Information Sheet No 2 (1st Issue) January 1990

VFT TOPICS

High-Speed Trains Overseas

Japan and France, originators of the rail revival

The first country to build a new railway for high-speed passenger trains was Japan. The Shinkansen network's first section was opened in 1964. In the 25 years since then, it has grown to more than 1800 kilometres. Further extensions are being planned — not only totally new lines but also converted narrow-gauge lines.

At first, Shinkansen[1] trains travelled at 210 km/h. Now their maximum speed is 240 km/h. Soon they will travel at 270 km/h; later they are planned to reach 300 km/h.

The Shinkansen system plays a vital role in Japan's internal transport. The network carries some 160 million passengers per year (440 000 each day). Very high engineering standards and railway work practices have produced an impeccable safety record: in its 25 years of operation, the Shinkansen has carried more than 2.7 billion passengers (about the same as half the world's population) without a single casualty.

Such superb standards of safety have been achieved hand–in-hand with impressive punctuality: for the Shinkansen, being "on time" is measured in seconds rather than minutes.

Recent initiatives to meet new demands have been double-deck carriages which carry more passengers, and telephones and working areas for business travellers.

The second country to enter the high-speed arena was France, with its TGV.[2] The first section of high-speed TGV line was opened in 1981. Unlike the Shinkansen, whose track gauge is different from that of other lines, the TGV shares a common gauge with the rest of the rail network.[3] As a result, TGV services extend well beyond the dedicated high-speed sections of line. Operating speeds have increased from 260 km/h in 1981 to 300 km/h at present, so that the TGV currently provides the world's fastest land transport. An increase in speed to 320-330 km/h is projected for the TGV-Nord, to open in 1993.

A French TGV-A, holder of the world rail speed record of 482.4 km/h (300 miles/hr). – SNCF photo

Shinkansen trains introduced modern high-speed rail travel in 1964 with cruising speeds of 210km/h

– Japanese Railways photo.

Many other countries are now operating, building or planning new high-speed railways, based on the success of operations in Japan and France. Japanese and French high-speed railways have not only been technologically successful: they have also allowed passenger trains to return a profit. The initial sections of the Japanese Shinkansen are extremely profitable, with revenues exceeding operating costs by almost two to one. (This is not the case with more recent Shinkansen lines which were built for social and political reasons). The French TGV system from Paris to Lyon is very profitable: it is showing a real rate of return of 12 percent and its capital costs will be paid off by 1990 — seven years from the start of full operations. The TGV's success is reflected in the increasing demand for services:

- in 1980, before the TGV line opened, 12.2 million rail passengers were carried in this corridor;
- by 1987, patronage had climbed to 20.6 million.

The profit derived from these TGV services in 1987 was as follows:

Revenue	4.1 billion francs
Operating cost	1.5 billion francs
Depreciation and interest	1.2 billion francs
Net profit	1.4 billion francs (= $285 million Aust)

The French section of the TGV-Nord, from Paris to London and Brussels, is expected to show a rate of return on investment of 15 percent.

1 Shinkansen means "New Trunk Line."

2 Train à Grande Vitesse, or High Speed Train.

3 The gauge of all high-speed trains so far built is 1435 mm, known throughout the world as "standard gauge."

High-Speed Trains Overseas

A full-size mock-up of a new generation of Shinkansen trains.
– Japanese Railways photo

When CSIRO's Dr Paul Wild conceived the idea of a fast Australian train in late 1983, there were only two high-speed systems in existence. Those systems have been so successful that many more are now under construction, or are being planned, in other countries. Here is a summary of these new developments.

The main reason why high-speed railways are profitable is that they are used much more, and are much more productive because of their speed, than conventional trains. Expenditure on trains, the lines on which they run, and the salaries of staff who operate them is more than balanced by high income from fares.

The main factors in high-speed trains' popularity are their:

- speed,
- comfort,
- price (usually less than competing air service fares),
- convenience (including the ability to operate between city centres, short check-in times, and punctuality in all weather conditions), and
- frequency of service.

In France especially, enormous savings have been achieved by reducing the volume and cost of earthworks. This followed recognition of the "roller-coaster effect," whereby kinetic energy (the energy of movement) at high speeds improves the trains' ability to climb steep grades.[4]

It is very much cheaper (as well as being less intrusive on the environment) to build a line that virtually follows the natural undulations of the land — instead of cutting deeply through hills and running on high embankments to keep a level grade, as conventional railways do.

The VFT, following this lead, will have grades as steep as 3.5 percent (the line climbs 1 metre for every 28.6 metres travelled). Conventional Australian railways normally have ruling grades of 1.5 percent (1 in 67). A saving of the order of $2 billion in civil construction costs will be achieved by this fundamental difference between high-speed and conventional railways.

Japan

Work is continuing on the link between Ueno station and Central station in Tokyo, to provide a common terminal for the northern and southern Shinkansen systems. Four new sections of line: Morioka to Aomori, Takasaki to Komatsu, Hakata to Kagoshima and Fukushima to Yamagata, have been approved. The first to be completed will be the line to Yamagata, scheduled to open in 1992.

To reduce costs, some sections of these lines are being built to modified standards:

- either the existing narrow-gauge line will be converted to standard gauge, with only minor improvements to its alignment,[5] or
- new high-speed alignments will be built, but narrow-gauge track will be laid as an interim measure.

Among several new rolling-stock developments in Japan, the most interesting is the recent order for a prototype of a train which will cut the time from Tokyo to Osaka to 2 hours 30 minutes by travelling at 270 km/h. The planned target is 300 km/h. Production units are expected in 1991–92. The 16-car train will have 1 323 seats.

France

In France, the first stage of the *TGV-Atlantique*, from Paris to Le Mans, was opened in September 1989. The second leg to Tours will open this year. Also under construction, or committed, are:

A TGV of the type introduced in 1980, speeding through French farmland similar to Australia's. – John Nicolson photo

4 The enormous significance of kinetic energy in high-speed train operation is shown by two trains whose drivers cut off the power at the foot of a 40 metre hill and coast to the top. A train travelling at 100 km/h when the power was cut off would come to rest at the summit; a train travelling at 350 km/h (the projected cruising speed of the VFT) would pass over the summit at 335 km/h.

5 Alignment: the line's actual location on the route. Alignments of the existing lines often have tight curves, which must be increased for high-speed running. This measure would be ineffective in Australia, as the VFT's curves will be about 20 times broader than ruling curves on the State-owned Sydney-Melbourne line.

- an extension of the *TGV-Sud Est* to Valence, by–passing Lyon;
- the *TGV-Nord* linking Paris with Brussels and London via the Channel Tunnel; and
- a line connecting the *TGV-Nord* and the *TGV-Sud Est* via a high-speed route east of Paris.

Other new TGV lines are planned, including a further extension of the *TGV-Sud Est* route to achieve a Paris-to-Marseille timing of three hours over a distance of some 750 km. Traffic growth on TGV services has been such that the French Railways are turning to double-deck TGV trains to gain increased capacity. These trains are likely to be used on shorter journeys such as those from Paris to Lyon and Lille.

The present world speed record of 482.4 km/h (almost 300 miles per hour) was set by a TGV–A on 5 December 1989.

Britain

In Britain, plans have been announced for a new high-speed line to link London with the Channel Tunnel. It will be financed by the private sector, and is likely to be completed in 1997 or 1998 — although the tunnel itself will be opened in 1993, using existing rail connections on the British side for four or five years. When the British high-speed line opens, the journey from London to Paris will take 2 hours and 30 minutes. The London-to-Brussels journey will take 2 hours and 15 minutes. With these timings, 50 percent or more of air travellers on these routes are expected to switch to rail.

The Channel Tunnel

The Channel Tunnel between England and France is a specialised railway project scheduled for completion in mid–1993. All traffic through the tunnel will move by rail at a speed of 160 km/h. Cars will be carried on shuttle services between terminals at either end. High-speed passenger trains will use the tunnel as mentioned, and conventional freight trains will also be operated. The construction and operation of the tunnel is a private-sector project.

Italy

The Italian ETR450 trains achieve their high speeds in part through tilting on curves. They have been running at 250 km/h on the Rome-Florence high speed *Direttissima* since May 1988. Being slower than the French TGV but faster than the Shinkansen, they are the second-fastest trains in the world. In the 1990s, a new generation of ETR500 trains will run at 300 km/h on a high-speed *Alta Velocita* (High Speed) network between Naples, Rome and Milan.

West Germany

In West Germany, a fleet of 40 Inter-City Express — ICE — trains is being built to run on the Neubaustrecke between Hamburg and Munich. These trains are expected to enter service in May

The German ICE will enter service in 1991. Speeds of up to 300km/h are planned and a speed of 406.8 km/h has been achieved. – Deutsche Bundesbahn photo.

1991, running at 250 km/h. The prototype *ICE* was the first train in the world to exceed 400 km/h when it set a new record of 406.8 km/h in May 1988 — a record which was overtaken in the following December when a French TGV–A reached 408.5 km/h.

The German Federal Railways are now planning a new link between Köln, Bonn and Frankfurt which will use the steeper "roller coaster" gradients pioneered by the French. The line will operate only passenger trains; they will travel at 300 km/h.

Spain

In Spain, a new high-speed line is to be built to link Madrid with Seville and Barcelona. The trains will be virtually identical to French TGVs; 24 have been ordered for a service to begin in February 1991.

USSR

The present maximum train speed in the Soviet Union is 200 km/h, but plans are being developed for a high-speed Centre-South main line which will link Moscow to the Caucasus and the Crimea. The planned operating speed is 300-350 km/h. The first section could open in 1996.

United States

Many high-speed railways have been proposed in North America, but none has been committed yet for construction. Currently the most likely prospect is in Florida, where two consortia have been short-listed for a franchise to build and operate a high-speed system between Miami, Orlando and Tampa. Selection of the successful tenderer will not be completed until 1991.

The European network

The increasing momentum of high-speed rail developments in Europe has led to the concept of an integrated high-speed network across Europe. Both the EEC Commission and the European Parliament have given it their backing.

High-Speed Trains Overseas

The plan proposes that by the year 2015 there will be a network of 30 000 kilometres available for high-speed operation, which will generally reduce travel times by half. The network will include:

- 8 000 kilometres of totally new line,
- 11 000 kilometres of reconstructed line, and
- 11 000 kilometres of existing routes which already allow high-speed operation.

The proposed network for Europe requires an investment of 88 billion ECUs (132 billion Australian dollars). Some 15 billion ECUs are already funded or committed. Until completion in 2015, about $A5 billion per year will be spent on average.

The European high-speed network project was announced in January 1989 by the Community of European Railways — the railway administrations of the 12 EEC members plus Austria and Switzerland. The project covers infrastructures, rolling stock and the timing of future connections.

The network will be built in several stages, gradually incorporating new links. 1995 will see the completion of current European projects now under way, which total 12 300 kilometres of new or upgraded railway lines. They include:

- the Channel Tunnel,
- the change-over from broad-gauge to standard-gauge track on the France-Barcelona-Madrid-Lisbon corridor, and
- an international project linking London-Paris-Brussels-Amsterdam-Frankfurt (an area with 10 percent of the population of the European Community) by sections of 300 km/h line.

By 2005, most national plans for the upgrading or building of a further 15 500 km of line — in Italy, West Germany, France and Spain in particular — are expected to be completed. Finally, the construction of the remaining missing links will give the network its European dimension.

When the European network is completed, traffic is expected to grow from 110 billion to 420 billion passenger-kilometres:[6] a four-fold increase in just 30 years. This growth, combined with improved productivity, could lead to rail administrations achieving around a 10 percent global rate of return. The over-all rate of return is expected to range from 24 to 28 percent within the first few years of operation. While there is agreement on the basic economic viability of the project, it is not yet known how the project will be financed: the funds could come from either the public or the private sector.

7 Passenger-kilometres are the measure of the task undertaken by a transport system. For example, 10 passengers travelling 10 kilometres represent 100 passenger-kilometres. So also does one passenger travelling 100 kilometres.

Innovative designs have allowed the German ICE to enter tunnels at high speed without discomfort to passengers. – Deutsche Bundesbahn photo.

VFT Topics is a series of information sheets about Australia's high-speed train. The sheets are published individually, as required, to advance public understanding of the project. Publisher: the VFT — a joint venture of The Broken Hill Proprietary Co Ltd, Elders IXL Ltd, Kumagai Gumi Co Ltd and TNT Australia Pty Ltd. The VFT office address is: 5th Floor, Capital Centre, 54 Marcus Clarke Street, Canberra. Address all mail to: GPO Box 2188, Canberra ACT 2601. Telephone: (06) 257 2565. Facsimile: (06) 257 2319.

Single sets of *VFT Topics* are posted free on request. Please inquire for the cost of sending multiple copies.

Series ISSN 1034-3962

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