional Manager.</p> </li> <li>- Develop typical sections that identify clearances to water bodies, roadways, structures, access points, wayside equipment, etc.</li> <li>- Define right of way limits</li> </ul>	<ul style="list-style-type: none"> <li>- Base mapping and photo aerials</li> <li>- Horizontal Alignment</li> <li>- Vertical Alignment showing key existing features (ground, water bodies, over and under crossings)</li> <li>- Typical cross sections</li> <li>- Station location alternatives</li> <li>- Limits of at-grade, elevated, and underground structures</li> <li>- Right-of-Way limits for each alternative including easements</li> </ul>
<b>Temporary Construction Facilities</b>	<ul style="list-style-type: none"> <li>- Develop design to a level where the feasibility of construction can be confirmed i.e., plan and profile level studies</li> <li>- Identify construction methods/staging/laydown/tunnel mucking/shaft and access requirements, and assess and identify suitable disposal sites for each alternative consistent the requirements of the decision documents and the two Final Program EIR/EISs (Statewide and Bay Area to Central Valley)</li> <li>- Identify roadway/highway traffic control requirements</li> <li>- Identify other railroad operator requirements</li> <li>- Determine temporary construction easements</li> </ul>	<ul style="list-style-type: none"> <li>- Constructability assessment memorandum</li> <li>- Construction staging concepts as needed to determine limits and to characterize temporary impacts during construction</li> <li>- Temporary construction/staging measures, sites and facilities</li> </ul>
<b>Stations</b>	<ul style="list-style-type: none"> <li>- Develop general station programs and identify and design potential sites including at a minimum:                             <ul style="list-style-type: none"> <li>o Station Platforms</li> <li>o Preliminary Station layout</li> <li>o Station facilities (ticketing, waiting areas, etc.)</li> <li>o Vertical and horizontal passenger circulation</li> <li>o Parking facility footprint, height, access and egress</li> <li>o Traffic circulation and intermodal connections</li> <li>o Pick up, drop off, access, and egress roadways and facilities</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Station Site alternatives</li> <li>- Station footprints</li> <li>- Parking and site configuration</li> <li>- Station Platforms: number, configuration, location</li> <li>- Vertical and horizontal circulation elements</li> </ul>

Infrastructure (cont.)	15% Design Scope	Engineering Output
<p><b>Bridges and Elevated Structures</b></p>	<ul style="list-style-type: none"> <li>- Develop approximate length, width, height, and depth of structures based on alignment design</li> <li>- Identify appropriate types of bridges and structures for consideration</li> <li>- Identify transition structures i.e. at-grade to bridge, at-grade to tunnel, bridge to tunnel, retaining walls, etc.</li> <li>- Prepare Advanced Planning Study (APS) level of analysis and documentation</li> <li>- Identify need for scour protection and preliminary requirements</li> <li>- Identify site constraints including, hydrology, salt spray and water, problematic soils, geologic problems, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Structure design (plan, elevation, cross section) to APS level including:                             <ul style="list-style-type: none"> <li>o Bridge length, width, depth, max. height</li> <li>o Column / footing locations</li> <li>o Foundation type</li> <li>o Number of spans</li> <li>o Transitions structures</li> <li>o Retaining walls</li> <li>o Changes to affected adjacent facilities (pedestrian, roadway, highway, railroad)</li> <li>o Major utility relocations</li> </ul> </li> <li>- Advanced Planning Study Tech Memo/Report including                             <ul style="list-style-type: none"> <li>o Structure importance classification (i.e. lifeline, etc)</li> <li>o Key design and site constraints</li> <li>o Seismic design considerations</li> <li>o Construction costs</li> </ul> </li> </ul>
<p><b>Tunnels</b></p>	<ul style="list-style-type: none"> <li>- Determine basic tunnel configuration, tunnel location alternatives and lengths</li> <li>- Confirm number of tracks and approximate tunnel diameter</li> <li>- Identify major seismic considerations</li> <li>- Locate faults and avoid fault crossings in tunnels</li> <li>- Assess need for pilot tunnels</li> <li>- Determine portal location options and length</li> <li>- Determine ventilation requirements as required to define tunnel size and any major ventilation facilities</li> <li>- Assess fire and life safety requirements and develop project footprint needs for as required (i.e. structures, equipment/ operation rooms, access, shafts, egress, etc)</li> <li>- Identify local requirements for first responders</li> <li>- Assess constructability including methods, access, temporary construction areas, muck disposal, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Tunnel horizontal and vertical alignments</li> <li>- Tunnel cross sections including consideration for fire and life safety requirements, OCS, and other required equipment</li> <li>- Mitigation and design requirements for seismic</li> <li>- Tunnel lining requirements</li> <li>- Portal and ventilation structure locations</li> <li>- Cross passage spacing and locations</li> <li>- Construction methods assessment</li> <li>- Temporary construction easements</li> </ul>
<p><b>Buildings</b></p>	<ul style="list-style-type: none"> <li>- Develop footprint based on general program of functions for the following:                             <ul style="list-style-type: none"> <li>o Operations Control Center and redundant line facilities</li> <li>o Maintenance facilities (Heavy and Light Maintenance)</li> <li>o Lineside facilities for maintenance-of-way</li> <li>o Access, parking, utility services for the above facilities as required to define right-of-way requirements</li> <li>o Employee considerations as appropriate</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Site Selection</li> <li>- Building footprint limits and size</li> <li>- Parking and Site Configuration</li> <li>- Access requirements</li> <li>- Utility services requirements</li> </ul>

Infrastructure (cont.)	15% Design Scope	Engineering Output
<b>Grading</b>	<ul style="list-style-type: none"> <li>- Determine cut and fill slope limits based on 2:1 side slopes (typical)</li> <li>- Identify retaining structures as required to reduce ROW requirements and/or mitigate impacts</li> <li>- Determine retaining wall type, locations, lengths and heights</li> <li>- Identify temporary construction requirements</li> </ul>	<ul style="list-style-type: none"> <li>- Cut and fill slope catch points included on alignment plans</li> <li>- Retaining wall locations, lengths and heights</li> <li>- Retaining wall type (standard, MSE, tie-back, etc)</li> <li>- Construction easement requirements</li> </ul>
<b>Hydrology / Hydraulics / Drainage</b>	<ul style="list-style-type: none"> <li>- Prepare Hydrology and Hydraulic studies required for environmental impact studies including:               <ul style="list-style-type: none"> <li>o Type, location and cost of major drainage facilities or modifications as well as their footprint and costs</li> <li>o Assess and incorporate rise in tidal waters (and expansion of tidal waters) due to climate change (global warming)</li> <li>o Environmental methodologies for hydrology and design practices to reduce impacts or improve water quality</li> </ul> </li> <li>- Prepare a floodplain impacts assessment (i.e Location Hydraulic Study)</li> <li>- Review stormwater runoff water quality issues and identify best management practices</li> </ul>	<ul style="list-style-type: none"> <li>- Hydrology and Hydraulics Report</li> <li>- Floodplain Impacts Assessment Report</li> <li>- Storm Water Management Report</li> </ul>
<b>Utilities</b>	<ul style="list-style-type: none"> <li>- Contact utility companies for data collection</li> <li>- Identify conflicts, ownership and rights for major utilities affected by the alignment.</li> <li>- Identify planned new High-Risk utilities that could conflict with alternatives.</li> <li>- Identify possible relocation/mitigation options, responsibilities and costs for high risk utilities.</li> </ul>	<ul style="list-style-type: none"> <li>- Major utilities identified</li> <li>- High Risk Utilities Conflict memo</li> </ul>
<b>Geotechnical</b>	<ul style="list-style-type: none"> <li>- Research available literature and geotechnical studies within the project limits for use to identify and resolve geotechnical related design and cost issues</li> <li>- Prepare preliminary Geotechnical design recommendations based on available geotechnical data</li> <li>- Geotechnical investigation plan recommendations to support 15% Design</li> <li>- Subsurface investigations for special circumstances where additional geotechnical information is required to establish the project footprint or to establish a reasonable construction cost estimate</li> </ul>	<ul style="list-style-type: none"> <li>- Updated Geotechnical Database</li> <li>- Preliminary Geotechnical Design Report</li> <li>- Geotechnical investigation plan recommendations</li> </ul>
<b>Right-of-Way</b>	<ul style="list-style-type: none"> <li>- Identify adjacent parcels and ownership for alternatives</li> <li>- Identify adjacent parcels and estimated costs for:               <ul style="list-style-type: none"> <li>o Full and partial takes</li> <li>o Permanent easements</li> <li>o Construction areas</li> <li>o Temporary staging areas and easements</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Preliminary right-of-way Requirements Report</li> </ul>
<b>Construction Cost Estimate</b>	<ul style="list-style-type: none"> <li>- Develop quantities per CHSTP 15% Design Construction Cost Guidelines</li> <li>- Prepare construction cost estimates per CHSTP Construction Cost Guidelines (cost categories consistent with FRA and FTA guidelines)</li> </ul>	<ul style="list-style-type: none"> <li>- 15% Design level quantities</li> <li>- Cost adjustments to reflect regional conditions</li> </ul>

<b>Systems</b>	<b>15% Design Scope</b>	<b>Engineering Output</b>
<b>Traction Power</b>	<ul style="list-style-type: none"> <li>- Identify site locations, access, and parking for substations.</li> <li>- Determine facilities for power between substation to the railway</li> <li>- Coordinate preliminary CHSTP load requirements with CPUC</li> </ul>	<ul style="list-style-type: none"> <li>- Traction Power System Computer Model Analysis</li> <li>- Approximate substation locations and footprint requirements</li> </ul>
<b>PUC / Electric Power Connections</b>	<ul style="list-style-type: none"> <li>- Identify power supply points in coordination with the Utility Companies</li> <li>- Identify needed facilities and site options, including high voltage transmission or tie lines, to connect substations to commercial power lines</li> </ul>	<ul style="list-style-type: none"> <li>- Possible power supply points</li> <li>- Engineering requirements for Grid connections</li> </ul>
<b>Overhead Contact System (OCS)</b>	<ul style="list-style-type: none"> <li>- Develop conceptual design for OCS for design speeds</li> </ul>	<ul style="list-style-type: none"> <li>- Conceptual OCS Design</li> <li>- Electrical Clearance Diagrams</li> <li>- Standard Drawings</li> </ul>
<b>Communications</b>	<ul style="list-style-type: none"> <li>- Determine communications technology</li> <li>- Identify footprint and access requirements for communication facilities</li> </ul>	<ul style="list-style-type: none"> <li>- Physical requirements to support communications technology outside the CHSTP corridor</li> </ul>
<b>Trackside Services</b>	<ul style="list-style-type: none"> <li>- Identify requirements for equipment houses, signal houses, troughs, wayside equipment, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Physical requirements within the corridor for trackside equipment</li> </ul>
<b>Rolling Stock</b>	<b>15% Design Scope</b>	<b>Engineering Output</b>
<b>Technology</b>	<ul style="list-style-type: none"> <li>- Identify Rolling Stock performance requirements to meet CHSTP requirements including operating speed, capacity</li> <li>- Review available technology from HSR systems in the U.S., Europe and Asia</li> </ul>	<ul style="list-style-type: none"> <li>- Rolling Stock performance characteristics for use in Train Simulation Model and Traction Power Model</li> </ul>
<b>Clearances</b>	<ul style="list-style-type: none"> <li>- Develop vehicle clearance requirements that is inclusive of potential vehicle technologies for the CHSTP</li> </ul>	<ul style="list-style-type: none"> <li>- Vehicle Clearance Diagrams (Structure Gauge)</li> </ul>

Operations	15% Design Scope	Engineering Output
<b>Facilities</b>	<ul style="list-style-type: none"> <li>- Identify activities and functional requirements for an operations center</li> <li>- Review requirements for redundancy of the operations facilities</li> <li>- Identify potential locations and develop size of operations facilities</li> </ul>	<ul style="list-style-type: none"> <li>- List of activities and functionality of the operations facilities</li> <li>- Types and size of operations facilities including a Central Control Center and redundant line facilities as required</li> </ul>
<b>Operations Concept</b>	<ul style="list-style-type: none"> <li>- Identify train performance characteristics that meet CHSTP performance requirements including operating speed and capacity</li> <li>- Identify operational parameters to provide a train service that supports the projected ridership</li> <li>- Develop a train dispatch schedule using computer based train simulation models to confirm operational feasibility and number of trainsets</li> </ul>	<ul style="list-style-type: none"> <li>- Concept of Operations Report</li> </ul>
Maintenance	15% Design Scope	Engineering Output
<b>Rolling Stock</b>	<ul style="list-style-type: none"> <li>- Develop list of activities and functions for a Heavy Maintenance/Repair facility</li> <li>- Develop list of activities and functionality for the Light/Medium maintenance facilities located near terminal stations</li> <li>- Determine facility requirements for rolling stock maintenance facilities</li> <li>- Develop track layout and access requirements for central maintenance and repair facility (Heavy Maintenance /Repair) and terminal maintenance facilities (Light/Medium Maintenance)</li> <li>- Identify potential hazardous waste generators, special requirements for storage, and current best practices for disposal</li> </ul>	<ul style="list-style-type: none"> <li>- Alternative sites and approximate size of Heavy Maintenance/Repair facility</li> <li>- Alternative sites and sizes of Light/Medium maintenance facilities near terminal stations</li> </ul>
<b>Maintenance of Way</b>	<ul style="list-style-type: none"> <li>- Determine maintenance-of-way (MOW) activities and access requirements based on expected CHSTP infrastructure</li> <li>- Identify and develop siding locations for MOW maintenance facilities</li> <li>- Identify and develop HST railway access points from local roads including easement requirements</li> <li>- Identify requirements for continuous longitudinal access for inspection and maintenance</li> <li>- Identify effects on maintenance of adjacent railroads.</li> <li>- Identify requirements for emergency access and incident response</li> </ul>	<ul style="list-style-type: none"> <li>- Sites for MOW facility locations and functional requirements</li> <li>- Determination if MOW facilities require additional footprint</li> <li>- Confirmation of accessibility of CHST alignment for maintenance</li> </ul>