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California High-Speed Train Project

Peer Review
Of
Current Planning on Operations and Maintenance

Comments by Renfe Operadora
Spain

February 2011

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1. Preliminary remarks

1.1 Renfe Operadora (Renfe) acknowledges and feels honoured of the interest shown by the California High Speed Rail Authority (CHSRA) in sharing with us and invite our Company to contribute to a “peer review” of the work done and the planning documents elaborated so far by the Operations and Maintenance Planning Team of the California High-Speed Train Project (CHSTP).

The scope of this work covers – according to the documents submitted for the review - the current status of the Project’s planning in regards to the setting up and the two-phased development of the network, the “concept level” service plans elaborated for each one of the two stages of network development (expected to become operational in 2020 and 2035), the basic design of the new HST passenger stations and their operation, aspects related to rolling stock storage and maintenance, maintenance of way, train dispatching and control, as well as the manpower estimates for operations and maintenance activities. In this regard, it should be noted that our comments will focus mostly on the aspects dealt with in the documents that are specific or more relevant from the viewpoint of the Operator(s); and that there are other aspects, also very relevant from this standpoint, which are not mentioned or sufficiently developed in the material provided for the review (such as operator’s safety management system; security/safety of passengers, equipment and facilities; or many of the commercial aspects of the service to be provided).

In accordance with the indications given in the letter of invitation received from CHSRA’s CEO”, our attention was particularly addressed to providing feedback to the “Questions and Issues” described in pages 34 to 40 of the Introductory Material prepared for this “peer review, as well as to the “Operational Assumptions” described in page 33 of the same document. However, other aspects of the document have also been commented, taking into account, where appropriate, the more detailed information contained in the four “Technical Memoranda” also enclosed. In all cases, we have tried to base our comments on our practical experience with operation of High-Speed Train services since 1992.

The review of the CHSTP documents and the elaboration of the comments contained in this paper were coordinated by Renfe’s International Directorate. Experts from the following areas of the Company were involved in the review:

- Directorate-General for Passenger Services (responsible for the management of Renfe’s “Alta Velocidad” - HST – services, among others): High-Speed/Long-Haul Operations’ Planning and Management Department, Department for Marketing and Product Design, and Quality Assurance & Management Service.
- Directorate-General for Manufacturing and Maintenance (Renfe’s Industrial Division): Departments responsible for High-Speed Rolling Stock and for Design, Construction and Management of Maintenance Facilities.
- Department for Traffic Safety (responsible for the operator’s Safety Management System).
- Department for Security, and Civil Protection/Safety.

1.2 Spain's High-Speed rail network (> 250 km/h – 155 mph) is presently the longest in Europe (and also longer than the Japanese network). This network currently stretches over a distance of more than 2,000 km (1,246 miles), and has been gradually established – and expanded - over a period of almost 25 years (1986-2011). At present, the network encompasses four main corridors (South, East, Northeast and North/Northwest); all of them built on dedicated tracks and – in most segments – specific rights of way, with a central point at Madrid-Puerta de Atocha terminal station. The Spanish HS rail network has been built in UIC gauge (1,435 mm), with complete separation from the conventional network[1], which was set up and developed on the specific Iberian gauge (1,668 mm), common to Spain and Portugal. In addition to this totally new network in UIC gauge, another 621 km of the conventional Iberian-gauge network have been upgraded for HS services at speeds of up to 220 km/h (137 mph).

Three of the HS corridors in UIC gauge have a main line, with additional branches to reach other destinations. At present, the South corridor has the line Madrid-Seville (477 km/297 miles) as its main backbone, with branches to Toledo (21 km/13 miles - starting at approx km 54 of the main line) and Malaga (155 km/96.5 miles – starting at Km 358). The Northeast corridor runs from Madrid to Barcelona (621 km/387 miles), serving cities such as Zaragoza, Lleida and Tarragona along its main line, with a short branch to the city of Huesca (79 km/49 miles long, starting at km 312)[2]. The main line of the recently inaugurated East corridor runs from Madrid to Valencia (391 km/243.6 miles), with a 47 km (29 miles) branch heading to Southwest and currently reaching the city of Albacete. The North/Northwest corridor which, contrary to the other three, has its main terminal station at Madrid-Chamartin (Madrid-North station), for the time being features only a few operational segments, the most important being the Madrid-Segovia-Valladolid segment, with a length of just 180 km (112 miles).

Spain's HST network, which is built and equipped to support commercial operations at a speed of 300-350 km/h (185-220 mph), is still under development, the target being – as laid down in the Government's Transport Infrastructure Strategic Plan 2005-2020 – to ensure that 50 percent of the total population of Spain has a HST station at the city where they live and 90 percent of the population has it within a range of 50 km (31 miles) from their place of residence.

The commercial operation of this network started in April 1992 on the line Madrid-Seville; and the other HS lines (Madrid-Zaragoza/Huesca-Barcelona, Madrid-Málaga, Madrid-Valladolid, Madrid Toledo, Madrid-Valencia/Albacete, as well as Barcelona-Seville/Malaga and Toledo-Madrid-Albacete) entered into commercial exploitation as the new infrastructure was being built and made available for service. Most of these services are long-haul (> 200 km – 125 miles) and are operated with high-performance rolling stock (from various manufacturers). These trains are presently able to reach commercial speeds in the range of 300-330 km/h (185-205 mph) but this speed will increase with the introduction of level 2 of the ETCS[3]. However, the system also features medium-range

[1] However, the HS network and the conventional network have a number of connecting points. At those points, "Gauge-Changers" (a specific technological development of the Spanish railway system) are set up, in order to allow for the use of dual-gauge trains that run over both networks.

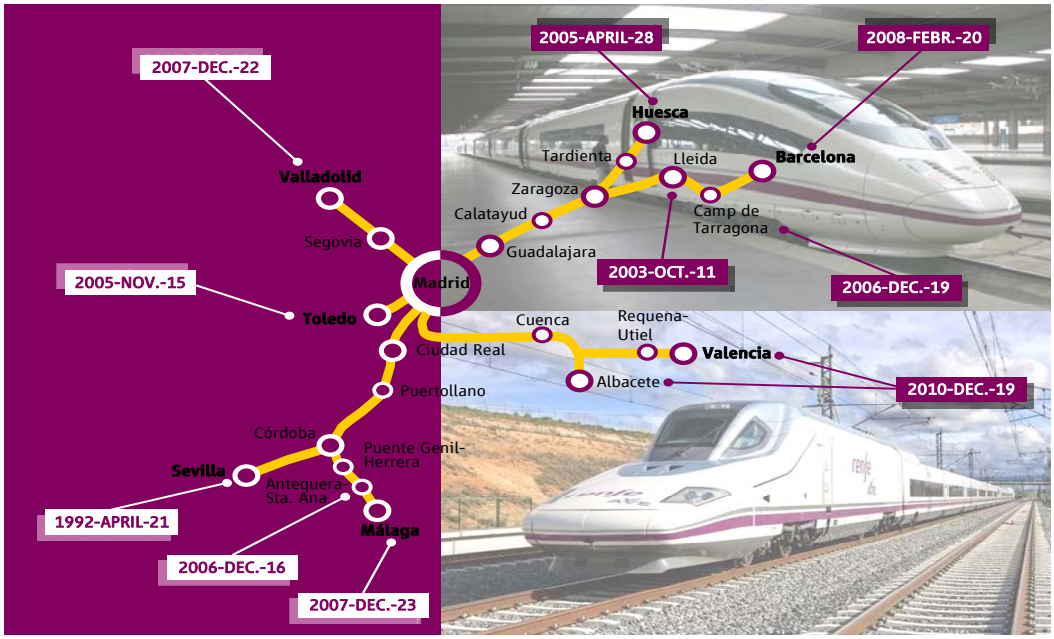
[2] Work is ongoing along this corridor, past Barcelona, so as to reach the border between Spain and France, with some segments (including a tunnel segment at the border) already built and partially operational (freight and trans-border passenger services).

[3] European Train Control System, a core component of the broader European Rail Traffic Management System (ERTMS)

services (up to 200 km) linking some of the cities along the HST corridors, which are normally provided with trains with a maximum commercial speed of 250 km/h (155 mph).

In addition to these trains and services, and in order to extend the benefits of HST to regions and cities not yet reached by the new HST network in UIC gauge, our HS services also feature long-haul services provided with trains equipped with a dual-gauge system. These electric or hybrid trains can run on the HS infrastructure at speeds up to 250 km/h (155 mph), then change gauge (and power supply/traction system), without stopping, at one of the "gauge changers" installed at the points connecting both networks, and continue on Iberian gauge tracks and infrastructure to their final destination, at speeds up to 220 km/h (137 mph).

3



At present, Renfe is the sole operator of HS passenger trains in Spain. The Company operates daily 300 HST services, of which 120 are provided with high performance electric trains (used for long-haul HS services), 100 are provided with electric trains with maximum commercial speed of 250 km/h (used for the medium-range services) and 80 are provided with dual-gauge/dual voltage or hybrid trains (also used for long-haul services).

Our HS fleet is presently made up of a total of 185 train-sets (93 high performance, 35 medium-range and 57 dual-gauge), with 67 additional train-sets already purchased and being manufactured. Once these additional trains will have been delivered, Renfe's HS fleet will consist of 231 train-sets (96 high- performance, 62 medium-range and 73 dual-gauge[4]). All these trains are from various manufacturers (Alstom, Talgo, Siemens, CAF).

Our high-performance HS train-sets have a length of 200 m, and capacity for a maximum of around 400 seats[5] (distributed in three – First, Business and Economy – or two –

[4] Of which 15 will be "hybrid" (bi-tension and diesel)
[5] In all our HS trains, there is a limited number of seats specifically adapted for persons with reduced mobility (PRM)

Business and Economy – classes). Medium range trains are shorter (just above 100 m) and their capacity is 240-280 seats (only economy class). There are two types of dual-gauge trains: one with a length of 107 m and 240-seat capacity (business and economy) and another one with a length of 180 m and 300-seat capacity (also business and economy).

1

The Spanish High Speed Rolling Stock Fleet

	HS - LONG DISTANCE					HS - REGIONAL	
	UIC Gauge			Double Gauge		UIC Gauge	
							
CLASS	100 R	102 / 112	103	130	120	104 / 114	121
MANUFACTURER	Alstom	Talgo	Siemens	Talgo	Caf	Alstom	Caf
LENGTH (IN METRES)	200	200	200	181	107	170 / 105.5	107.4
MAXIMUM SPEED Km/h	300	330	350	250	250	250	250
SEATS	332 (2 PRM)	316 (2 PRM) 365 (2 PRM)	405 (2 PRM)	299 (1 PRM)	238 (1 PRM)	237 (1 PRM)	281 (1 PRM)
GAUGE	1,435 mm./	1,435 mm.	1,435 mm.	1,435 mm./ 1,668 mm.	1,435 mm./ 1,668 mm.	1,435 mm.	1,435 mm.
IN OPERATION SINCE	1992	2005 / 2010	2007	2007	2006	2004	2008
:							

1.3 Renfe's HST business model is based on a high level and quality of the service provided to our customers, both on board of our HS trains as well as before/after the journey. Our model gives the greatest attention to an excellent treatment of our clients (namely our passengers) and a high level of commitment with them, particularly in case of any deficiency or fault attributable to our company. This has enabled our company to enjoy a high reputation and an unbeatable scoring by our clients in what concerns the quality of the HST services we provide.

5

AVE Trains - Service on board







On a yearly basis, our HS Division transports around 22 million passengers, of which 15 million use our long-haul services and 7 million the medium-range services.

As in other countries with HST, in Spain this new mode of transportation has changed dramatically the inter-modal distribution of passenger transport along the relevant routes, progressively gaining market share in an environment of strong competition with other modes (air and road transport). In this respect, it has to be noted that, in our experience, establishing and strengthening the competitive position of HST services vis-à-vis the other modes of transportation is a long-term process, which requires constant efforts and flexible business strategies and measures.

1.4 In our view, the establishment and implementation of a HST system in California, including the future exploitation of the services, bears important similarities with the Spanish case:

- The size of the State of California is approximately 83% of the total size of Spain; and their present and projected population is of a similar rank (40-50 million)

- The geographical distribution of the population and the urban settlements to be connected by the HST system may also be deemed somehow similar in both cases: a few areas with high population density, located at some distance from each other (in the range of 500/600 km – 300/400 miles); a number of medium-sized cities and towns in-between or at shorter distances from the big metropolitan areas; and some areas of low population density also in-between of all those urban areas.

- In both cases, the HST network is conceived as a totally (or almost totally) new system, both in terms of infrastructure (dedicated track) as well as concerning the type of transport service to be provided over it. This new transport mode will have to establish its competitive position in an environment traditionally dominated by road and air transport, in which the market share and the reputation of railway transport (with the exception of commuter trains) was (is) low.
- The climatologic conditions for HST operation are similar in Spain and California: temperature, humidity, salinity, winds carrying abrasive sands in suspension, terrain typology and orography, etc. All of these are factors having an influence on the operation of HS trains.

Hence, we believe our practical experience with the operation of HS trains may indeed be most valuable for California's future HST.

1.5 As an additional preliminary remark, it is to be noted that our comments to the materials submitted for peer review are inevitably conditioned by the content and scope of such materials, which, because of their nature (Operations and Maintenance) do not contain too much and detailed information that is equally relevant from the viewpoint of the (future) Operator(s) of the service.

For one thing, we should assume that the service plans developed to the date are not only based on the potential or projected "capacity" of the system, but also on research and studies already carried out concerning the expected ridership demand or the business model for California's HST. However, the materials under review do not provide all information needed or desirable on these aspects. Demand studies and estimates are critical not only for the most adequate dimensioning of the resources needed, but equally

for the competitive positioning of the system – the companies operating it and their service offer – in the passenger transport/travel market in the State (or even beyond its borders). Alongside total expected demand, it would be essential to have information on the typology of the potential customers/users, reason for travel, seasonal, weekly and daily distribution of expected ridership demand, estimated or projected market share, etc.

Notwithstanding the above remark, and based on the documents reviewed, our general conclusion is that the planning developed to the date is, in what concerns service and maintenance plans and the assumptions upon which they are based, viable from both technical and operational viewpoints. The comments that follow are aimed at pointing out some critical aspects of such plans that, based on our practical knowledge and experience on the operation and commercial exploitation of HST services, could raise problems and difficulties at a later stage or should possibly be further analysed and considered at the present stage.

In any event, some of these comments are also inspired by our own business model for HST services; and might not have the same importance or affect in the same way services that may be based on a different model.

2. Comments on operational assumptions

The model of HST services stemming from the documents submitted for our "peer review" and, in particular, from the Service Plans developed so far for the system, seems to differ from Spain's HST model in a number of aspects, Such aspects (very high traffic density, distance between trains/frequency of services – particularly at peak hours – estimated ridership demand, some of the options being considered for passenger handling at stations, including ticket check-in and boarding processes, bicycles handling, etc.) are, in our country, more characteristic of metropolitan commuter train systems.

However, in our view, a highly used HST network, with a large number of users/passengers, is not necessarily in contradiction with an equally high level of service quality, both on board of the trains and on the ground (before or after the journey).

The option for dedicated tracks for the HST system

Notwithstanding the existence of connecting points between both of them, Spain's HST network has developed since the 1980's as a rail network independent and separated from the conventional network, also used for passenger services (inter-city or commuter trains) as well as for freight transport.

It should be noted that a fundamental reason for this new HS network to be developed as a separate one was the decision to build it with international (UIC) gauge, so as to ensure its future connection with the HST networks also being developed in other European countries, at which this gauge is the common standard.

For most of its length, Spain's HST network is exclusively dedicated to passenger services, although there are lines (Madrid-Seville) and segments (Tarragona-French border) which were built so as to allow both passenger and freight services. However, at

present only some small segments[6] are used by both passenger and freight services (international). Other than these short segments, there is no other point or segment at which conventional trains (inter-city, commuter or freight) and HS trains use the same track or infrastructure.

In order to connect the HS network on UIC gauge with the conventional network on Iberian gauge - as a means to extend the benefits of HST to destinations and territories not yet reached by the former one, due to its progressive and gradual development - Spain has developed a specific technology that enables the use of dual-gauge rolling stock and the automatic change of gauge at the points of connection between both networks, without having to take the train to a full stop. These dual-gauge trains – which can reach speeds of up to 250 km/h (155 mph) on the HS track and up to 220 km/h (137 mph) on the conventional track – are also bi-tension, since the electric power supply on the HS network is 25,000 volts AC while in most of the conventional network the power supply is 3,000 volts DC.

Therefore, while being aware of the particular difficulties that the coincidence of both types of traffic (high-speed and conventional) may pose for the adequate planning and the management of HST operations in certain segments of the network projected in California (Peninsula and LOSSAN corridors), Renfe lacks specific experience in this area.

However, in the light of our own experience with the development of a new HST system, we believe correct the decision to build the CHST system to operate on dedicated tracks for this type of traffic.

Length and capacity of train sets

The highest-performance train-sets used by Renfe for its long-haul HS services have the same length as foreseen for the HS train-sets to be used in California (200m single composition and 400m double composition). However, due to our specific approach to this type of commercial services[7], which entails the availability of at least two and in other cases three classes in each train (first, business and economy), the maximum capacity of our HS train-sets is set at around 400 seats in single composition and 800 in double composition.

It should be noted that in the Spanish HS system, operated by Renfe, not only trains from different manufacturers (Alstom, Talgo, Siemens, CAF) are in operation, but also that trains with different characteristics and performance are presently being used: for long-haul services (> 200 km/125 m) we use trains that can reach a commercial speed of at least 300 km/h (187 mph), while for shorter distances (HS medium-haul services) we normally use specific trains with a maximum commercial speed of 250 km/h (156 mph). The length of these latter trains is around 100 m, and their capacity stands around 250 seats (in just one class). There are other differences between these types of train-sets, since the former ones are meant to develop speeds that are more adequate for long

[6] In Catalonia, nearby the border between Spain and France, including the “Le Perthus” tunnel, which was built and is exploited by a private concessionary company.

[7] In Spain, long-haul high-speed and conventional passenger train services are provided and exploited by Renfe strictly under market conditions (with no public subsidies), as opposed to medium-range inter-city trains and commuter trains, which are considered, under EU legislation, a “public service”.

distances without many intermediate stops, while the latter are more appropriate for shorter distances, with several intermediate stops.

Some of the services foreseen for the California HST system will cover a distance of around 200 km (i.e. Los Angeles-San Diego)[8] and/or will be operated as all-stop services. Bearing this in mind, it might be worthwhile to undertake – at this stage of the planning process - a more thorough analysis of the possibility and/or the convenience of diversifying the requirements envisaged for the fleet of rolling stock needed for the different types of services, including the length, capacity and maximum commercial speed of the trains to be used for each service. This might be crucial from the viewpoint of the overall economy of the system.

Service patterns and prioritisation of schedule paths

In principle, we agree with the basic assumption that the schedule will feature "clock-face" service patterns and regular intervals between trains (headways). In fact, this is also the way in which most of our HS services are scheduled.

However, considering the traffic density and the intervals between trains (headways) envisaged in the current Service Plans, it must be concluded that "non-regular" services such as those special services needed in periods of higher demand or "charter" services, which are relatively frequent in our commercial exploitation and operation, are already included in this planning. In this regard, it should be noted that, in Spain, the schedule for regular services allows for the allocation of free "paths" (already pre-established) that can, if need be, be used for this other type of services, which fall outside the regular daily offer.

As for the prioritisation of services, the assumption described in item 5 of the "Operational Assumptions" is, in our view, correct.

Grade separation at junctions

The premise described in item 6 of the Operational Assumptions appears as not only correct, but also crucial from the viewpoint of traffic safety.

Other than this, what does not seem to have been considered (is not regarded in the planning documents), but exists in the Spanish HS network, are the by-passes built in the vicinity of some important and populated cities along the HS lines (such as Zaragoza or Madrid), to allow direct (express) or limited stop trains to circumvent those urban areas, thus avoiding the inevitable slowing down before passing any intermediate station and subsequent acceleration after it, and enabling these trains to maintain their necessary speed.

This is an aspect that should perhaps be further considered and analysed in the next stages of the planning, both from the viewpoint of the infrastructure as well as in the Service Plans.

[8] Although the current planning does not seem to consider this option, if eventually an option for independent and direct services would be chosen for services linking, for instance, LA and Anaheim, SF-Merced or Sacramento-Merced, all these routes are shorter than 200 km and therefore could be provided with trains of different characteristics and lower performance (speed) and on-board service than those used for long-haul services.

Estimated passenger loads

As explained in the first item of the "Questions and Issues" section of the Introductory Material, the Operations and Service Plans developed so far, both for the Phase 1 and the Full-Build phase of the system, are based on a high level (even a maximum level) of utilisation of the two-track high-speed rail line. This is, in turn, based on an estimation of the highest ridership demand – point to point – expected for a work day. The current planning has been developed so as to enable the system to provide at any time a "mix" of services (express, limited-stop and all- stop) that can meet this highest estimated demand.

In our view (the view of an operator), it might be convenient to develop also a less-tight Service Plan for the start-up of the exploitation of the system and its lines/services, so as to avoid the inevitable problems and difficulties that may arise in the initial stages of operation. In this way, as long as the actual ridership demand will grow and consolidate, further revisions and updates of the Services' Offer will implement an increase in the frequency of the services and the adjustment and refinement of the travel times and overall time-schedule.

In sum, based on our practical experience, it is necessary to foresee a progressive alignment of the supply of services to the actual demand and conditions of the system. Our experience shows that the sheer establishment of HST services in routes where there is already a well-developed road infrastructure and in which airlines already enjoy a pre-existent and solid position in the relevant route, will introduce a dramatic shift in the inter-modal distribution for passenger travel along the route. However, from an initial market position that can be expected at the very start of the operations, high speed train has to compete to keep increasing its market share. In such competitive market environment, not only air passengers but also road travellers are to be constantly targeted by the HST operator (s).

Therefore, while the dimensioning of the infrastructure is to be studied and calculated so as to be able to support the services that may be required in a "mature" market, the Operator's Service Plans should be commensurate and adjusted to the actual evolution of the market. This is, in our experience, a requirement for an adequate dimensioning and utilisation of the Operator's resources and for the optimisation of the economic results of the operation.

Equipment cycles and daily equipment utilization

In Spain, each HS train-set makes around 450,000/500,000 km (285,000/315,000 miles) per year, although occasionally we have reached the figure of 550,000 km (345,000 miles) per train-set in a year. We consider the figure assumed in the CHST plans (600,000 km / 375,000 miles) possible, but quite demanding.

Typically, we design our train-sets' exploitation schedule assuming that every train-set comes into workshop, at most, after 5,500/6,000 km (3,750 miles). This is a standard requirement in our trains' Maintenance Plans (established by the manufacturers) [9].

[9] Also, our experience is that this figure (3.750 miles) is a limit-value for the necessary emptying of the deposits of chemical WCs (although using bacteriological WCs allows for an increase in this time lapse).

Out of the other factors that may have an incidence on the daily equipment utilization and on the equipment cycles, our years-long experience with the exploitation of HS trains demonstrates that the optimal solution is the one that minimises trains' coupling and uncoupling manoeuvres, because each of these manoeuvres involves certain risks, so that the fewer these operations are, the lower will be the possibility of negative incidences due to this cause.

3. Comments on "Questions and Issues"

3.1 Service Plan(s)

It stems from the documentation received (Introductory Material plus Phase 1 and Full-Build Service Plans) that CHSTP has developed the dimensioning of the services and their overall schedule so as to address conditions envisaged on a typically busy weekday (busier than average month and busier than average day of the week). However, it is not altogether clear in the text of the Service Plans whether the estimated ridership demand (159,000 trips daily for Phase 1, in 2030) is based on already existing demand market studies or rather on calculations based on the expected maximum capacity of the system from the viewpoint of its technical operation.

Without entering into further considerations, while this approach may be appropriate for a "concept level" service plan, in our view the actual dimensioning of the Operator's production should firstly be aligned – particularly for the start-up period of commercial exploitation of the new HS services - with what could be considered a reasonable profit-earning capacity of the planned services, in view of the expected demand at any given time, as evidenced by the relevant demand market analysis and corresponding ridership/revenue forecasts.

The following comments are therefore intended to not only confirm the correctness of the current "concept level" planning, but also to provide some insights and highlights that are based on Renfe's practical experience as the sole Operator of the HST system in Spain.

Density of train service and variety of stopping patterns (1-2)

The Spanish HST system also provides for a mix of various types of train services and a variety of station stopping patterns. We also have express services (between Madrid and Seville, or between Madrid and Barcelona), combined with limited-stop and all-stop services. And we have this mix of services in all our HS corridors or main lines (Madrid-Córdoba-Seville/Málaga, Madrid-Zaragoza-Barcelona and Madrid-Valencia/Albacete).

However, as explained above, alongside this variety of stopping patterns, in the Spanish HST system the different types of services are provided with different types of train-sets, which have different characteristics (length, capacity), performance (commercial speed) and other service patterns (number of classes, on-board services available). Typically, the services with a higher number of stops and lower performance/on board services are those covering medium-range distances.

Most of our long-haul HS train services (both with high-performance trains and double-gauge trains), as well as a significant number of our medium-distance HS train services have their point of departure or final destination Madrid "Puerta de Atocha" Station. For

this reason, it is in the proximity of this station (between Km 0 and Km 2.8) where the highest traffic density on dedicated HS tracks can be observed.

At this point of the network, traffic density stands at present at a figure of around 260 train movements per day, of which around 230 are on commercial (revenue) service (the remaining 30 being commercial train-set movements from/to maintenance or lay up/layover facilities and yards or movements of rolling stock dedicated to maintenance of infrastructure/right of way). Bearing in mind that our revenue service hours extend from 6 a.m. to 10 p.m. (with some trains still arriving at Puerta de Atocha Station around midnight), the average density per direction (incoming or outgoing trains) does not exceed, even in this point of maximum density, 8 trains per hour; and the highest – peak hour – 11 trains per/hour. In all the other segments of the our HS network, traffic density is notably lower (the segment between Km 2.8 from Atocha to La Sagra ranking second in this regard, with 121 movements per day).

However, we believe that the traffic densities envisaged in the Service Plans developed so far for the Phase 1 and Full-Build phase of the system projected for California are viable, provided that both the infrastructure and the traffic control and signalling systems (on ground and on board) meet the highest standards available today (ETCS 3 or equivalent), or which could be available by the time foreseen for the start-up of operations on the completed Phase 1 (2020); or in 2035, with the additional density that the entry into operation of the Full-Build network will bring about.

In any event, we think that, considering the service and stopping patterns foreseen in the current planning, the actual viability of the maximum traffic densities (peak hours) envisaged in each segment of the network will also depend on the characteristics of the trains, as well as on an adequate design of all necessary infrastructure and facilities, which encompasses tolerance margins allowing for the recovery of time-losses that may occur due to situations such as adverse climatology, ongoing works on the infrastructure, or other external situations external involving operation under degraded conditions.

Schedule recovery time or pad (3)

Although the documents provided for the review do not provide enough information on the technical parameters of the infrastructure to be constructed or the specific characteristics of the traction stock (two of the main factors that will have an impact on it), taking into account that the infrastructure will be used simultaneously by express, limited stops and all-stop trains, with a high density of the services, we think that the schedule recovery times or “pads” envisaged in the Service Plan (s) are too tight and may entail a high risk, particularly for “premium” services.

In any case, our experience in this field is that the planned and expected performances are usually not reached until a few months after the entry into operation of any new line.

Practical headways for train scheduling purposes (4)

We believe minimum spacing between trains (headways) of 3 minutes is possible, although this will require state-of-the-art systems and equipment for traffic management and control (both on ground and on board of the trains) which can allow it.

In any event, it would be convenient to undertake further and more detailed studies on the actions that would be needed to minimise the impact of any possible incidence, as well as to develop the necessary operational procedures, to be applied in such cases.

Train overtakes (5)

In our practical experience, at maximum speeds of 300-350 km/h (185-220 mph), train overtakes entail a high risk for the exploitation, even with headways of 5-6 minutes. Slower train's siding operations and the establishment of itinerary for the faster one may require a longer time interval.

Other than this, the option taken as the basic assumption for the planning, concerning utilization of siding tracks at intermediate stations for express trains to pass local trains making a station stop (instead of using purely technical siding tracks between stations), seems to us the most reasonable, since it allows minimizing the time lost by the slower train during the overtake.

However, in order to prevent undesirable delays that may end up distorting the overall schedule, strict compliance with the stopping time at station by each slower train being overtaken by a faster one should be ensured. To this end, specific training and clear instructions to train crews so as to ensure the immediate departure and acceleration of the train after doors' closure would be critical.

Deadhead movements over the main line to reach storage yard facilities (6)

In our exploitation of HST we give great importance to the need to minimize deadhead movements of the trains, in general and particularly over the mainline tracks; both during daily operations and in relation to maintenance operations (of any level).

To this end, we deem it highly convenient that storage yards for HS trains are located as close as possible to terminal stations and first level maintenance facilities. It is equally advisable that such terminal stations are built as "passing by" stations, so as to avoid – to the maximum possible extent – deadhead turnaround movements which involve occupation of mainline tracks and may interfere with revenue traffic movements.

During night periods (out of the revenue service time) one of the options commonly used in our system is to utilize tracks at terminal stations for the laying over and routine preparation of trains scheduled to enter into revenue service in early morning.

From a different perspective, the detailed planning of the movements and operations linked to the entry and exit of trains into/from revenue service and, in particular, the movements and operations to be realised at storage facilities and between them and the stations where the revenue service is to be started or finished is a critical issue, which has a decisive importance for the effective compliance with the daily schedule.

Terminal Station Operations' Plans ought to ensure a highly versatile operation within the station, allowing for the maximum number of movements between tracks and easing the permeability of station manoeuvres.

These manoeuvres have to be subject to detailed planning; and the necessary priorities and contingency plans have to be established should any delay occur. In this respect, when simulating all these movement and operations, it is important to foresee different scenarios or stages that may set degraded conditions for the operation.

Overall viability of shared operations and Train operations at the San Francisco end of the network (7-8)

As noted above, there are no parts or segments in Spain's HST network allowing for shared operations (on the same tracks) with conventional commuter trains, nor with diesel-traction trains. As for the stations, although we have commuter train stations and HST stations adjacent to each other (and, in a few stations, adjacent tracks for HS and conventional trains, sharing the same platform), station operations for each type of service remain physically separated (tracks, signalling, passenger access to platform, service to trains, etc.).

We nevertheless think it possible the sharing of tracks and stations as envisaged in the CHSTP for the Peninsula and Los Angeles-Anaheim Corridors. However, even if our experience with this type of shared operations is not as relevant as that of other Operators, we believe this aspect is one of those bearing a higher risk for the effective feasibility of the Service Plan (s) in the actual practice. We consider the shared operation in some segments of the CHST network as the major difficulty in the entire system, since compliance with the operations' schedule will not only depend on the Operator of the HS trains and services. Hence, in order to comply with its own planning and schedule, the Operator of the HST will have to coordinate them with those of the other Operators (inter-city or commuter trains); and the strict compliance with the relevant plans and schedules will have to be ensured through the appropriate and necessary commitments, both technical and economic.

Otherwise, in our view this shared operation will require substantive technical similarity among the vehicles to be operated on the same infrastructure, so as to enable conventional trains to go across HS trains along the track and in tunnels (compatible traction and collision devices and equipment, etc.), as well as a careful planning and design of some of the characteristics of the shared infrastructure (catenary voltage, signalling, electrical sub-stations' power, maximum speed allowed), in particular at stations (height and length of platforms, access of passengers to different services, etc.)

Overnight windows for maintenance of way versus optimisation of beginning/end of the day services required by customer service demands (9-10-11)

In our experience as an Operator, maintenance of way (infrastructure) is a key requirement not only from the viewpoint of safety, but also for comfort of train's march. Hence, it is an important component of the quality of HST service.

In most parts of our HS network there are no night (revenue) services so that situations of possible interference or potential conflict between late evening/early morning revenue services and way/infrastructure maintenance overnight windows are not common. Moreover, usually, our late evening traffic makes it possible simultaneous maintenance traffic and operations using one of the two tracks. In any event, our advice here would be that it is necessary to find ways and solutions to ensure that overnight maintenance windows are sufficient to prevent any degradation of the infrastructure.

In this respect, something that is not specifically mentioned in the documents under review but is also very important in our practical experience for ensuring the safety and quality of HST operations and service is the daily screening ("exploration") of the line, at low speed and with the appropriate rolling stock and equipment, before the start of daily revenue services.

Dwell times at intermediate stations and layover time at terminal stations (12 & 25)

Dwell time needed for a train at any intermediate station depends on a number of factors: number of passengers alighting and boarding the train at the station, number of doors with which the train is equipped, height difference between train and platform, visibility of platform, station design and signposting, etc.

Due to these factors, dwell time at intermediate stations as foreseen in the current planning (1.5-2 minutes) may in some cases be insufficient, depending on the actual number of passengers. In any event, in order to absorb possible delays in the schedule resulting from longer stopping times that may occur in the actual exploitation of the services, it is critical that the overall "recovery time" or "pad" for services with intermediate stops is planned at a slightly higher level than envisaged in the Service Plans (5% instead of 3.5 %). The possibility to plan different dwell times for peak demand/ridership periods or services than for the rest might also be considered.

As for the minimal time foreseen for layover of turnaround trains at terminal stations, between two consecutive revenue services, we would consider the bracket 25-40 minutes as possibly too tight, particularly bearing in mind the probable number of passengers who would be alighting/boarding the trains (up to 500 in single-composition trains and up to 1,000 in double-composition trains), the likelihood that, among those passengers, some of them could be persons with reduced mobility, and the time needed for train service. Access of porters (red cap) to the train (to help passengers with their luggage) and, indeed, possible access of passengers with bicycles may also slow down the process of alighting/boarding of the trains.

In our view, the 7 minutes time lapse foreseen for shift of cabin and train safety checks might also be too tight, although this will very much depend on the technology of the train-sets used and the characteristics of the signalling and control systems. A time lapse of 10 minutes would allow for a more reliable operation and could be a good starting point for the further refinement of the Service Plan (s).

Also, the current version of the Service Plans does not seem to have taken into account the additional time needed during train layover at terminal stations in cases where coupling or uncoupling of train-sets will be required (especially during transitions between peak to off-peak hours). In any event, we think it would also be convenient to foresee also a certain recovery time or pad for the turnaround operations at terminal stations so as to enable the overall schedule to absorb possible incidences during these manoeuvres.

Operations at terminal areas (equipment manipulations and deadhead movements to/from storage yards) (13)

The foreseeable location of the lay up and first-level maintenance facilities, at some distance from the system's terminal stations, will entail a high number of deadhead train movements. Due to their importance, these movements should be analysed and included in the planned schedule, especially concerning the movements that will be necessary for the commencement of the daily revenue services.

As for the manoeuvres of coupling and uncoupling of train-sets, our years-long experience with the operation of HS trains with single and head-and-rear traction is that

the optimal solution is the one that minimises the number of operations of this kind needed, because in each of these manoeuvres there is always a certain risk of experiencing problems that may have an incidence in the normal operation. For this reason, our standard practice is to deal with all these operations at the lay up/storage yards and to keep the train-sets coupled for as many trips as possible.

Train crew size - operating personnel and number of on-board service staff (14)

When compared to standard ratios in our HS trains, the basic revenue "road" crew (3 positions in 200m trains and 5 positions in 400 m trains) seems too large. In our practice, the typical basic "road" crew is comprised of just one engineer/head of train (driver) and one conductor (on board supervisor). A second conductor (assistant supervisor) is added in case of 400 m trains. As for the train crew needed for movements to/from lay up yards, storage and maintenance facilities, and not withstanding the presence at the relevant location of necessary yard operations' personnel, under normal conditions only the driver/head of train (engineer) makes up the operating crew member on board of the train.

In our HS trains' revenue "road" crew, there are no additional positions for ticket/fare verification/collection and general on-board services. Since access to the train is subject to a prior check-in of the ticket at the stations (before acceding the platform or at some point of it), any problem or issue related to the passengers' tickets (for instance, upgrades from one class to a higher one), including the collection of any additional fare, is dealt with by the sole conductor (or, in 400 m trains, by the conductor in charge of the relevant unit).

As for rest of the on-board positions in revenue services (staff dealing with on-board services to passengers, such as cafeteria, food and beverages' service at seat, distribution of newspapers and headphones, etc.) the number of personnel which will be required will obviously depend on the type of services to be provided on board (an aspect not described in the Service Plans). In any event, in the HS trains operated by Renfe all these services are outsourced and thus the relevant staff is employed by the contractor, not by the Operator.

For a 200m train, the number of this staff is variable – depending on the number of classes on board and the type of service to be provided in each train – and ranks between only 1 person in medium-distance/one class trains (in charge of the train's cafeteria/snack bar service), and up to 6 attendants in the highest-level long-haul services (1 for the cafeteria, 2 for class club passengers and 3 for business class). Naturally, these staff requirements match our specific business model and approach to HST services, which is based on a high level of service (in all its steps), that includes aspects such as food and beverages served at seat (a hot meal for passengers in business class and a range of menus – a la carte – and free additional beverages for passengers in first – "Club" – class), daily press (for free), headphones for listening to music channels or video movies available on board (available, for free, to all passengers), assistance to children or minors travelling without parents or other adult person, etc.

3.2 Ticketing and fare collection (14)

The trend is also in Spain that the use of electronic tickets – via internet or cellular phones – which can be automatically read by optical devices at the access or check-in point, is rapidly gaining ground over other ticket formats. In any case, this is an issue that may quickly evolve towards new and innovative technical solutions and, in a 2020 horizon, new solutions that could even make unnecessary the "physical" control of the tickets before boarding the train might be available. However, in the short-to-medium term stations will still have to be equipped with the necessary facilities and ticket control methods.

As for tickets' distribution and sales, Renfe Operadora is presently using the following channels and mechanisms:

- Ticket windows at stations (staffed): the issuing of the tickets is performed online, through a specific IT application.
- By telephone: a code (localizer) is provided, allowing the further issuing of the ticket either at ticket windows or ticket vending machines.
- Internet (e-ticket): allows for the purchase and printing of the ticket through Renfe's website. There are separate channels for travel agencies and private individuals.
- Ticket vending machines (usually located at stations): allow the issuing of the ticket by entering the localizer. A further development allowing for the direct sale of the ticket (without the need for a localizer) at theses machines is to be implemented soon.
- Virtual agencies: a channel reserved for tour-operators, which integrates the sales of Renfe tickets in their own portals.
- Travel Agencies (physical offices).

At present, our tickets are issued in two different formats (ATB and DIN A4). In both cases, alongside the ticket information, the format includes a bar code allowing for the optical identification of the ticket at check-in or, if needed, on board of the train.

In Spain's HST system, access to the train is always controlled by the operator's staff, who checks the tickets with bar-code reading' optical devices. In terminal stations of our HST network and in most of the intermediate stations there is no automatic control or check-in through access barriers or turnstiles[10]. However, these have been set up in two of our newest intermediate stations (Cuenca and Requena-Utiel, in the Madrid-Valencia line).

Tests are currently being carried out to implement cell-phone stored tickets. With this functionality, passengers will be able to download their tickets to their mobile phones, including the bar code needed for their identification. In the future, it is envisaged that this new application will also provide for the possibility to process changes, cancellations and even direct sales through data-transmission from mobile phones.

As for the place or location for tickets' control, in our HST system the check-in of the tickets takes place before boarding the train and is normally carried out before accessing the platform where the train is stationed and at point that is usually located in a dedicated zone of the station's passengers boarding area, specific for HS services. Only

[10] These control systems and devices are commonly used for access to the commuter train system

passengers with a ticket for a HS train service (which has to be produced) are allowed into this zone, and entry into the zone takes place through a security control point that is equipped with scanners for security check of the baggage and at which random person security screening may also be applied. The security control giving access to the boarding zone and the ticket check-in before access to platform and train are performed by specialised staff (outsourced).

In conclusion, in these aspects our system and procedures do not differ too much from what is presently envisaged in the CHST service plans. However, in our case, control of access to the stations' "paid" area fulfils a double role: check that passengers are in possession of a valid ticket for a HS train and perform a preliminary and standard security check. It is to be noted here that security is a fundamental attribute and a constitutive element of our customer service philosophy and orientation.

Finally, in the Spanish HST system the sole document that is also used for boarding is the ticket itself (in any of its two formats). To this end, once the bar code has been scanned at the check-in point, a stub with the bar code is detached from the ticket and kept by the operator's personnel.

3.3 Station Operations and Passenger-Handling

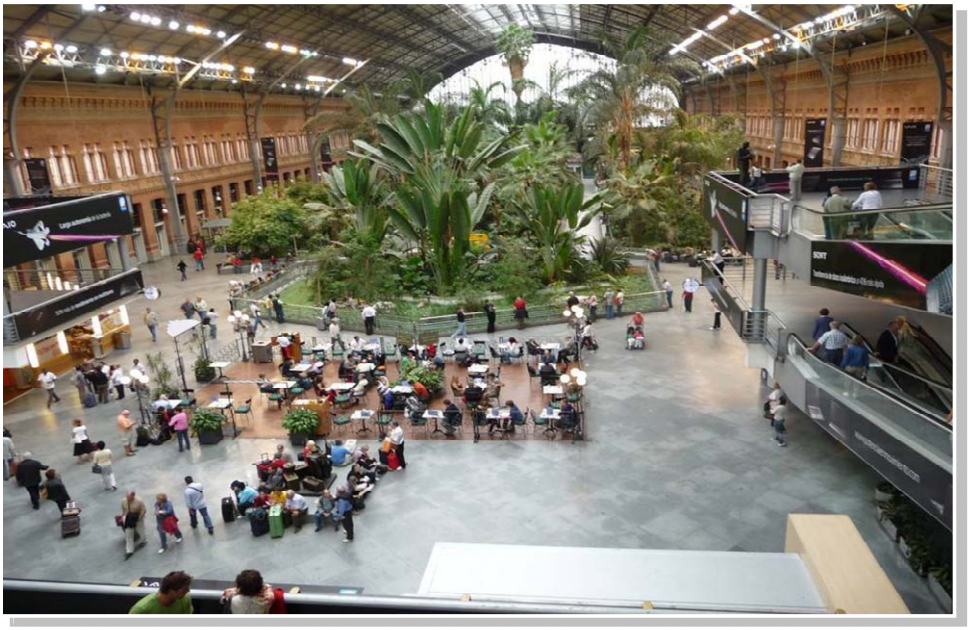
In our system, all spaces and zones of passenger transit in stations dedicated to HST services or otherwise served by HS trains are standardised. In Spain, design, construction and operation of stations along the HST system is a responsibility of the infrastructure manager (ADIF). However, once the relevant station has been built, ADIF and Renfe (this later one, at present, the sole operator of HS trains) jointly develop and set up the protocols and procedures to be applied for passenger handling at the station.

Other than this, we at Renfe have a clearly designed ·"customer's corridor" which encompasses all aspects and situations, depending on the circumstances or typology of the client: car parking in the station's access area (free or not), customer service centres where our clients can solve any problem or issue related to their journey and assistance centres for passengers with reduced mobility or other impaired passengers (both types of centres located in the public or free area of the station, near the access), boarding zones and waiting lounges with the necessary facilities (such as information boards) and comfort equipment (including a special first class/frequent traveller lounge), ticket check-in and access to platform, welcome to the train and assistance when boarding it, well-defined operational sequences and procedures for on-board services (enabling a high-quality and attentive service), information about the journey and the services available on board through loudspeakers and video-screens, attention to unaccompanied children, staff uniforms and behaviour codes, etc.

All and each one of these activities are standardised and subject to pre-established procedure and protocols.

2

Services in stations



Passenger Security Screening and Access Control at Stations (16)

In these aspects, the normal operating mode at stations, as described in the “Introductory Material”, seems to coincide basically with the one being applied in the Spanish HST network. Our system is also based in the use of portable equipment, set up at the line of demarcation which separates the free or public access zone from the specific passengers’ boarding zone, where a double control (ticket and security) is performed, the latter based on magnetometers and baggage screening devices.

However, it should be noted that, concerning security, the controls and mechanisms performed at the points of access to boarding zones in stations are just a portion of the multiple aspects involved in ensuring the security of the HST operations and services.

Although, logically, it is not up to the Operations/Service and Maintenance Plans to provide details about the security requirements for the whole system, we would like to underscore here that, for Renfe, security is an essential component of the HST service. The security requirements (levels and measures), both preventive and reactive, will have to be developed on the basis of the Services’ scope, problematic, complexity and other characteristics. However the detailed analysis of such requirements (risks analysis and assessment, security systems and measures needed at the various elements of the system) should be undertaken and carried out in parallel to the development and refinement of the operations and service plans, the design and construction of the infrastructure and facilities and the determination of the technical specifications that the rolling stock should meet.

In our practice, this wider concept and approach to the security aspects of the system includes everything related to Traffic Safety, as well as to the security of passengers, facilities and equipment, the protection of the system's environment and even aspects related to safety at work of those who work at/for the system. The early development of strategies and plans aimed at ensuring a level of security commensurate with the expect risk level, system's functionality and passengers' comfort is, from this viewpoint, an issue to be considered.

Passenger Boarding Process (19-20-21)

The process depicted in the diagram shown in item 19 of the "Questions and Issues" section of the IM looks, in general correct. The process is similar to our own process, perhaps with a few minor differences: 1) There is no "baggage check" at public concourse (this is performed typically at security screening line, alongside primary ticket control); 2) In addition to the information and customer service point of the station itself, we have also operator's customer service point/office, as well as a point of assistance to impaired or reduced mobility persons, at the entrance of the station or in the public concourse; 3) We do not have direct access to platform and train for just-in time or late minute arrivals. Access always takes place through the boarding gate, where the ticket check-in is performed.

Other than this, the time intervals envisaged for alighting passengers to be discharged from the arriving train and further clearance of the platform at terminal stations (5 minutes) could, in our experience, turn out to be insufficient; particularly when it comes to double-composition trains (carrying up to 1,000 passengers). Naturally, the time needed for this operation will depend on a number of factors, including the actual number of passengers, the possible presence of a certain number of persons with reduced mobility

or other especial needs among them, the volume and way of picking-up the baggage inside the train, and the number and configuration of the platform exit points.

We also relieve that the time foreseen in the Service Plans for the train servicing (cleaning of car interiors and rest rooms and restocking of train's food service supplies) at terminal stations, for turnaround trains (20 minutes as a rule, and only 10 at San Francisco-Transbay) may have been underestimated too. Compliance with these tight times would require the deployment of an important number of human resources and equipment (particularly for cleaning), particularly for double-composition trains and peak hours, which may involve additional costs.

In Renfe-operated HST services, the time allocated for the boarding of passengers in terminal stations (once the cleaning and restocking of service supplies has been completed) are significantly longer than the 15 minutes envisaged in the Service Plans developed for the CHST. In our case, boarding of passengers (opening of ticket check-in at boarding gate and access to platform and train) starts, as a rule, 30 minutes before departure time in single composition trains (200m) and 40 minutes in double-composition (400m) trains. These times may nonetheless be shortened if there is a need to recover some time to comply with the schedule (either in cases of delayed arrival or stationing of the train at the platform or when train layover service was not completed on time). Access to the boarding platform is closed 2 minutes in advance to scheduled departure time. If need be (because of the number of passengers boarding the train), additional gates and ticket check-in points are set up, so as to speed-up boarding.

In any case, while understanding the priority given by the Operations Planning Team to the optimisation of services through the minimisation of layover times at terminal stations, based on our practical experience we would advise to totally discard the option of allowing passenger access to platforms and boarding of the train before the cleaning and restocking of the train has been completed (or almost completed).

As for the passenger alighting and boarding process at intermediate stations, the process described in the documents provided for the review (item 20 of the "Q & I" section and Service Plans) is similar to the process applied in our system. However, the stop times foreseen in these documents (1.5 – 2 minutes) might have to be made more flexible, taking into account the volume of passengers estimated for each station at different moments of the operation (peak and off-peak hours).

Passenger and Services' Access to Platforms (22)

Concerning the coexistence of passengers' alighting/boarding operations and train service operations on the same platform and their possible simultaneity, in our operating protocols and procedures we always try to avoid such physical coexistence between these two flows on the same space and, whenever this is not feasible, we establish a clear-cut time separation and sequence between all these operations.

It is highly recommendable that stations are provided with underground service galleries with direct access – ramps or elevators – to the platforms, so as to facilitate access of these services to the train, without interfering with passengers' access.

Baggage-Handling (17)

In Spain's HST system, baggage check-in is allowed only in the Madrid-Seville service, and only for group travellers. Once the baggage has been screened at security control,

passengers carry their own baggage to the train boarding point, from where Renfe staff is in charge of placing it in the specific area of the train reserved for this purpose. This is possible due to the configuration of the train-sets used in this line.

In all the other HS services and trains, passengers are normally required to carry their baggage by themselves, the sole exception being the help that can be solicited and provided to persons with reduced mobility or otherwise unable to carry their own baggage (under the stations and trains' accessibility programme, named ATENDO service). In the Spanish HS stations there are no porters (red cap), allowed to carry the passengers' baggage to the platform and/or inside the train. It is our belief that such service may actually slow down the alighting and boarding of passengers rather than speeding it up, thus increasing the time needed to complete these operations and putting into question the time intervals foreseen in the current Service Plans. On the contrary, baggage carts can be used not only at the concourse/waiting lounge but also taken to the platform.

The number and volume of baggage pieces to be allowed at CHST system is not detailed in the documents received. In any event, we do not recommend the implementation of a system of baggage check-in. In case baggage of a certain volume – not fitting into the standard on-board shelves – would be accepted, this should be placed in a specific area of the car where the passenger travels, and these areas should be protected (by mechanical and/or electronic arrays).

Renfe applies rigorous restrictions concerning baggage allowed on board of its HS trains (number and volume of pieces). Contrary to standard practice in air transport, there is no possibility to carry additional baggage by paying and additional fare (excess-baggage). These stringent limitations stem from the fact that HS train-sets are especially designed to meet the needs of business travellers (who normally carry no or little baggage), and their interior is arranged so as to optimise the available space, maximising the number of (comfortable) seats. Furthermore, these new trains are built as a sole and non-deformable structure, and therefore do not permit the adding of units that could be used as baggage car.

Last but not least, security screening of baggage is deemed of a great importance. No piece of baggage should be introduced on board of the train without having been previously inspected by the security staff (usually through fixed or portable scanners).

Bicycle-Handling (18)

Access of bicycles to Renfe's long-haul / high-performance HS trains is not allowed. In our medium-distance HS trains and services, however, bicycles that can be folded and do not exceed certain size can be considered as personal baggage and be transported in the train.

Exceptionally, in some of our HS "shuttle" services, trains are equipped with a purpose-built space which can accommodate in a safe way and position (upright, including lockers) up to three bicycles.

3.4 Rolling Stock Maintenance

The Spanish model for HS rolling stock maintenance is somehow different from the model foreseen for the CHST.

In Spain, the system entails two levels of maintenance operations and corresponding facilities: A first level, which roughly matches levels 1, 2 and 3 of the system envisaged for CHST; and a second level that would be equivalent to levels 4 and 5.

Number and location of maintenance facilities

In our HST system, there is at least one first-level workshop for each one of the HS corridors currently under exploitation (South, East, North-East and North/North-West). To the extent it is possible, vehicles of the same type (Renfe series) are always maintained at the same workshop and each workshop specialises in the maintenance of one type of vehicle.

First-level maintenance facilities are located in the proximity and as close as possible to one of the terminal stations[11]. Ideally, firs-level workshops and layover facilities should be located passing the terminal station. In this way non revenue traffic and revenue traffic would be totally independent and this would reduce possible interferences between both traffics especially during peak time period.

In any case, a more detailed study of the equipment exploitation cycles developed for CHST would allow to confirm whether it is possible to carry out the first-level maintenance operations for the entire fleet at just one workshop or if two different

[11] For instance, “Cerro Negro” and “ Santa Catalina” facilities are located at 3.5 km – 2.2 miles – from Madrid.Puerta de Atocha station; and “Los Prados” Workshops are located nearby Málaga-María Zambrano station).

facilities would be required (as it seems to envisage the current planning). Nevertheless, as noted in the documents under review, an obvious condition to be borne in mind when making decisions on the number and location of maintenance facilities is the availability of land at the cities along the corridor/line and, in particular, in the cities where terminal stations are located.

We consider correct the idea to have a (the) second-level (heavy) maintenance facility already available and operational at the start-up of the line. This workshop would already be used for final assembling of the first trains, as well as for maintenance tasks required during the period leading to their commissioning. We agree that to this end, it is not necessary that the second-level workshop is fully completed, staffed and equipped. This is the way in which we have worked during the period preceding the launch of new HS lines and services.

However, our opinion is that, if possible, the second-level workshop (heavy maintenance facility) should also be located and built in the proximity of one of the terminal stations, nearby or as close as possible to one of the first-level maintenance facilities/workshops[12]. This would reduce deadhead movements and the costs attached to these movements, as well as the time in which the main tracks are occupied with this type of traffic.

Also, as final remark on this issue, base on our experience with the maintenance of HS trains (as explained below), we believe that one of the most important criteria to be taken into account when it comes to deciding on the location of the HST workshops and maintenance facilities, in particular in regards to the second-level or heavy maintenance facility, would be its insertion or proximity to already existing industrial concentration areas, where there the auxiliary industry (mechanical and electrical/electronic components, air conditioning, upholstery, etc.) that will have to be involved in the manufacturing, repair or replacement of the various elements of the trains, is available.

Lay up / lay over tracks

Notwithstanding the need to have a sufficient number of these kind of tracks within the Heavy Maintenance Facility, the most convenient location for lay up/ lay over tracks is next (or near) the first-level maintenance workshop (s).

It is highly recommendable that such tracks or storage yards are well equipped with all that is necessary for the cleaning and provisioning of the trains, the emptying of the WC depots, the realisation of pre-service routine checks and inspections and small repairs.

As for the total amount of storage and maintenance tracks needed, pursuant from the contents of the current planning and once all the fleet of operable train-sets foreseen for the Full-Build phase has been delivered (212 sets, 200m long), a figure of about 48 km (30 miles) of track would be theoretically required. However, an adequate dimensioning of the storage yards / maintenance tracks needed should take into account the train movements and their routes, as well as the number of trains in operation at any given time and the general conditions of the operation and train manoeuvres. As pointed above, our recommendation would be to utilise terminal station tracks for lay over and conditioning/provisioning of the train-sets entering into revenue service in early morning.

[12] Renfe's HS second-level workshop (La Sagra) is located 55 km (35 miles) from Madrid-Puerta de Atocha. From an operational viewpoint, the location of this workshop is deemed too far away and rather unconvenient.

Layout of maintenance facilities

The layout concept shown in the relevant documents received from CHSRA for lay over and maintenance facilities could, in our view, still be improved.

In our opinion, the planned configuration risks saturating the two main entrances to the facilities as they would be used for rolling stock entry and exit as well as for movements from the storage yard to the workshop and vice verse. Based on our experience, in order to have enough room for manoeuvres inside the facilities, all lay up areas should be dimensioned with a 10 percent increase over the theoretical space needs.

Other than this, our recommendation is to place automatic wheel inspection devices and the train washer in tracks where these operations can be carried out without interfering with the incoming or outgoing traffic. Also, it would be advisable that some of the lay up tracks are set as a continuation of internal inspection/work (pit) tracks at workshops, since this would facilitate the workshop's operation and logistics.

We also recommend that CHSTP should foresee the provision and availability, at first-level maintenance facilities, of air pressure blowing devices, which will be needed, under California conditions, to eliminate sand and dust in suspension that may negatively affect some of the extremely sensitive elements and Systems with which HS trains are equipped.

Equally, we would advise a careful consideration and study of the negative effects of abrasive sands on the vehicles outer painting, particularly at their most extreme points. Use of especial paint products or more frequent painting of the train-sets should be considered. To this end, paint shops for car vehicles – not explicitly foreseen in the general concept guidelines – should be integrated in the layout of the maintenance facilities.

Organisation of rolling stock maintenance

In Spain's HST system, rolling stock maintenance was first contracted out to the train manufacturers. At present, maintenance is carried out by joint venture companies set up by the manufacturers (51%) and Renfe (49%). However, maintenance operations are carried out in facilities owned by the operator.

Maintenance staff works in three shifts, 365 days a year. The distribution of work load between shifts is approx. 25% morning shift, 25% afternoon shift and 50% night shift.

In order to minimize costs, a number of maintenance activities are outsourced to specialised companies. In general, these are activities that belong to levels 4 and 5 (components' repairs and modifications and improvements on the occasion of mid-life overhauls of train-sets). In this way, it is not necessary to undertake at the maintenance workshop manufacturing or components' repair activities, but just the functional checks and tests as well the replacement of train's components. For instance, there is no need to have upholsterers employed at the maintenance workshop, since upholstery repairs/ manufacturing is always contracted out.

Workshop capacity and manpower estimates for maintenance of Rolling stock

Renfe's HS first-level workshops are dimensioned so as to provide a 200m long "work post" (pit track) for each 4-6 train-sets in the relevant fleet. For the second-level workshops (equivalent to levels 4-5 of CHST / Heavy Maintenance Facility) this ratio is of one "work post" (200m) for 10 train-sets.

Therefore, concerning the capacity of the main workshop (HMF), we think that when Full-Build phase becomes operative, 32 200m work posts total capacity for the service and inspection area should be enough, even in the event of an accident or acquisition of new material, or various other possible circumstances.

Pit tracks in our first-level workshops are built so as to allow service operations with 400m trains. However, this is more important for first-level facilities than for the HMF, at which 200 m tracks would be an equally functional setting.

As for the maintenance staff required, due to likely differences in legal framework, employment/work patterns and the lack of sufficient information on the volume of activity and the approach to and scope of maintenance operations to be directly carried out by the operator, it would be difficult for us to issue a more specific opinion. However, what can be pointed out is that, in our system (in which, as noted above, many second-level maintenance tasks are outsourced), the ratios are 60% of our maintenance staff working at first-level facilities and maintenance operations, and 40% dealing with second-level maintenance. Out of the total number of employees in our Maintenance Division, and for a fleet of about 50 train-sets, 55% deals directly with maintenance tasks, 30% deals with trains' cleaning and 15% deals with general management functions. The high number of train-sets envisaged for the operation of CHST system may indeed require a higher number of direct work-force.

Test track

So far, a track specifically built and used for testing the HS trains, of the length and kind envisaged in the CHSTP, has not been available in our HS system

There is, however, a 3.5 km (2.2 miles) test track at La Sagra second-level maintenance workshop, which is used for minor tuning checks and tests, after the assembling of new trains or the realisation of a mid-life overhaul in the already existing ones. Maximum speed on this track is about 100 km/h (60 mph).

In Spain, tests at high speed are carried out on the main lines' tracks, during off-peak time or hours of low traffic density.

For us, this has proven to be a workable and lower-cost solution up to now.

Spare fleet ratio (26)

To guarantee the required level of services, we at Renfe also operate with a 10% spare ratio in our train fleet (dimensioned as comprising a maximum of 50 train-sets per series/type). However, we think that, for a more numerous fleet (as envisaged in the CHSTP), it would be possible to ensure the necessary supply of operational vehicles with a somehow lower ratio (thus decreasing the investment required).

3.5 Contracting and outsourcing services (29)

In Spain, activities and services such as train cleaning, on-board food and beverage service (meals at seat and cafeteria) and other services to passengers, security/access controls and ticket check-in, services at boarding and frequent-travellers lounges, etc, are all outsourced.

In the field of rolling stock maintenance, other services also subject to outsourcing are: operation of fork-lifts and package handling inside workshops, maintenance, cleaning and security at workshops and facilities, as well as other low added-value rolling stock maintenance activities.

4. Other Issues of interest for the present or further stages of planning

In addition to the previous comments and remarks, there are a number of issues that are, in our view, very relevant for the planning and operation of a HST system, which are not mentioned or sufficiently developed in the documentation received from CHSRA for this peer review. Some of them are:

- Contingency Plans.
- Operation Safety Management System
- Active security and safety of the system.
- Operations' Control and Process Management System and tools (including management system for on-board staff)

Contingency plans

The smooth operation of a HST system requires the availability of well-developed Contingency Plans, which retail all the measures and procedures needed to ensure an appropriate "response capacity" to unexpected events.

In this regard, the following aspects should be considered:

- Availability of spare vehicles and staff at each line/service terminal stations.

- Deployment of equipment, material and staff resources at key points along the line, so that, in case of need, immediate support can be provided to any train that gets out of operation in between or at intermediate stations. Availability and adequate deployment of diesel locomotives that can help or tow these trains in case of incidents related to electric power supply should be envisaged in these plans.

- It is important to ensure the reliability of the on-board equipment, stressing the need for redundant devices and systems, to avoid incidences and undesirable stops on the tracks.

- It is also critical to ensure the correct performance of the operations of coupling and uncoupling of train-sets, both at storage/lay up yards and at terminal stations.

Operations' Safety Management System

In order to start with the development of a necessary Operations' Safety Management System, a number of additional issues should possibly be considered in further steps of the planning:

- Technical characteristics of the future network and rolling stock, particularly as regards to signalling and communications, heat sensors for axes and wheels, sensors for impacts on the tracks, safety equipment on board of the trains.

- Qualification requirements and specific training and certificates required for train drivers (engineers) and other staff involved in the safe operation of the trains.

- Requirements set by the legal framework and rules for the certification/accreditation of rolling stock

- Analysis of specific situations and safety requirements for train operation under degraded conditions.

Active security and safety of the system

Aspects such as the following should be further analysed and defined:

- Security elements and equipment to be set up at large lay up / lay over facilities (to protect them from intruders and possible vandalism).

- Security elements to be installed at ticket sales facilities and in access to stations, boarding areas and platforms.

- Security elements on board of the trains

- Communications system for security personnel and management.

Operations' Control and Process Management System

Base on our experience, we consider convenient to foresee the setting up o fan Operations (Exploitation) Control Centre, independent from Traffic Control Centre, specifically oriented to ensuring the coordination of the supply and operation of passenger services and related activities. This Centre should be responsible for ensuring compliance of all those involved in the exploitation of the HS trains with pre-established procedures, so that deviations from service plans and Schedule can be minimised.

Renfe, as the operator of the High-Speed Passenger Train services in Spain, would be pleased to contribute, with its knowledge and years-long practical experience, to the further development of the Plans and Systems that will be needed for a successful set up and operation of California's High-Speed Train System.