STATE OF CALIFORNIA

GRAY DAVIS
GOVERNOR

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

October 3, 2000

Maria Ayerdi
Transportation Policy Advisor
Office of the Mayor
1 Dr. Carlton B. Goodlett Place, Suite 448
San Francisco, CA 94102

Dear Maria,

Thank you for inviting me to attend your meeting held on September 7, 2000 regarding the rail design for the Transbay Terminal. At that meeting, I offered to use the Authority's peer review contracts with high-speed rail operators, and other contacts in the industry to obtain information regarding the absolute minimum curves that can be used by "high-speed" trains – when they are traveling at very slow speeds. In addition to understanding current operational practices, we need to know if high-speed trains can be designed to accommodate curves with a radius as small as 375 feet just before the platforms of a terminus station. If design modifications are necessary to meet such a design criteria, it is also important to know of any potential negative consequences from these modifications.

High-speed trains operate in many countries. In terms of maximum speeds, both the French TGV and the Japanese Shinkansen maintain regular operational speeds of 186 mph (300 km/hr) on dedicated high-speed segments of their networks. While these are the highest speeds in the world achieved today by trains in revenue service, both types of trains have been tested at much higher speeds – the TGV has been tested at 320 mph. For California's future high-speed train system, the Authority's work has assumed steel-wheel-on-steel-wheel trains (like the TGV or Shinkansen) will operate at maximum speeds of nearly 220 mph. It is the legislative mandate of the Authority to implement a high-speed train system capable of speeds of 200 mph or greater.

Because of their vast experience with high-speed train operations, the Authority entered into peer review contracts with SNCF (the French National Railways), JARTS (the technical consulting division of Japan Railways), and DE Consult (the technical consulting division of the German National Railways). In addition to these operators, I have also contacted representatives of Alstom (the manufacturer of the TGV), Talgo (train manufacturer based in Spain), and

CALIFORNIA HIGH-SPEED RAIL AUTHORITY

925 L Street, Suite 1425, Sacramento, CA 95814 (916) 324-1541, (916) 322-0827 fax

Bombardier (train manufacturer based in Canada, partner with Alstom for North American high-speed train manufacturing). I have attached responses from these entities with this letter. For foreign high-speed trains operated today, the absolute minimum radius of curves used at slow speeds were reported as follows: 656 feet for Japan, 410 feet for France (however it is 493 feet for the design stage), and 493 feet for Germany. While the "Acela" trainset built by Alstom/Bombardier for the Northeast Corridor (Boston-New York-Washington D.C.) can negotiate curves as tight as 250 feet, it has been developed for 150 mph maximum speed operations (see letter from Bombardier). Therefore, the Acela trainset does not meet the performance criteria established by the Authority's legislative mandate. According to Talgo, they have developed a new trainset capable of speeds of nearly 220 mph that can negotiate curves "with a minimum radius of 328 feet without any design change or modification". However, this new trainset (Talgo's first high-speed train) has not been implemented in revenue service.

The French and German operators/manufacturers acknowledge that high-speed trains can be modified to accommodate curves with a radius as tight as 375 feet (at very slow speeds). However the French operator and manufacturer responded that this would result in maintenance problems and cause excessive wear on the wheels and the rails. It also may have a negative impact on the stability of the system at high-speed operations. SNCF strongly recommends that the absolute minimum curve radius be no less than 493 feet (150 meters). The Japanese would like to research the concept of modifying the Shinkansen to accommodate smaller curves. They noted that a curve with a 375 foot radius is "much smaller" than their tightest curves.

The Authority is beginning the environmental clearance process for a statewide high-speed train network. With the chaptering of AB 1703 (Florez and Costa), the Authority is poised to move from planning to implementing a high-speed train system. At our October 18, 2000 Authority meeting in San Francisco, our board will approve a work plan for the development of the program EIR for the statewide high-speed train system. This action effectively initiates the program EIR process—and starts the project. At the meeting, the Authority will also approve the awarding of three regional environmental/engineering contracts to provide detailed review of how a high-speed system would be built and operated between the Bay Area and Merced, Sacramento and Bakersfield, and Bakersfield and Los Angeles. These analyses will form the technical backbone of the program EIR.

For the Authority's previous planning work, and for the studies of the California Intercity HSR Commission (1993-1996), the design standard used for the absolute minimum curve radius was 650 feet (200 meters). Within the next few months, at an Authority meeting, the board will be asked to approve new design standards and parameters for the construction and operation of high-speed trains in California. These will include design standards and parameters for high-speed train stations. Our program management team is further investigating these issues and will soon issue a draft report on design standards and parameters for public comment. I will make sure that you receive a copy once it is available.

I hope that this information is useful and helps with the design of the Transbay Terminal. If you have any questions, please do not hesitate to call.

Sincerely,

Dan Leavitt
Deputy Director

Memorandum

To: Dan Leavitt
Deputy Director, HSRA

From: Kip Field

Date: July 5, 2000

Subject: Corridor Evaluation – Station/Consist Assumptions

As requested, we have outlined the key assumptions and parameters used in the corridor evaluation studies regarding station platform and train consist lengths. This information will provide context for our coordination with the proposed Transbay Terminal project.

For the previous and current high-speed rail studies in California, we assumed a minimum platform length of 400m or approximately 1,300 feet to provide for initial and future capacity needs. This length was primarily based on German practice as a result of DE Consult's early involvement in the Los Angeles to Bakersfield studies. In the statewide corridor evaluation studies, the trains were assumed to carry between 600-650 seated passengers. The capacity, number of cars, and length of a consist can vary widely depending on the manufacturer, classes of service, and power design (i.e., emu's). In European (Germany and France) high-speed rail practice, train consists are typically designed as half-train units that can be combined to form a full (maximum) train length. The maximum train length defines the platform length required.

Based on approximately 50-55 seated passengers on a single level coach car and 70-75 on a dual level coach, we assumed a 10 coach (single level) and an 8 coach (dual level) train consist for costing purposes. With the passenger coach portions (not including power cars or assuming emu's) of these train consists only 650 - 850 foot long, the 1300 foot platform length allows for considerable more capacity.

As for access to the Transbay Terminal site, the minimum radii are 650 feet (200m) for steel wheel and 1150 feet (350m) for Maglev.

We currently do not have enough information to assess the specifics of the Transbay Terminal concept in relation to high-speed rail needs. Please request any available scaled drawings of the site (including entry and exit path) and cross-section or elevation drawings showing the approximate elevation of the Caltrain tracks in the station area relative to other modes.

TELEFAX

DE-Consult

HGV - Innovative Systeme
Oskar-Sommer-Straße 15 · D-60596 Frankfurt am Main
P.O.Box 700 254 · D-60591 Frankfurt am Main
Telefon: 069 / 63 19-280
Telefax: 069 / 63 19 355
Telex: 414 515 decon d

Fax-Nr./no.: 001 714 973 4918	Seiten/pages: 1	Datum/date: 18.07.95	
an/to: Kip Field Parsons Brinckerhoff 505 South Main St., Suite 900 Orange, CA 92668	von/from: Ottmar Grein H G V - Innovative Systeme Tel./tel.: 069-6319-284 Fax-Nr/no.: 069-6319-355		
Betr./ref.: California HSR Corridor Evaluation			

In response to your fax of July 7 regarding the absolute minimum horizontal curve radius for the ICE technology, we can offer you the following information:

1. The minimum radius for the <u>current</u> ICE generation is 150 m.

2. This radius can be further reduced through modifications of the vehicle design, e.g. shorter vehicles, modifications to the spring suspensions. As a general rule, the ICE industry will modify the design to meet any specific requirements stipulated by California. Thus, a 100-m minimum radius will be possible.

3. If it is necessary the ICE Industry will consider design modifications for future ICE generations to meet the UIC standard of 80 m.

We trust that this information will be helpful in your ongoing project. Please, do not hesitate to contact us if you need further details.

TELEFAX

DE-Consult

fax: 001-916-322 0827	pages: 3	date: October 11, 2000
to: California High-Speed Rail Authority Attn.: Mr. Dan Leavitt, Deputy Director Sacramento, CA U.S.A.	from: Deutsche Eisenbahn-Consulting GmbH BUSINESS UNIT INTERNATIONAL TRANSPORTATION AND RAILWAY SERVICES Oskar-Sommer-Straße 15 D-60596 Frankfurt am Main, Germany name: Gerd H. Morhenn phone: +49-69-6319 274 fax: +49-69-6319 355 e-mail: morhenn@de-consult.de	
ref.: Peer Review - Minimum Curve Radius		

Dear Mr. Leavitt,

we finally received a brief statement by Adtranz (member of the ICE consortium) on the minimum curve radius issue. As stated in the attached German letter (with English translation), the previous statement made by Ottmar Grein is still correct, i.e., a minimum curve radius of 114.3 m which may be required in San Francisco will be possible in future.

Tight radii like this do require a widening of the dynamic clearance envelope (as well as track gauge widening) and most likely the installation of a third guard rail; obviously, a very low operating speed would be mandatory. Otherwise, we do not see any significant maintenance, safety and cost implications.

Sincerely,

DE-Consult
Deutsche Eisenbahn-Consulting GmbH

Dr. Wolfgang Henn   Gerd Morhenn

<u>Attachments</u>

Translation of letter from ADtranz dated October 09, 2000
to Mr. Naupert of DE-Consult

1351/00
Design of ICE trains for California
Mail from Dan Leavitt to Gerd Morhenn

Dear Mr. Naupert,

regarding the minimum operable curve radii, we can confirm the remarks made by Mr. Ottmar Grein for the ICE 1 in 1995.

Also, the ICE 3 would be adaptable through modifications to the requirements (e.g., curve radii, clearance envelope, longitudinal forces) existing in California.

Sincerely

DaimlerChrysler Rail Systems GmbH
Large-scale Project ICE 3

Signed by Dr. Helmut Hassel

Mr. Dan Leavitt,

I am appointed by SNCF International from last monday, and I would like to inform you that I will take in charge your Californian High Speed Rail Project. Jean Pierre Mathieu will be assigned in a couple of weeks to work in Korea on the HSR project.

It would be a pleasure for me to integrate this exciting project.

In accordance with the contract signed June 26, 2000 between CHSRA and Rail Europe Group,Inc, we will send you an official letter informing you of the Project Manager substitution.

In addition to the mails you have exchanged last week with Jean Pierre Mathieu I have prepared a complementary answer to your question regarding minimum radius possible.

Tigth curves are sensitive points in railway layout. We have to consider the respons of the Rolling Stock and the track.

Rolling Stock:

> You have received Andre Huber answer; for him a tighest radius than 125m is undesirable. That means that it is the technical limit of the current HST, in terms of efforts acceptable by the train by running in a plain curve.
>
> To apply a very short radius we need to know :
>
> > Is it exceptional or normal to use this curve?
> >
> > Is this curve be used by others trains (conventional, freigth, maintenance) subject to radius restrictions (in terms of R/S)? Bear in mind that you have specific gauges for each type of trains, and also to take into accountend of the end and the centre throws of the R/S.
>
> In addition such radius will imposed a deep speed restriction, further the passenger comfort will be degraded.

Track layout:

> Generally such tight curves are used in station or depot or yards areras, specially at the extremities of the site, trains running on sinuous routes. This type of curve is preceeded or followed by an inverse short radius curve or a turn-out. This succession of tigth curves needs additional conditions such as a minimum straigth alignment between the curves. SNCF recommendations are to use 150m as the minimum radius.

Maintenance problems:

> A short radius means more lateral efforts in the track, more abrasion of the rail (specially rail head on the interior side), the sleepers and the fastenings. Such tigth radius must be subject to

more supervision and the rail life duration is shorter. As an exemple some years ago bull-headed rail was prefered in these curves with the possibility to change the head of running table.

Conclusions:

The idea of curve of 114,3m is not acceptable in terms of comfort, maintenance conditions and cost both for R/S and Track.Such radius can be used for tramway design or harbour tracks, not for high speed train ones.

SNCF highly recommand a 150m as a minimum.

If you need more information please do not hesitate to contact me.

Sincerely,

Bernard Bahurel

CURVE RADIUS

The curve radius of 375 feet (114.3 meters) is smaller than the minimum value prescribed by SNCF and set out in the draft specifications for the interoperability of the European High-Speed Rail network, as explained below :

4.3.3.5 Stabling tracks: minimum radii (longitudinal and vertical), maximum gradients, distance between track-centres
* lines which are dedicated to high-speed line operation, lines which are upgraded for high-speed line operation and connecting lines:

On such lines where only low-speed movements of interoperable trains take place (station, passing, depot and stabling tracks), the minimum curve radius in alignment shall not be less than 150 meters for an individual curve, at the design-stage. Operationally, the minimum radius shall not be less than 125 m, subject to alignment changes.

The lay-out of lines with a series of curves and successive reverse curves shall comply with the provisions of CEN standards...(currently UIC leaflets 527-1 dated 1/1/81, article 2 and appendix 3, to be turned into EN standards). This allows for a minimum radius of 190 meters without straight between curves, and 150 meters with a straight between curves of at least 6 meters.

In accordance with CEN standard...(* standard to be developed), the longitudinal profile of passing tracks shall not include radii of less than 600 meters upwards and 900 meters downwards.

It follows that a 150-meter radius (493 feet) should at least be required in order to safely operate a TGV at low speed in a station.

AL SOTM

POSITION PAPER ON COMPATIBILITY OF HIGH SPEED TRAINS AND SHARP CURVES

High Speed lines are designed with very smooth curves in order to allow trains to run at speed up to 320 km/h (200 mph) or even higher in the future. Typical radii for such curves are 4000 m (2.5 miles) and above in order to limit the lateral acceleration due to cant deficiency.

But such large curve radii are not practical for the design of an alignment in an urban area where the speed of the trains is anyway limited by other constraints, and much smaller radii are used within station areas.

UIC Code 645 requires trainsets to accept curve radii down to 125 m (410 feet) an European High Speed Trains follow this rule. Urban railways such as Tramcars accept even much tighter curves, down to 20 m (65 feet).

The design criteria which are the base for high speed and for high curve ability are contradictory, and this explains why the trend is to avoid as much as possible sharp curves for tracks used by high speed trains:

Design Criteria	Optimum for High Speed	Optimum for sharp curves
Wheel Base	Large (3 m for TGV)	Short (typically 2 m)
Wheel Conicity	Low (1/40 for TGV)	High (typically 1/20)
Truck Rigidity	High	Low
Vehicle Yaw Stiffness	High	Low

The result of High Speed Trains running on sharp curves is high stress on the track, the need oftrackside lubricators, and high wear of the track.

An alignment layout which would include curve radii lower than 125 m would, in addition to the above, need a detailed analysis and in most cases a redesign of thetrainsets.

Dear Mr.leavitt:

We are in the peak time for review work. Then we would like to reply to your
question as follows, refering to the information
and data in hand.

1.Minimum curve radius
(1) In case of Shinkansen, 400m is the minimum curve radius for main track
and 200m for side track(in car depot).
(2) Your curve radius of 114.3m is much smaller than our minimum curve radius for side track in car depot.
Then, we hope to study and find together with you a possible solution to
adapt a small curve radius at the said place
for high speed rail, if you could provide us with some drawings and more
detailed information concerned.

2.Turn-around time at stub-end rail terminus
We would like to provide you with some example.
In case of Tokyo Station for Tokaido Shinkansen; from 7:30 AM to 9:30 AM.
(1) drop off and board passengers: min. 7minutes, ave. approx.20minutes
(2) arrive from storage and board passengers: min. 3.5minutes, ave. approx.16 minutes
(3) drop off and then leave for storage: min. 13.5minutes, ave. approx.16minutes

We hope the above-mentioned information will be of some help to you

Best regards,

Yasuyuki Sakakibara, JARTS

BOMBARDIER
TRANSPORTATION
Bombardier Inc.
1101 Parent Street
Saint-Bruno, Québec, Canada J3V 6E6
Telephone 1(450) 441-2020
Fax 1(450) 441-1515
http://www.transportation.bombardier.com

October 2, 2000

Mr. Dan Leavitt
Deputy Director
California High Speed rail Authority
925 L Street, Suite 1425
Sacramento, CA
95814

Dear Mr. ~~Leavitt~~ Dan,

This is in response to your questions of last week regarding low speed curve capabilities, as well as the current and future maximum speed capabilities of various High Speed Rail technologies offered by Bombardier and its partners.

As we have discussed in the past, Bombardier currently offers two families of High Speed rail technologies.

- For speeds above 150 mph, Bombardier along with Alstom offer the TGV technology. In Europe, TGV trains have been tested at speeds up to 320 mph and are operated on a daily basis at speeds of 186 mph. For the Texas and Florida High Speed Rail projects, the consortiums that included Bombardier and Alstom proposed to build and operate TGV systems with trains running at 200 mph.

  The tightest curve on which TGV trains can be operated at low speeds, such as in train yards, is 410 feet.

- For corridors where High Speed Trains need to operate on existing infrastructure in mixed traffic with conventional North American trains such as Amtrak's Northeast Corridor, Bombardier and Alstom have developed the Acela Express trains.

At low speeds, the Acela Express trains are capable of negotiating curves as tight as 250 feet.

The Acela Express trains are designed to operate at 150 mph but have undergone qualification testing at 168 mph. There are no plans to extend the Acela Express revenue speed capabilities significantly beyond 150 mph.

I hope this letter may clarify any confusion that exists about this issue.

Best regards,

Paul Larouche P.Eng.

Paul Larouche P.Eng.
Director TGV Projects

cc: Gary Hallman
André Huber
George Mekosh

Talgo Pride and Dedication

September 14, 2000

Mr. Dan Leavitt
Deputy Director
California High-Speed Rail Authority
925 L Street, Suite 1425
Sacramento, CA 95814

Subject: Talgo 350

Dear Mr. Leavitt:

This is to confirm that the Talgo 350 (Talgo's very high-speed trainset capable of speeds of 220 mph) can negotiate curves with a minimum radius of 328' without any design change or modification. This does not impact negatively the integrity of the trainsets, their operation, their safety or their manufacturing and maintenance costs.

However, it should also be noted that the low radius curves referred to above, should be negotiated at very low speeds and that the clearance gauge of the line might not be respected at that point. Unless the clearance gauge is wider, there could be clearence gauge interferences at these low radius curves.

Sincerely,

JLaforgue

Javier Laforgue
Marketing Manager
Talgo America Inc.

100 South King Street • Suite 320 • Seattle WA • 98104 • tel: 206.748.6140 • fax: 206.748.6147