

SYSTEMWIDE REQUIREMENTS for the Peninsula Rail Program
San Francisco to San Jose on the Caltrain Corridor
Description of the Systemwide Context for the High-Speed Train Project

This document provides a general and concise overview of the technical requirements and operational context for the high-speed train project. These include characteristics of the system and basic design requirements which must be considered in the development of project alternatives for a high-speed train system, particularly in the San Francisco to San Jose corridor where there will be shared use between commuter, freight, and high-speed intercity train service.

1. Characteristics of the California High-Speed Train Project:

- a. Statewide network:
 - 800-mile statewide network, connecting major population centers of Sacramento, San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County and San Diego.
 - Electric-powered trains via overhead contact wires
 - Steel-wheel-on-steel-rail technology
 - Maximum speed of 220 miles per hour
 - Fully grade-separated, dedicated track alignment
- b. San Francisco to San Jose section (ways it is different from statewide system):
 - Maximum design speed of 125 mph
 - Railroad right-of-way owned by Peninsula Corridor Joint Powers Board (JPB)
 - Shared corridor/tracks with Caltrain commuter operations; freight operator to run on corridor from midnight to 5:00 a.m.
 - The Trackage Rights Agreement between JPB and freight allows freight operations window to be restricted by passenger rail revenue hours

2. Infrastructure

- a. **Urban Environment** – High-speed train service is ideal for getting people to urban centers quickly. Therefore, the projects often occur in developed, densely urbanized areas, which makes construction more complex and challenging because of the need to build around existing infrastructure and rail corridors. While working with existing rail infrastructure has its challenges, introducing rail infrastructure to a roadway environment that has a significant number of freeways can be even more challenging.
- b. **Track** – High-speed trains can operate on standard gauge rail, which is the same type of track used by intercity, commuter and freight trains in the U.S. They do not operate on the same track as heavy rail transit systems (like BART), and therefore cannot share tracks with them.
 - To accommodate high-speed train service, two additional tracks will be added to the Caltrain corridor to accommodate the increase in the number of trains using the corridor. By operating compatible vehicles (See 3c

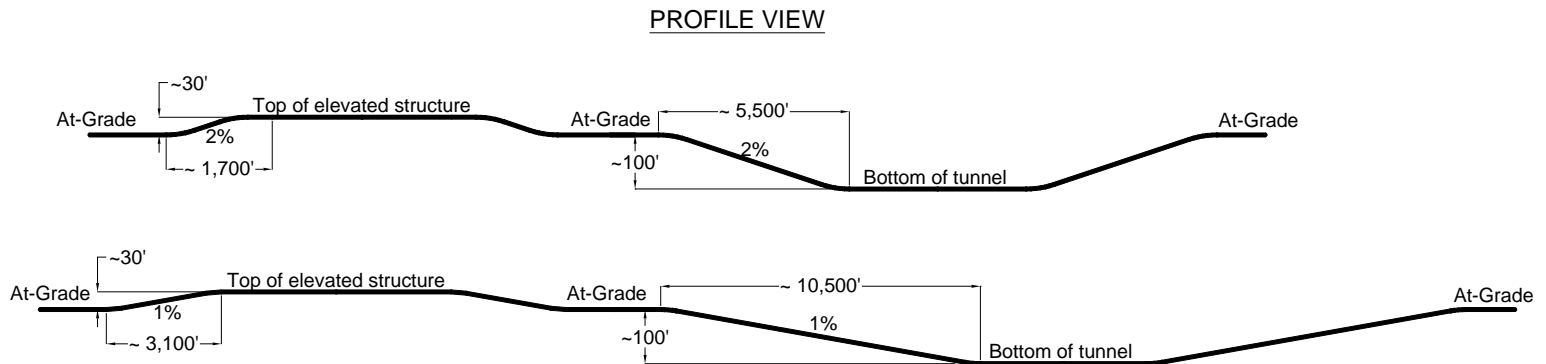
“Vehicle Technology”), high-speed trains and Caltrain can operate on the same tracks if needed, but operationally, it is more efficient for trains that do not stop as often to use different tracks from trains that serve multiple stops. It is advantageous for both high-speed trains and Caltrain to have the ability to share track during maintenance periods or in the case of emergencies.

- Because of the high travel speeds, any curves in the track must be longer (i.e. more gradual and not a sharp or tight curve) than those of typical rail operations. Sometimes tracks are banked or superelevated to take curves at high speeds and maintain comfort for passengers.
- c. **Grade separations** – The high-speed train project is required to completely separate its operations from vehicular roads on a dedicated right-of-way. While Caltrain is not required to have these grade separations, the benefit of sharing tracks and the corridor with high-speed trains is that Caltrain service could also be separated from motor vehicular traffic. If high-speed trains were to be completely separate from Caltrain (i.e. the high-speed tracks and Caltrain tracks are not adjacent to each other), the project cost for electrification and grade separations would increase because the two rail operators could not share infrastructure. The different characteristics of the grade separation options are provided in the Typical Grade Separation Methods reference document (CSS1_001_GradeSepMethods).
- **Above grade** – options include raising the railroad tracks onto aerial structures (viaducts) or berms.
 - **At-grade** – railroad tracks can be kept at grade, while the crossing roadway is raised over the tracks, lowered beneath the tracks, or cross traffic is closed.
 - **Below grade** – railroad tracks are located into a trench (open air), covered trench (cut and cover), or a deep tunnel.
- d. **Gradient** – A straighter (vertical and horizontal) track profile is preferred for train operations, passenger comfort, and construction/cost efficiencies. The profiles for adjacent segments of the corridor are to be considered to minimize the “roller coaster effect.” The steeper the incline, the longer it will take trains to reach their maximum design speed. The maximum gradient for the rail corridor is determined by which user(s) will be on the corridor. Therefore, the lowest of the maximum allowable gradients restricts all rail traffic.

Elevated or underground railroad tracks require:

- A maximum one percent grade change (approximately one foot in vertical elevation every 100 feet of horizontal distance) to accommodate freight trains, which translates to over 10,000 feet of distance for a train to surface from a 100-foot deep tunnel.
- A maximum two percent grade change (approximately two feet in vertical elevation every 100 feet of horizontal distance) to accommodate diesel-hauled passenger trains, which translates to over 5,000 feet of distance for a train to surface from a 100-foot deep tunnel.

- A maximum two-and-half to three-and-a-half percent grade change is allowable for tracks that serve only high-speed trains. However, the steeper the grade, the more difficult it is for high-speed trains to reach top speed, if at all.



- e. **Stations** – There are two types of stations: terminal (end-of-service) and through (intermediate) stations.
- Terminal stations tend to require more land because they must accommodate a larger number of trains for a longer period of time. For this reason, the ticketing/waiting areas and station access needs (parking, pick-up/drop-off, transit connections, bicycle parking) tend to be greater as well.
 - A through-station may get skipped by express trains, and therefore requires fewer platforms. Similarly, trains do not layover at through stations, so less storage is needed. The vertical location (above ground, at grade, below ground) influences the size of the station because the more vertical circulation (stairs, escalators, elevators) there is, the more space that is required.
 - High-speed trains require longer platforms (1327 feet for the California High-Speed Train Project) than commuter rail (800 feet for Caltrain). Level boarding (no stairs needed to board or alight the train) is to be provided for all high-speed trains.
- f. **Maintenance Facilities / Storage Yards** – The rail operators in the corridor will need to have access to maintenance facilities and storage yards for trains that are not in service. Ideally, facilities must be located within 3 miles of terminal stations, in order to minimize the travel time required for an empty train to reach the terminal station where service will begin.

3. Power, Signal Systems and Vehicle Technology

- a. **Electrification** – Most high-speed train systems in the world are powered by electricity via overhead contact wires. It is an efficient way to deliver a significant amount of electricity to the trains, which is necessary in order for them to operate at high speeds.

- Caltrain has completed the Environmental Document for its Electrification project. This project will provide electric power via overhead contact wires to the future fleet of electric-powered commuter trains. Diesel-powered trains will be able to run underneath the overhead contact wire. This system is also designed to be compatible with high-speed trains, meaning high-speed trains can draw power from the overhead contact wire, as well.
- b. **Signal System** – All major railroads in the U.S. are mandated by the federal government to install safety systems known as positive train control on all trains by 2015.
 - Positive train control greatly reduces the likelihood of train collisions and other accidents by applying automatic brakes when a train exceeds allowable speeds or is running on restricted tracks where it could potentially have a conflict with another train.
 - There is no standard signal system technology designated for high-speed train systems in the U.S. A standard is being developed.
 - Caltrain has been developing its own version of positive train control since 2007, which is anticipated to be in service by 2013. Installing positive train control in the San Francisco to San Jose section in advance of the construction of the high-speed train project will enable Caltrain to maintain its operations during construction and will provide critical collision avoidance protection in the corridor when future high-speed trains are in service.
- c. **Vehicle Technology** –
 - California plans to operate high-speed trains that are electric multiple unit vehicles (EMUs), where the power is distributed amongst multiple cars, instead of being concentrated in a locomotive. The EMU vehicle technology delivers higher performance (quicker acceleration and deceleration) and reliability of service than conventional equipment, especially when combined with an advanced signal system.
 - Caltrain must replace a majority of its fleet by 2015. Caltrain intends to procure EMUs, which will be compatible with high-speed trains in that they meet the same safety standards, and therefore, can share tracks.
 - High-speed trains are built differently from commuter trains and are greater in length and capacity but lighter in weight (axle load) and smaller in profile to accommodate travel at higher speeds, passenger comfort at higher speeds and longer distances, and less frequent boarding and alighting of passengers. Most high-speed trains have different floor heights than commuter trains, which means level boarding may not be accommodated at the same platform edge.
 - A high-speed train can carry almost 1000 passengers, while a Caltrain train set carries about 650 passengers.

4. Rail Operations and Connecting Service

- a. **Number of Stops** – High-speed train operations are more comparable to air travel, rather than conventional passenger train travel. High-speed train systems around the world tend to be most competitive with air travel for trips between 100 and 500 miles. Fewer stops are preferable, so that higher/maximum speeds can be achieved for as much of the trip as possible. It can take 12 to 15 miles for a high-speed train to reach maximum speed and two miles for it to come to a complete stop. Therefore, the utility of high-speed train service is reduced if the train must stop too often or at stops that are too close together. Other commuter rail services, like Caltrain, are more suited to local service with stops that are ideally spaced three miles or more apart.
- b. **Reliability** – Because of the separated corridor and less vulnerability to weather conditions, high-speed train systems have extremely high on-time performance records. The reliability and on-time performance of a system depends on the efficient layout of terminal stations area and facilitating quick boarding and alighting of passengers at each station.
- c. **Freight Rail Access** – The corridor will continue to be used by freight trains that must access industries along the corridor.
- d. **Station Connectivity** – The ease and efficiency of connecting transit services is just as important as the high-speed train service itself. The “last mile” problem – how to get to one’s final destination from the station – can be a major deterrent that prevents people from taking the train altogether. Parking facilities require a significant amount of land and can increase traffic congestion, so alternative means of providing access to and from stations is preferable, especially in urban areas.

5. **Constructability and Sequencing** – The construction methods and sequencing of project phases will have a major influence on the schedule and the cost of the project. Often, phasing the construction is required when the project area must support operation of the existing transportation facility, in this case, Caltrain, other passenger rail, and freight rail service. Sometimes temporary track and/or temporary stations must be constructed, while old infrastructure is being removed and new infrastructure is being built. Construction methods vary depending on the type of structure being built and site conditions. Some methods can significantly reduce construction time over others, especially if prefabrication occurs off site.

6. **Regulatory Environment** – the development of the Caltrain corridor and high-speed train systems is governed by a number of regulatory bodies:

- a. **Federal Railroad Administration (FRA)** – One of the main purposes of the FRA is to promulgate and enforce rail safety regulations. The FRA is the sponsoring agency of the Environmental Impact Statement for the California High-Speed Train project and the administrator of the American Recovery and Reinvestment Act (ARRA) funds.
- b. **Surface Transportation Board (STB)** – The STB is an economic regulatory agency that Congress charged with the fundamental missions of resolving railroad rate and service disputes and reviewing proposed railroad mergers. The STB is decisionally

independent, although it is administratively affiliated with the Department of Transportation.

- c. **California Public Utilities Commission (CPUC)** – The CPUC employs federally certified staff inspectors and coordinates with the FRA and is the largest participating state agency in the nation to ensure that railroads comply with federal railroad safety regulations. The CPUC investigates railroad accidents and responds to safety related inquiries made by community officials, the general public, and railroad labor organizations. The CPUC is an active participant in Operation Lifesaver, a grade crossing awareness training program.
- d. **National Environmental Policy Act (NEPA)** – Any major transportation project receiving federal funds must comply with NEPA. NEPA requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. To meet NEPA requirements federal agencies prepare a detailed statement known as an Environmental Impact Statement (EIS). EPA reviews and comments on EISs prepared by other federal agencies, maintains a national filing system for all EISs, and assures that its own actions comply with NEPA.
- e. **California Environmental Quality Act (CEQA)** – CEQA is a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Any major transportation project receiving state funds must comply with CEQA. The preparation of an Environmental Impact Report (EIR) is a requirement of CEQA.

7. Funding – The California High Speed Rail Authority (CHSRA), the state entity responsible for planning, constructing and operating the California High-Speed Train Project, anticipates that 50 percent of the project's capital funding will come from the federal government, 25 percent will come from the State of California, and the remaining 25 percent will come from private sources. The following is a partial listing of some secured and anticipated sources of funding.

- a. **PRIIA** – The Passenger Rail Investment and Improvement Act of 2008 created a new capital grants program for states and eligible authorities to provide high-speed and intercity passenger rail.
- b. **ARRA** – The American Recovery and Reinvestment Act of 2009 included \$8 billion in stimulus funds for state investment nationwide in high-speed and intercity passenger rail. In February 2010, California's high-speed train project was announced as the recipient of \$2.25 billion in ARRA funds, which will help advance the four high-speed train corridors in the project's first phase. This phase includes the San Francisco to San Jose section. As of March 2010, it has not been determined how the funds will be allocated specifically.
- c. **FY 2010 Federal Budget** – Congress approved \$2.5 billion for high speed and intercity passenger rail in 2010, which was \$1.5 billion more than the President requested.
- d. **FY 2011 Federal Budget** – The President has recommended that Congress appropriate another \$1 billion for the program in 2011.

- e. **Surface Transportation Act** – Soon Congress will consider the next six-year Surface Transportation Authorization Bill. Policymakers have indicated that the legislation will include at least \$50 billion for high speed and intercity passenger rail.
- f. **AB 3034 and Proposition 1A** – With the passage of Proposition 1A in 2008, California voters approved the issuance of \$9.95 billion in general obligation bonds for statewide high-speed rail (\$950 million of which is designated for connecting local transit services). Proposition 1A funds require matching funds in order to be utilized by the project. Assembly Bill 3034 defines restrictions and protections for how Proposition 1A funds can be spent.