APPENDIX 5-A

# Operations and Service Plan

# CALIFORNIA HIGH-SPEED TRAIN

## Project Environmental Impact Report / Environmental Impact Statement

# DRAFT

# Operations and Service Plan Summary

July 2011


CALIFORNIA High-Speed Rail Authority

U.S. Department of Transportation
Federal Railroad Administration

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# 1.0 INTRODUCTION

This summary provides background information on the intended service and operations of the California high-speed train (HST) system to provide sufficient detail for the environmental assessment of proposed HST operations. Recognizing that the California system is still at a relatively early stage of the planning process, and that many operational issues remain to be resolved, this section summarizes how the system is envisioned to operate at this point in project planning.

Inspired by successes of high-speed train systems around the world, California has for more than 13 years been planning a statewide high-speed rail line that will serve as a backbone and a needed alternative to the state's existing transportation network. The system will interface with and complement other modes of transportation – commercial airports, mass transit, the state's highway network, bike paths and pedestrian traffic. It is envisioned as a new system stretching initially from Anaheim/Los Angeles through the Central Valley to San Francisco in the year 2020, and later, in the year 2027 to Sacramento and San Diego. It will be capable of 220 mph revenue operating speed and a travel time between Los Angeles and San Francisco of 2 hours 40 minutes. It will interconnect with other modes of transportation and provide an environmentally friendly alternative to vehicle and air travel.

The California HST system will initially cover 500 route-miles and service is planned to start in 2020, beginning in Anaheim/Los Angeles, running through the Central Valley from Bakersfield to Merced, and traveling northwest into the Bay Area. Subsequent phases of the high-speed rail system are planned for a southern extension from Los Angeles to San Diego via the Inland Empire and an extension from Merced north to Sacramento to be implemented in 2027.

Proven train technologies similar to those used in other countries with established high-speed train systems (for example: Japan, France, Germany, Great Britain, Spain, Korea and China) will be used. This technology includes steel-wheel-on-steel-rail, entirely electric power, state-of-the-art safety and signaling systems, and automated train control. This technology, although new to North America, was introduced in Japan in 1964, France in 1981, and in many other countries within the past two decades.

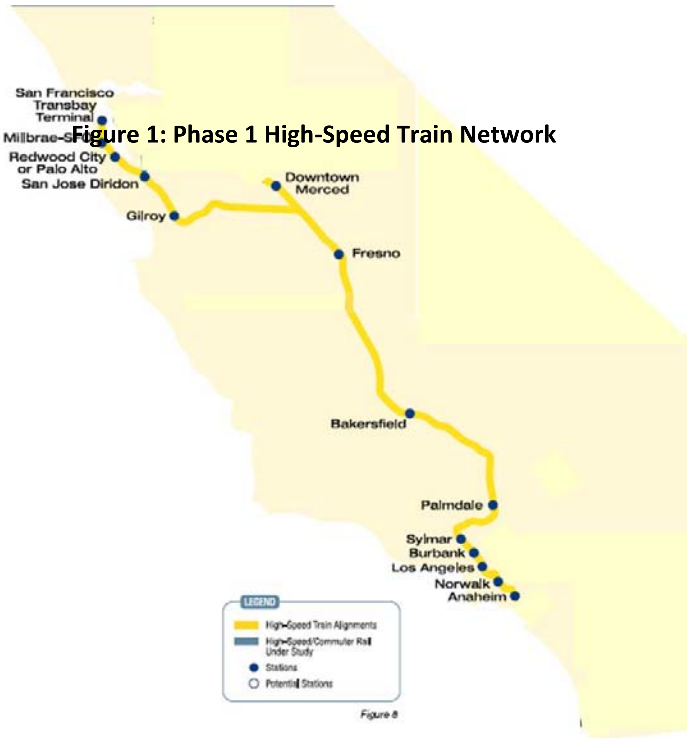
The HST will operate primarily on exclusive (dedicated) track with portions of the route shared with other existing passenger rail operations. The route (alignment) will be constructed either at-grade, in an open trench, in a tunnel, or on an elevated guideway, depending on the terrain, physical constraints, environmental impacts and community input along each section. The system will predominately be within, or adjacent to, existing rail or highway right-of-way to reduce potential environmental impacts and minimize land acquisition.

# 2.0 SERVICE PLAN OVERVIEW

## 2.1 PHASE 1 SERVICE PLAN (2020)

Phase 1 is planned to begin operation in 2020 and will implement high-speed train service between San Francisco and Anaheim, via the Peninsula corridor, Pacheco Pass, Central Valley and Antelope Valley. In San Francisco, high speed trains will operate at two terminal stations: the new Transbay Terminal and a reconstructed high- speed terminal at the existing Caltrain commuter station at 4th and King Streets. Other major stations along the route include the San Jose Diridon Station and Los Angeles Union Station. The southern terminus of the high-speed line will be at the planned ARTIC regional transportation center in Anaheim.

**Figure 1: Phase 1 High-Speed Train System**




## 2.2 FULL BUILD SERVICE PLAN (2027)

The full build-out of the HST system is expected to be ready for the operation of revenue service in 2027 and will include four branches off of a main spine running through the Central Valley and serving Los Angeles Union Station. In addition to the San Francisco and Anaheim branches implemented in (Phase 1) of development, the full build system will provide high-speed train service to the northern portion of the Central Valley and the state capital at Sacramento, and to Riverside and San Diego via the Inland Empire and Interstate 15 corridors.

**Figure 2: Full Build High-Speed Train System**

### 2.3 IMPLEMENTATION PHASING

Phase 1 initial revenue service is expected to begin in 2020 with the operation of an estimated 120 trains per day (on average). Several significant interim steps are anticipated. A portion of the new dedicated high-speed track will be built early and used for testing and commissioning the high-speed trainsets as they are received from the manufacturer. In addition, early revenue service over a portion (or portions) of the Phase 1 line is planned, once sufficient trainsets have been commissioned and are ready for service. Detailed service and operations planning for these interim stages has not yet been undertaken.

Phase 1 will be designed to be operable as a permanent, stand-alone system. While estimated to be operational by 2027, the branch extensions to Sacramento and/or San Diego could be added to the network at any point following completion of the Phase 1 system.

## 3.0 SERVICE PLANS

Concept level rail operations and service plans have been developed to serve several purposes:

- Confirm the level of service assumptions (travel times and service frequencies between station pairs) used to develop the estimates of system ridership and revenue
- Validate the operational feasibility of the desired level of service at a conceptual level
- Identify operable patterns of train service, particularly the general requirements for non-stop or limited-stop trains to pass slower trains that need to make a greater number of (local) stops along the route (i.e., the locations and frequencies of occurrence of these “overtakes” at various times of day)
- Provide a basis for an order of magnitude estimate of the number of train sets and overall rolling stock fleet requirements for the full build-out
- Provide a basis for estimating platform track and storage track capacity to support operations at the end terminal stations
- Provide a basis for sizing train storage and maintenance facilities throughout the HST system
- Provide a basis for planning passenger-handling operations at HST stations, which can be used to help size and configure station facilities.

The HST system ridership and revenue estimates are used in developing the operations and service plans so the level of service that would be provided at each station is generally equivalent to the level of service assumed in developing the ridership and revenue estimates for the HST system. Weekday ridership demand is assumed to reach peak levels during a three-hour period in the morning and again in the afternoon. Train service density would be greatest during these periods, reverting to a slightly lower level of service during the remainder of the day.

Currently, the proposed mix of services would offer regular clock-face patterns, with each service type leaving passenger stations at the same time each hour, with relatively limited exceptions. Slightly more service is assumed during the three hour peak periods in the morning and late afternoon than during off-peak hours, consistent with expected ridership peaking.

Trains would run in diverse patterns between various terminals. Three basic service types are envisioned:

- Express trains, which would serve major stations only, providing fast travel times; for example, between Los Angeles and San Francisco during the morning and afternoon peak with a run time of 2 hours and 40 minutes.
- Limited-stop trains, which would skip selected stops along a route to provide faster service between stations.
- Frequent-stop trains, which would focus on regional service.

The vast majority of trains would provide limited-stop services and offer a relatively fast run time along with connectivity among various intermediate stations. Numerous limited-stop patterns would be provided, to achieve a balanced level of service at the intermediate stations. The service plan (Authority 2010b) envisions at least four limited trains per hour in each direction, all day long, on the main route between San Francisco and Los Angeles. Each intermediate station in the Bay Area, Central Valley between Fresno and Bakersfield, Palmdale in the High Desert, and Sylmar and Burbank in the San Fernando Valley would be served by at least two limited trains every hour—offering at least two reasonably fast trains an hour to San Francisco and Los Angeles. Selected limited-stop trains would be extended south of Los Angeles as appropriate to serve projected demand.

Including the limited-stop trains on the routes between Sacramento and Los Angeles, and Los Angeles and San Diego, and the frequent-stop local trains between San Francisco and Los Angeles/Anaheim, and Sacramento and San Diego, every station on the HST system would be served by at least two trains per hour per direction throughout the day, and at least three trains per hour during the morning and afternoon peak periods. Stations with higher ridership demand would generally be served by more trains than those with lower estimated ridership demand.

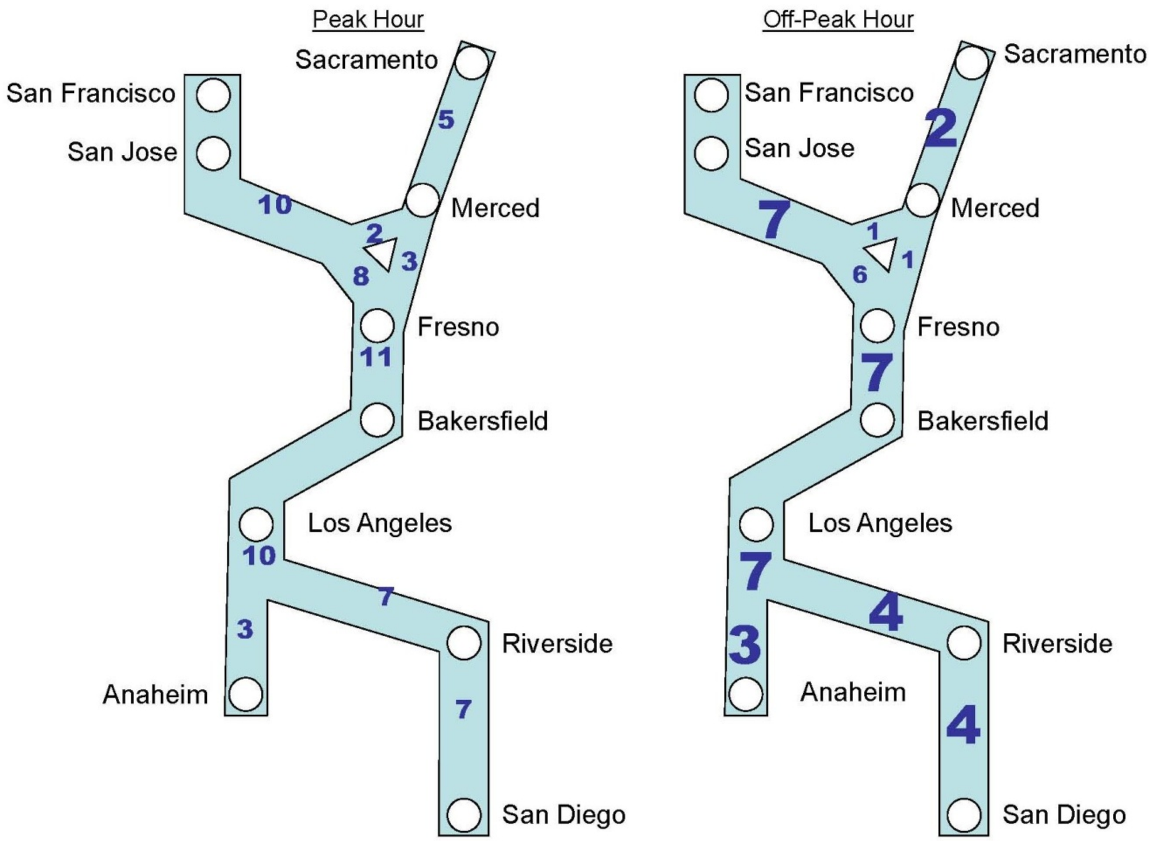
The service plan provides direct train service between most station pairs at least once per hour. Certain routes may not always be served directly, and some passengers would need to transfer from one train to another at an intermediate station, such as Los Angeles Union Station, to reach their final destination. Generally, the Phase 1 and full-build conceptual operations and service plans offer a wide spectrum of direct service options and minimize the need for passengers to transfer.

These service plans provide a useful initial estimate of the level of service that matches projected long-range demand on the HST system. As the HST system is implemented and both the operating plan and the ridership estimates are refined, it will be possible to make informed benefit and cost tradeoffs to develop the most appropriate mix of limited, express and all-stop services, which will affect the trip times between stations and the frequency of service offered at each station for each route.

### 3.1 HORIZON YEAR (2035)

Figure 3 presents the estimated level of train service along various HST sections that is required to deliver the appropriate choices of train stopping patterns to riders at all stations and satisfy the projected weekday ridership demand in the horizon year of 2035. Weekday ridership demand is assumed to reach peak levels during a three-hour period in the morning and again in the afternoon. Train service density will be greatest during these periods, reverting to a lower level of service during the remainder of the day.

**Figure 3: Horizon Year 2035 Service Plan --**
**Peak Hour and Off-Peak Train**




This service plan concept estimates that the main HST line through the Central Valley would have eleven trains per hour in each direction during the peaks, and seven trains per hour at other times. It is important to note that even though this conceptual service plan estimates less than twelve trains per hour (per direction) over most of the network during peak periods, the HST system is being designed for a headway (time between trains) of three minutes, which could allow up to twenty trains per hour per direction if all trains adhered to precisely the same schedule.

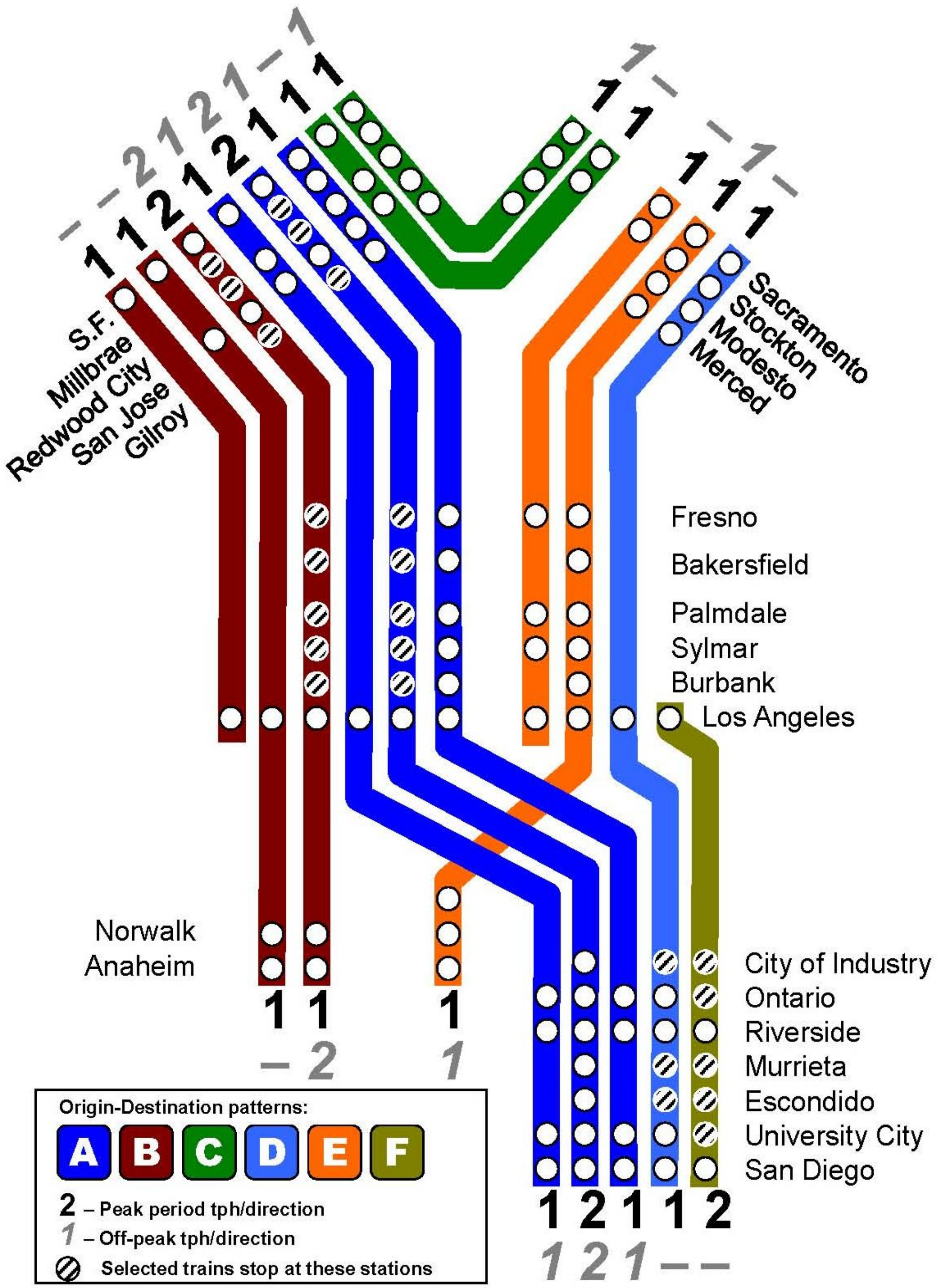
The level of service during the business travel peaks at San Francisco, along the Peninsula Corridor and across Pacheco Pass would be ten trains per hour in each direction. The corresponding level of service between Merced and Sacramento would be five trains per hour per direction – with two of these trains operating towards San Francisco and the other three trains operating towards Los Angeles. During off-peak periods, the base level of service would provide six trains per hour between San Francisco and Los Angeles (with four of these trains extended to San Diego and three trains extended to Orange County [Anaheim]). One train per hour would be operated between Sacramento and San Francisco, and between Sacramento and San Diego via Los Angeles.

The operations and service plan concept would provide up to seven trains per hour in each direction along the route between Los Angeles and San Diego and three trains per hour per direction between Los Angeles and Orange County (Anaheim) during the peak hours. This service scenario assumes that between Los Angeles and Anaheim the tracks will be shared with a peak period operation of four Metrolink Orange County trains (per hour), three HST (per hour) and one Amtrak Pacific Surfliner (per hour) sharing tracks on the new alignment between Los Angeles and Anaheim. The base level of off-peak service would be four trains per hour on the San Diego section.

Figure 4 illustrates the service types and trains that are assumed to be operated during a typical peak hour and off-peak hour in 2035. (Limited-stop patterns are simplified for presentation clarity.)

Table 1 shows the detail of all 15 stopping patterns that are assumed to be provided in the northbound direction during the morning peak hour and the eight stopping patterns that would be provided during mid-day off-peak hours. In both cases, each pattern would be operated by one train per hour, with the patterns repeating each hour.

**Figure 4: Horizon Year 2035 Service Plan**
**Basic Train Stopping Patterns**




** Note: The Origin-Destination patterns, A through F, correspond to the Route column A through F, shown in Table 2 on the following page.*

**Table 1: Horizon Year 2035**
**Train Stopping Patterns – Typical Peak and Off-Peak Hours**

**Typical Peak Hour** (AM Peak Northbound)

| | Route / Service Type | Stopping Pattern ID | SFT S.F.-Transbay | SFO Millbrae | RWC Redwood City | SJO San Jose | GLY Gilroy | SAC Sacramento | STN Stockton | MOD Modesto | MCD Merced | FNO Fresno | BFD Bakersfield | PMD Palmdale | SYL Sylmar | BUR Burbank | LAU Los Angeles Union | NSF Norwalk | ANA Anaheim | COI City of Industry | ONT Ontario | RIV Riverside | MUR Murrieta | ESC Escondido | UNI University City | SAN San Diego |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | Bay Area-L.A. Basin Limited Express | 1 | ● | | ● | ● | ● | | | | | | | | | | ● | | | | ● | ● | | | ● | ● |
| A | Bay Area-L.A.-San Diego Limited | 7 | ● | ● | ● | ● | | | | | | ● | ● | | ● | | ● | | | ● | ● | ● | ● | ● | ● | ● |
| A | Bay Area-L.A.-San Diego Limited | 29 | ● | | ● | ● | ● | | | | | | | ● | ● | | ● | | | ● | ● | ● | ● | ● | ● | ● |
| A | Bay Area-Los Angeles All-Stop | 4 | ● | ● | ● | ● | ● | | | | | ● | ● | ● | ● | ● | ● | | | | ● | ● | | | ● | ● |
| B | Bay Area-Los Angeles Express | 2 | ● | | | ● | | | | | | | | | | | ● | ● | ● | | | | | | | |
| B | Bay Area-Los Angeles Express | 2a | ● | | | | | | | | | | | | | | ● | | | | | | | | | |
| B | Bay Area-L.A.-Orange County Limited | 18a | ● | ● | | ● | ● | | | | | ● | | ● | | ● | ● | ● | ● | | | | | | | |
| B | Bay Area-L.A.-Orange County Limited | 21a | ● | | ● | ● | ● | | | | | | ● | ● | ● | ● | ● | | | | | | | | | |
| C | Sacramento-S.F. All-Stop | 14 | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | |
| C | Sacramento-S.F. Limited | 39 | ● | | ● | ● | | ● | ● | | | | | | | | | | | | | | | | | |
| D | Sacramento-L.A.-San Diego Limited | 35 | | | | | | ● | ● | ● | ● | | | | | | ● | | | | ● | ● | | | ● | ● |
| E | Sacramento-L.A.-Orange County All-Stop | 15 | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | | |
| E | Sacramento-L.A.-Orange County Limited | 25 | | | | | | ● | ● | | | ● | | ● | ● | | ● | | | | | | | | | |
| F | Los Angeles-San Diego All-Stop | 41 | | | | | | | | | | | | | | | ● | | | ● | ● | ● | ● | ● | ● | ● |
| F | Los Angeles-San Diego Express | 42 | | | | | | | | | | | | | | | ● | | | | | ● | | | | ● |
| | **Number of trains stopping at station** | | 10 | 4 | 7 | 9 | 6 | 5 | 5 | 3 | 3 | 5 | 4 | 6 | 6 | 4 | 13 | 3 | 3 | 3 | 6 | 7 | 3 | 3 | 6 | 7 |

**Off-Peak Hour**

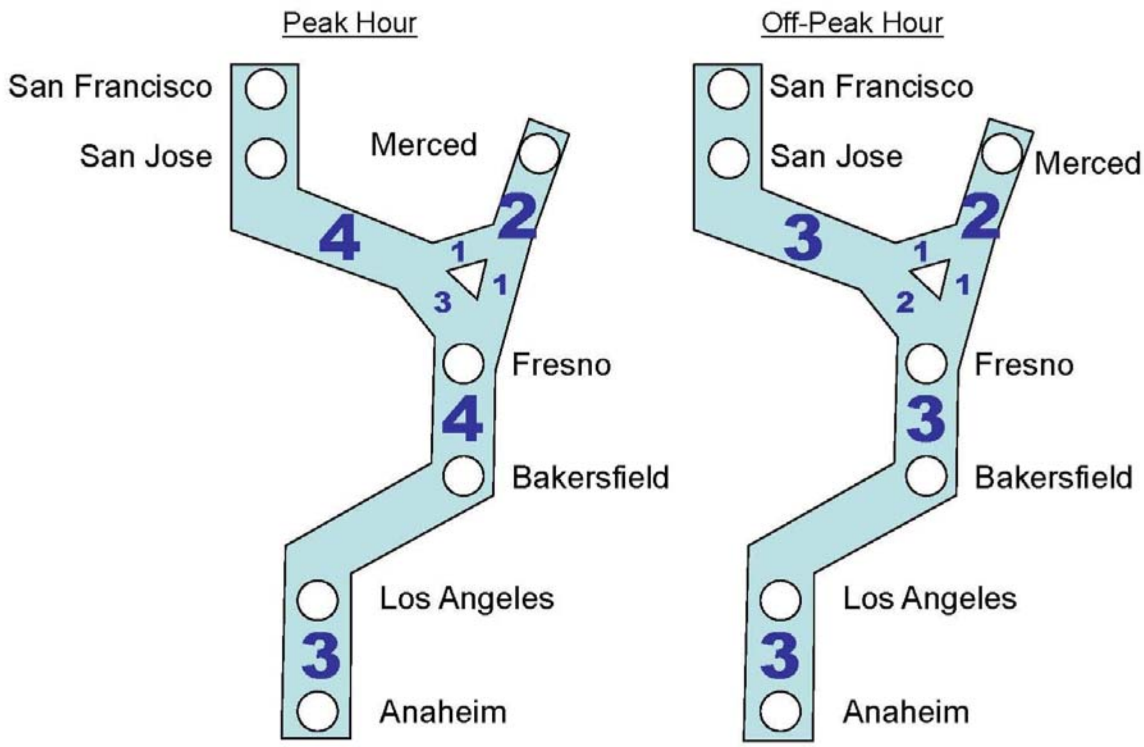
| | Route / Service Type | Stopping Pattern ID | SFT S.F.-Transbay | SFO Millbrae | RWC Redwood City | SJO San Jose | GLY Gilroy | SAC Sacramento | STN Stockton | MOD Modesto | MCD Merced | FNO Fresno | BFD Bakersfield | PMD Palmdale | SYL Sylmar | BUR Burbank | LAU Los Angeles Union | NSF Norwalk | ANA Anaheim | COI City of Industry | ONT Ontario | RIV Riverside | MUR Murrieta | ESC Escondido | UNI University City | SAN San Diego |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | Bay Area-L.A. Basin Limited Express | 1 | ● | | ● | ● | ● | | | | | | | | | | ● | | | | ● | ● | | | ● | ● |
| A | Bay Area-L.A.-San Diego Limited | 26 | ● | ● | ● | ● | ● | | | | | ● | ● | | | | ● | | | ● | ● | ● | ● | ● | ● | ● |
| A | Bay Area-L.A.-San Diego Limited | 27 | ● | | ● | ● | ● | | | | | | | ● | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● |
| A | Bay Area-Los Angeles All-Stop | 4 | ● | ● | ● | ● | ● | | | | | ● | ● | ● | ● | ● | ● | | | | ● | ● | | | ● | ● |
| B | Bay Area-L.A.-Orange County Limited | 16 | ● | ● | ● | ● | ● | | | | | ● | ● | | | | ● | ● | ● | | | | | | | |
| B | Bay Area-L.A.-Orange County Limited | 17 | ● | | ● | ● | ● | | | | | | | ● | ● | ● | ● | ● | ● | | | | | | | |
| C | Sacramento-S.F. All-Stop | 14 | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | | | | | |
| E | Sacramento-L.A.-Orange County All-Stop | 15 | | | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | | |
| | **Number of trains stopping at station** | | 7 | 4 | 7 | 7 | 7 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 7 | 3 | 3 | 2 | 4 | 4 | 2 | 2 | 4 | 4 |

*Note (2): The "Route" column on the left of the Table showing the letters A through F, corresponds to the Origin-Destination patterns, A through F shown in Figure 4 on the preceding page.*

## 3.2 PHASE 1 SERVICE PLAN (2020)

Figure 5 presents the level of HST service that is estimated to be required to deliver the appropriate array of choices of train stopping patterns to riders at all stations and satisfy the projected weekday ridership demand on the Phase 1 system in 2020.

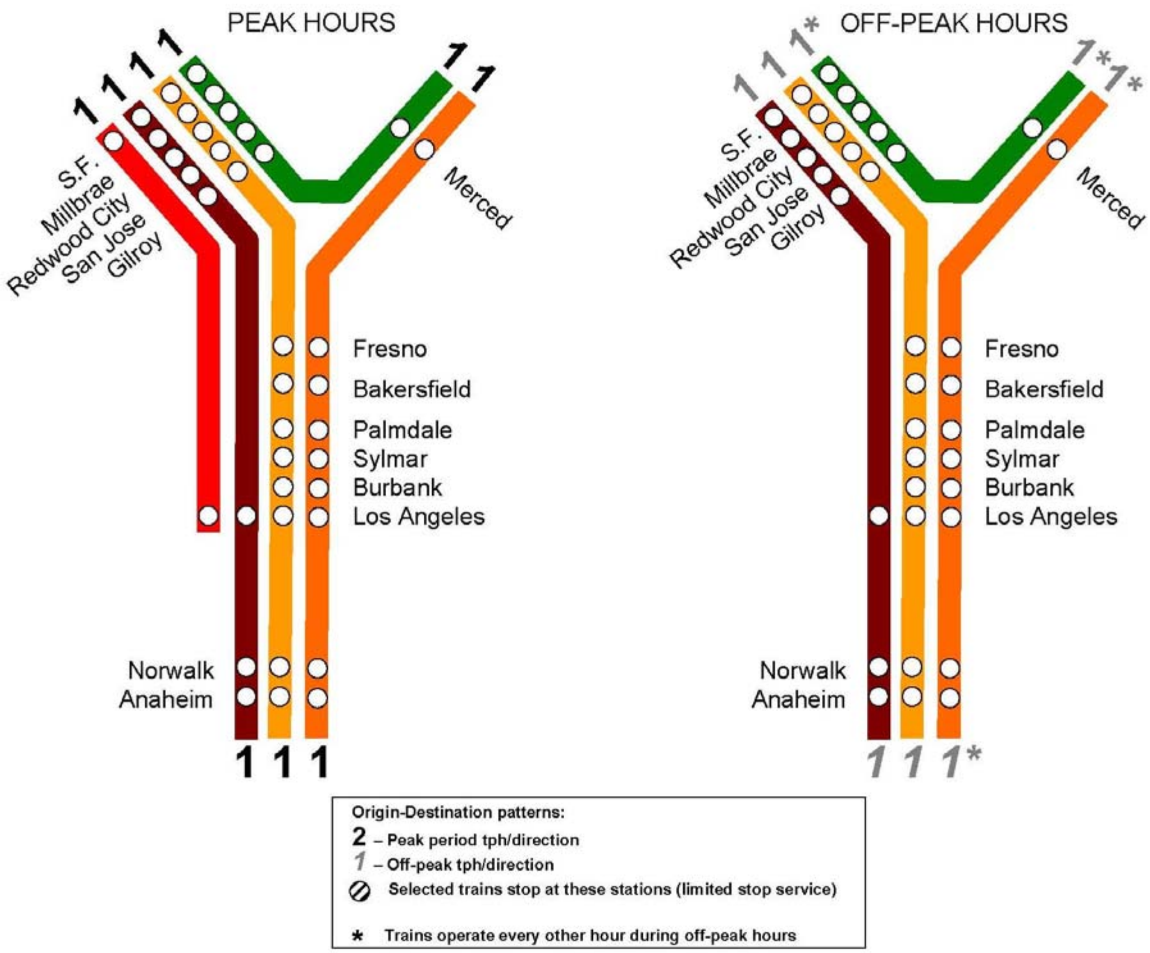
**Figure 5: Phase 1 Service Plan (2020)**
**Peak Hour and Off-Peak Train Movement Density**




For Phase 1 in 2020, the greatest density of train traffic will be between San Francisco and Los Angeles, with four high-speed trains per hour in each direction during the morning and afternoon peak hours.

Phase 1 train service would include trains operating over a subset of the routes listed previously for the Full Build network. Most stations and segments of the network would be served by more than one route. Figure 6 provides an illustration of the types of service and the number of trains of each type that would operate on each of the HST routes during a typical peak hour and off-peak hour in the year 2020.

**Figure 6: Phase 1 Service Plan (2020)**
**Basic Train Stopping Patterns**




# 4.0 PASSENGER STATION OPERATIONS

The horizon year 2035 service plan encompasses 24 passenger stations, including 20 intermediate stations and four terminal stations. The Phase 1 service plan (expected to be operational in 2020), envisions 11 intermediate and three terminal stations. Los Angeles Union Station (LAUS) and Merced would function solely as intermediate stations in the Full System but in Phase 1 Merced would be a northern terminal, and LAUS will serve both roles – as an intermediate station for some trains and a terminal station for others.

Station platforms are assumed to be 1380 feet long. In accordance with Code of Federal Regulations (CFR) regulations that require that platform design meet the Americans with Disabilities Act (ADA) Accessibility Guidelines, the HST platforms will be designed to allow for level boarding.

## 4.1 Intermediate Stations and Platform Tracks

All the intermediate stations in the exclusive, dedicated sections of the high speed system incorporate platform tracks for stopping trains. Stations are spaced about 50 miles apart in rural areas and approximately 15 miles apart in metropolitan areas, with overall average spacing about 30 miles.

Because the Los Angeles high speed rail station is both a terminal station and intermediate station in Phase 1 and the Full build out, and a high-volume station, it has a special layout that incorporates intermediate and terminal station features.

The typical intermediate station will have the configuration shown in Figures 7 and 8, with platform tracks on the outside flanked by side platforms. The platforms will be high-level, tangent and will cover the full length of a 1312 foot train, permitting level boarding through all train doors.

**Figure 7: Intermediate Station Typical Configuration**

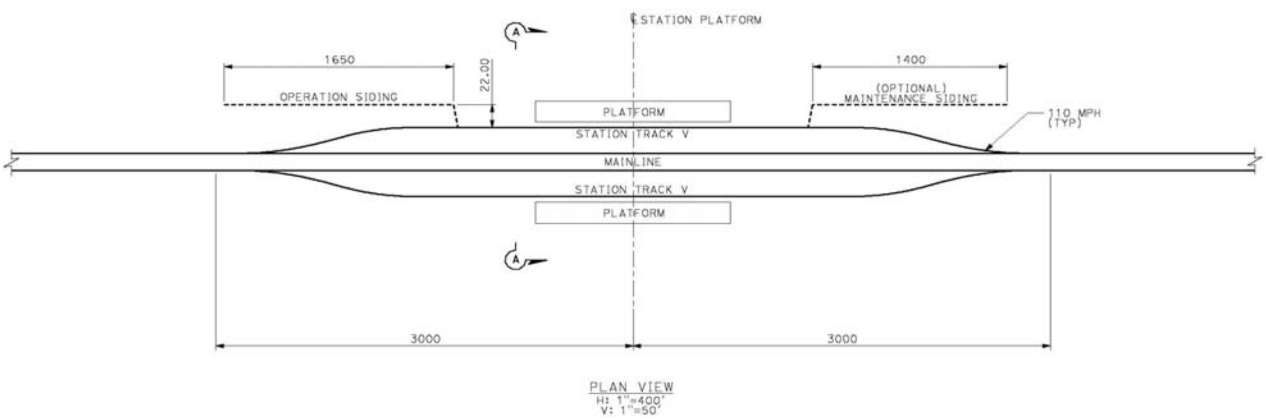
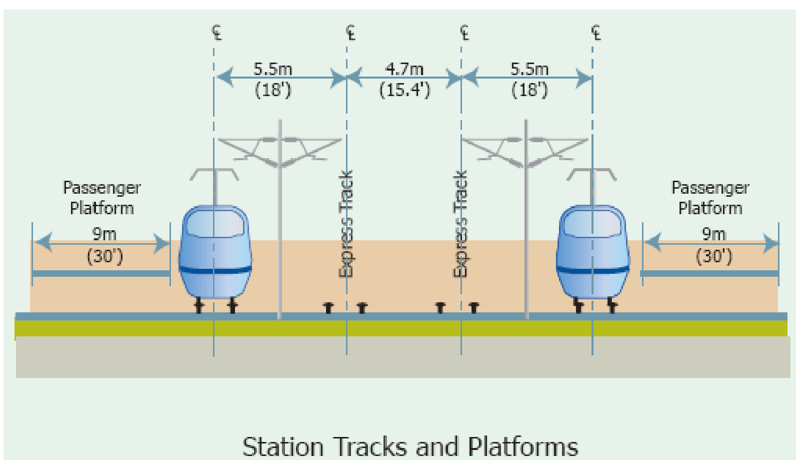



**Figure 8: Intermediate Station Typical Cross-Section**



## 4.2 TERMINAL STATIONS

Four stations are identified as terminal stations in Phase 1 (2020): San Francisco-Transbay, San Francisco 4th & King, Anaheim, and Merced, with Los Angeles serving as both a terminal and intermediate (run-through to Anaheim) station. In the Full Build network configuration (commencing in 2027), San Diego becomes the southern terminus of the inland branch from Los Angeles. Merced will become an intermediate station as the Central Valley line is extended north, with Sacramento becoming the terminal station on this branch. Terminal stations are envisioned to have island platforms serving tracks on both sides and be able to accommodate train cleaning, restocking with on board food service, mandatory train inspection and as-needed maintenance and repair of trainset components – along with the alighting and boarding of passengers. The track and platform configurations at terminal stations vary based on the level of projected train service, local physical constraints, and requirements for other (non-HST) train services that would be located adjacent to the HST facilities. Figures 9A and 9B show typical configurations for a four-track and six-track terminal.

**Figure 9A: Terminal Station**
**4 Track Terminal and 2 Island Platforms**

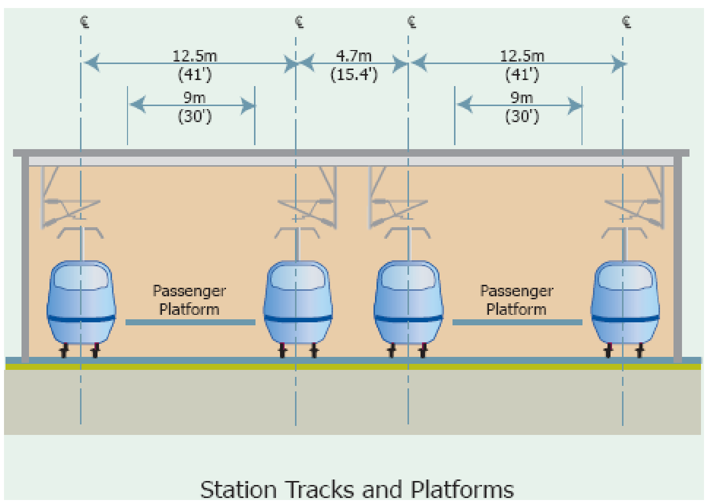
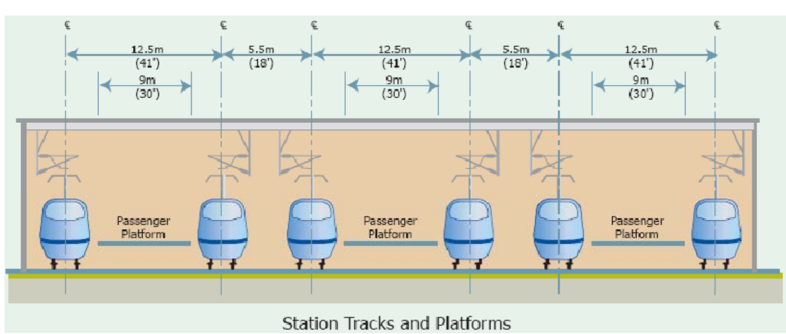



**Figure 9B: Terminal Station**
**6 Track Terminal and 3 Island Platforms**



### 4.2.1 Passenger Boarding

There are several different ways in which passenger boarding could be managed at HST terminal stations. The HST project has not finalized the preferred methods for passenger-handling system wide, and the HST sponsors and operator likely will want consistent passenger handling practices across the entire system. Passenger-handling requirements affect the design and configuration of the physical facilities used for passenger-processing, waiting, queuing and horizontal and vertical circulation.

Examples of potential variations in passenger-handling procedures and required facilities encompass the following:

*Advance staging of boarding passengers*

- Retain all boarding passengers at concourse level until cleaning/servicing is substantially complete and the train is ready for boarding
- Permit boarding passengers to descend to platform level as soon as the load of detraining passengers has cleared the platform (passengers and service personnel and equipment would occupy the platform level simultaneously)

*Number and location of boarding concourse points*

- Board from a single concourse location
- Board from dual locations
- Board from multiple locations spread along a mezzanine or longitudinal concourse situated above or below the platform level, with multiple vertical circulation connections to the platforms

*Reserved seat policy*

- Open seating, where passengers select the car that they will board
- Reserved seating (similar to most European and Asian high-speed rail systems), where passengers are assigned to a seat in a particular car, and where the time required to board the train can be minimized by pre-positioning passengers either on the platform or at concourse level close to where their seat will be located.

These options have differing implications in terms of required facilities, the configuration of concourse and vertical circulation elements, and the station operating costs associated with managing the boarding process.

### 4.2.2 Train Cleaning and Servicing

At terminal stations, train servicing would be done using the passenger platforms. As a result of space constraints at the proposed terminal sites, dedicated service platforms are not envisioned. To maximize passenger safety, servicing operations efficiency, and achieve predictable layover (train parking) times, normal operating procedures would plan for providing temporal separation between the passenger unloading and loading processes and train servicing activities at the terminal platforms.

To attract and keep a dedicated passenger clientele it is important to establish and maintain a cleanliness standard aboard the train consists. This service is accomplished by cleaning techniques implemented at selected times in a service day. Two types of cleaning are envisaged.

- "Normal" (Lay-up) Cleaning – This service is performed at a train storage and maintenance facility, and is generally done when a train is parked for a sufficient time to receive a thorough interior cleaning of the passenger areas to include seats and bathrooms. It is usually scheduled daily and is completed prior to a train entering revenue service in the morning. All trash is removed, seats and floors cleaned, and bathrooms sanitized.
- "Light" (Pick-up) Cleaning – When a train turns around (i.e. the rear end of the train arriving at the station becomes the front end of the train departing) in a terminal station or on a storage track with insufficient opportunity for a full normal cleaning, this service is performed to return the interior to an acceptable condition.

Cleaning toilets (and emptying the "holding" tanks) would occur during the overnight layup period at maintenance facilities and would not be done in the terminals during the turnaround time.

### 4.2.3 Train Layover Times at Terminal

Because the terminals are stub-ended, all HST trains will change directions (turnaround with rear end of the arriving train becoming the front end of the departing train) at terminal stations. Three types of train turnaround will occur in terminal stations:

- Revenue to Non-Revenue: Revenue trains (with passengers) arrive, with the equipment turning around and going to the rail yard for storage or servicing, without passengers
- Non-Revenue to Revenue: Trains enter the terminal from the rail yard (without passengers), departing passengers board (the train), and the train departs as a revenue train (with passengers)
- Revenue to Revenue: Revenue trains (with passengers) arrive and passengers unload, the train would park at the platform while it is inspected, cleaned and restocked with bathroom and food service supplies, departing passengers board the train, and the train departs as a revenue train (with passengers).

Estimating the time required to carry out the various terminal turnaround train servicing and passenger processing functions, and identifying which functions can proceed in parallel with each other and which depend upon the prior completion of other activities, allows definition of a "critical path" of activities that governs the minimum time necessary between an inbound train arrival and the subsequent outbound train departure.

The functional and timing relationships are presented diagrammatically in Figure 10, which illustrates the required sequence of steps that must be followed for four basic processes that occur during the turnaround layover period:

1. Passenger alighting and boarding

Re-stocking of food and beverage service items

Coach cleaning and re-stocking of bathroom supplies (critical path item)

Train safety system pre-departure preparation

In addition, minor equipment repairs that can be accomplished during the layover (parking) period will be addressed.

Facilities would need to be provided at the terminals to support the food service provisioning (commissary), coach cleaning and railroad mechanical department (equipment maintenance and repair). These facilities would need to be located in proximity to the HST platforms, to minimize the time required to access a train when it arrives at the terminal. Direct service elevator access would be required between these facilities and the HST platforms, separate from the elevators and access points used by passengers.

The HST scheduled terminal station turnaround time is composed of four primary "critical path" factors: Passenger alighting, interior cleaning, passenger boarding, and a "Recovery Time Factor". The following table summarizes HST assumptions for the minimum exception and minimum standard scheduled turnaround times (based on a 1312 foot train).

**Table 2: Time Required for Terminal Layover Activities**
**(HST Planning Assumptions, Revenue Train to Revenue Train)**

| Critical Path Activity | Minimum Exception | Minimum Standard |
|---|---|---|
| Passenger Alighting | 5 minutes | 5 minutes |
| Cleaning, Restocking, Servicing & Provisioning | (2) 10 minutes | (1) 20 minutes |
| Passenger Boarding "Window"<br>(includes up to 10 min "Recovery Time" Factor) | 15 minutes | 15 minutes |
| Total Scheduled Turnaround Time Assumption | 30 minutes | 40 minutes |

(1) 1312 foot train requires coach cleaning staff of 16.
(2) 1312 foot train requires coach cleaning staff of 31.
Note: Train safety system preparations can be accommodated within time windows available for alighting, cleaning and boarding.

Providing a scheduled 15-minute "window" for passenger boarding would permit train cleaning and servicing functions to be concluded prior to the start of the boarding process and minimizes the time spent queuing by departing passengers while also providing for a necessary allowance of up to ten minutes of "recovery time" for trains arriving later than scheduled in the timetable.

**Table 3: Minimum Schedule Terminal Layover Times (HST Planning Assumptions, Revenue Train to Revenue Train)**

| Code | Station | Phase 1 | Full Build | Minimum Scheduled Layover Time (minutes) |
|---|---|---|---|---|
| SFT | San Francisco – Transbay | X | X | 30 |
| SF4 | San Francisco – 4th and King | X | X | 40 |
| SAC | Sacramento | | X | 40 |
| MCD | Merced | X | | 40 |
| LAU | Los Angeles - Union Station | X | X | 40 |
| ANA | Anaheim | X | X | 40 |
| SAN | San Diego | | X | 40 |

# 5.0 ROLLING STOCK STORAGE AND MAINTENANCE

## 5.1 FLEET REQUIREMENTS

In 2035, 212 train sets are estimated to be required to operate the 339 daily trains envisioned for the conceptual full build revenue service plan. Each train set is 656 feet long and seats approximately 500 passengers. Two of these train sets can be coupled together to create a train 1,312 feet long, seating approximately 1,000 passengers. An additional 85 train-sets are estimated to be needed to create double-set trains, 1312 feet long, to handle peak passenger demand during the peak periods and on all-day limited express services, as shown in Table 4. The determination of requirements for single-set versus double-set trains was based on estimated train-specific passenger loadings on the various routes during the peak, peak shoulder and off-peak hours and will be refined as the ridership estimates are updated.

**Table 4: Horizon Year 2035 Service Plan**
**Revenue Train Sets Required at Each Terminal to Start**

**Weekday Morning Train Service**

| Terminal | For Single-Set Trains | For Double-Set Trains | Total Single Sets |
|---|---|---|---|
| San Francisco – Transbay & 4th & King Terminals | 6 | 24 | 30 |
| Sacramento | 3 | 14 | 17 |
| Merced | - | 3 | 3 |
| Los Angeles Union Station | 2 | 16 | 18 |
| Orange County (Anaheim) | 9 | 8 | 17 |
| San Diego | 2 | 20 | 22 |
| Total Sets Required | 22 | 85 | 107 |

The Horizon Year 2035 operations and service plan envisions the need for 107 revenue train sets. The estimated proportion of 656 feet versus 1312 feet sets is indicated in Table 5, along with an allowance for spare train sets, resulting in an overall fleet estimate of 212 total 656 feet units. The 10 percent spares is the mid-range of spare ratios for U.S. and international intercity and high-speed rail fleets. The estimated fleet requirement numbers will be modified as the operating plan, demand projections, and maintenance plans are refined.

**Table 5: Horizon Year 2035 Train Fleet Requirements**

| | Trains | Single Sets Required |
|---|---|---|
| For Single-set Trains | 22 | 22 |
| For Double-set Train | 85 | 170 |
| Subtotal Revenue Requirement | 107 | 192 |
| Spare Equipment (Assume 10 percent) | | 20 |
| Total | | 212 |

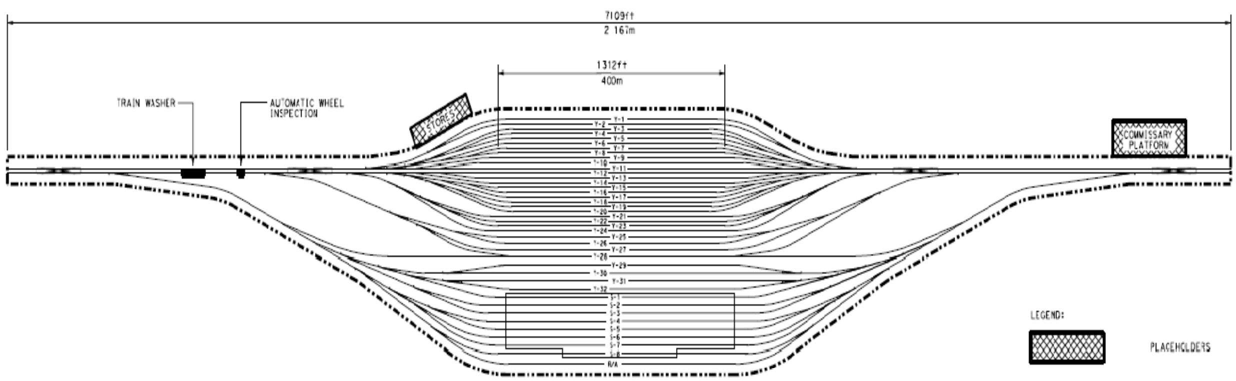
## 5.2 Train Storage and Maintenance Facilities

Train storage yard facilities should be located as close as physically possible to the terminal stations.

Generally, the terminal stations are in heavily urbanized areas that do not have land available immediately adjacent to the terminal for new train storage yards. As a result, trains that are entering or leaving service at a terminal station will have to operate as non-revenue or “deadhead” train movements to and from the storage yards.

The overnight layup facilities are the basic facility at each of the terminal locations that provide overnight storage (parking) for the trainsets and daily inspections and cleaning. Layup facilities would be located close to the terminals in San Diego and Sacramento but be without a shop capability. Yards including a periodic inspection facility (shop) would be located in northern California along the Peninsula Corridor and one in southern California near Los Angeles. One heavy maintenance facility will be located in the center of the statewide system to provide all of the overhauls and component refurbishment capability. An example of a typical concept configuration for an overnight storage facility equipped with a shop to perform periodic inspections is shown in Figure 11.

**Figure 11: Example of Typical Concept Configuration for Overnight Storage Yard with Shop**




The storage capacity of each facility is based on the number of trains estimated in the Full Build-Out (2035) Operations and Service Plan and is summarized in Table 6 below.

**Table 6: Full Build Network (2035) Storage/Layup Track Requirements**

| Location | Single-Set Trains | Double-Set Trains | Total Trains | Single-Set Equivalents | Number of Tracks long enough to accommodate double-set trains |
|---|---|---|---|---|---|
| San Francisco | 6 -12 | 18 - 24 | 30 | 48 - 54 | 24 - 27 |
| Sacramento | 3 – 6 | 9 - 14 | 15 - 17 | 24 - 31 | 12 - 16 |
| Merced | 0 | 0 - 3 | 0 - 3 | 0 - 6 | 0 - 3 |
| Los Angeles | 2 - 2 | 11 - 16 | 18 – 19 | 30 - 34 | 15 - 17 |
| Anaheim/Irvine | 8 - 9 | 8 – 9 | 17 | 26 - 25 | 13 |
| San Diego | 2 – 8 | 11 - 20 | 19 - 22 | 30 - 42 | 15 - 21 |
| Total | 22 - 42 | 58 - 85 | 100 - 107 | 158 - 192 | 79 - 97 |

***Note: this table shows a range of values, depending upon the level of future ridership and the specific Service Plan that is operated.***

### 5.3 ROLLING STOCK MAINTENANCE PROGRAM

**Consistent with international methods, the California high-speed train system** is planned to provide 5 different levels of train maintenance activity:

- Level 1 – In-Service Monitoring: daily testing and diagnostics of certain safety sensitive apparatus on the train in addition to automatic on-board and on-ground monitoring devices.
- Level 2 – In-Service Examinations: inspections, tests, verifications and "quick" replacement of certain components on the train. Examples include inspection and maintenance tasks associated with the train's running gear, bogies, underbody elements and pantographs.
- Level 3 – Periodic Inspections: part of a planned preventive maintenance program requiring specialized equipment and facilities. Examples include: a) examination of interior fittings and all parts of the train in the immediate environment of the passengers, b) in depth inspection of axles and underbody components, critical to train safety by identifying and repairing any condition in the running gear and connecting components, c) wheel condition diagnostics and re-profiling (wheel truing).
- Level 4 – Overhauls (HMF only): part of the planned life cycle maintenance program requiring a specialized heavy maintenance shop with specific heavy duty equipment. Activities include the complete overhaul of train components replaced during Level I, II and III. In addition, a full complement of heavy maintenance is completed on each trainset every 7 to 10 years (30 days per trainset) as well as mid-life overhauls which are performed on each trainset every 15 to 20 years (45 days per trainset).
- Level 5 – Rolling Stock Modifications & Accident Repair (HMF only): Activities to support installation of a major modification to the design of the trainset for purposes of

improving safety, reliability and passenger comfort. In addition, this category includes repair to a trainset which has "suffered" significant damage.

The frequency with which these maintenance procedures are performed varies by level. To minimize cost, maximize flexibility and to address all of the levels of maintenance and inspections, these maintenance functions will be undertaken at a relatively small number of facilities spread across the HST network. The locations at which maintenance will occur can be broken into three groups:

- Overnight Layup Facility – Provides Levels 1 and 2 maintenance and inspections
- Periodic Inspection Facility – Provides Levels 1 to 3 maintenance and inspections
- Heavy Maintenance Facility – Provides Levels 1 to 5 maintenance and inspection, including overhauls and component refurbishment.

## 5.4 Facility Site Location Criteria

It is important that each of these facilities be located immediately adjacent to the HST main line tracks and connected directly to them with a 110 mph turnout (switch) and two connecting tracks (i.e. "double track") of approximately 3,696 feet on both ends of each facility. The connecting tracks will transition to become the slow speed (15 mph) lead tracks within each facility.

In addition to proximity and connectivity to the HST system main line tracks, the site of the Terminal Storage Maintenance Facilities (TSMF) should be such that the distance between the TSMF and the Terminal Stations is minimized. The preferred distance is up to 1.5 miles, an acceptable distance is from 1.5 to 3.0 miles and anything further than 3.0 miles would be considered as an exception. Terminal Storage Maintenance Facilities are required for the terminus stations or end points of the system at San Francisco, Los Angeles, Anaheim and Merced for Phase 1, with additional TSMF at San Diego and Sacramento for the Full Build-Out. In addition, consideration is being given to a possible combined TSMF for Los Angeles and Anaheim.

The desirable site for the Heavy Maintenance Facility (HMF) is that it be located centrally on the HST System between Merced and Bakersfield. The section between Merced and Bakersfield is in the "central part" of the system, is part of the trunk line (Anaheim-San Francisco), and has the ability to include a high-speed test track. No other part of the system meets these criteria. The required length of this test track is based upon current high-speed train manufacturers' recommendations for testing and commissioning which includes a protocol for sustained running for ten minutes up to 250 mph. Train operations at these speeds require straight alignment of approximately 80 to 105 miles.

## 5.5 Estimated Site Requirements

Based on a conceptual rendering of these facilities they would require the following land parcel "footprints" range (depending on the shape of the land parcel), inclusive of buildings, outdoor service areas, storage, roadways and parking:

- Merced to Bakersfield Heavy Maintenance Facility Concept, 154 Acres
- Los Angeles Storage Yard and Maintenance Facility Concept, 62 to 83 Acres
- San Francisco Storage Yard and Maintenance Facility Concept, 90 to108 Acres

- Anaheim Yard and Maintenance Facility Concept, 52 to 74 Acres
- Sacramento Yard and Maintenance Facility Concept, 54 to 76 Acres
- San Diego Yard and Maintenance Facility Concept, 70 to 93 Acres
- Los Angeles / Anaheim (combined TSMF) Yard and Maintenance Facility Concept, 88 to105 Acres

### 5.6 COMMISSIONING OF ROLLING STOCK

In addition to the in-service maintenance regimen, the HMF is assumed to be used during the pre-revenue service period (from 2016) for the assembly, testing, acceptance, and commissioning of the HST System new rolling stock fleet. Implementation of the testing, acceptance and commissioning activity would also require a main line test track between 80 and 105 miles in length connected directly to the HMF. The HMF would also be used for decommissioning or retirement of equipment from the system to make way for the next generation of rolling stock.

## 6.0 TRAIN DISPATCHING AND CONTROL

### 6.1 OPERATIONS CONTROL CENTER

A train operations control center has been assumed within the HMF "compound", on a second level of the HMF building. Space for employee parking, pedestrian access/egress and appropriate bathroom and lunchroom facilities has been accounted for. However, the operations control center can be located at any place along the system. Utilizing the second level of the HMF building will allow space for the operations control center without increasing the foot print of the HMF building or the additional cost of a separate building.

### 6.2 COMMUNICATIONS WITH HST STATIONS

HST trains will be dispatched and controlled from a central control facility remote from the individual stations and terminals. A direct communications link will exist between the central control facility and the Terminal Operations Center or HST Passenger Services office at each HST station and terminal, to enable station staff of the HST System Operator (and the Terminal Operator, at facilities where the terminal is managed by a third party) to monitor the status of train operations on the rail network and respond to any unusual conditions that may arise.