Bullet Train & Maglev System to Cross the Pacific

By Yoshiyuki KASAI

Central Japan Railway Co. (JR-Central or JRC) established a section called Consultation and Coordination (C&C) in July 2009 in order to promote overseas sales of its high-speed rail (HSR) systems.

The main reason for this decision was to ensure economies of scale outside Japan for Japanese rail-related manufacturers. It will enable them to remain committed to enhancing their production quality, which will in turn help our *Tokaido Shinkansen* HSR to better secure passenger safety and to continue to provide improved service.

Setting Sail on a Fair Wind

Luckily our endeavor will gather a fair wind, as across the world interest is growing in the HSR for its energy efficiency. Indeed the latest model of our rolling stock, named N700, emits just half the amount of carbon dioxide discharged by the first generation of *Shinkansen* bullet trains, one-12th that of a Boeing 777 aircraft and one-15th that of a sedan-type automobile (all measured per passenger), testimony that its energy efficiency is unrivaled.

In promoting overseas sales of our HSR, we started by defining which specific model should be deployed. Our reference model is the "N700-I Bullet," which is based on the N700, the single most advanced model ever built for HSR, whose technological advancement is near perfection.

JRC is willing to provide foreign markets, such as Florida, with the N700-I Bullet. By organizing all the related manufacturers, and in close collaboration with the Japanese government, JRC is ready to provide a turnkey, total systems solution.

Why the Bullet Train?

The N700-I Bullet consists of eight cars, each motored, the total length of which is 200 meters. To compare this with the French TGV and the German ICE, firstly, all three are about the same length at 200 meters, with the TGV comprising 10 cars and the ICE eight.

Secondly, the N700-I Bullet comes with 636 passenger seats while a TGV has 357 and an ICE 413. Yet in terms of roominess – the square meters and leg room available per passenger – the N700-I Bullet offers by far the most space among the three.

Thirdly, measured per seat, the N700-I Bullet weighs only one half as much as either of the other two. It thus emits one half of the greenhouse gas, excelling at energy conservation capacity.

Fourthly, the N700-I Bullet accelerates considerably faster at 3.2 km/h per second, whereas the TGV accelerates at 1.8 km/h/s and the ICE at 2.2 km/h/s.

Fifthly, the *Tokaido Shinkansen* has adopted a system whereby motor power is distributed evenly among the cars. As such, with the N700-I Bullet, the number of cars can be varied in accordance with the ridership without any effect on the efficiency of the motive power. In the case of the TGV, however, motor power is concentrated in the two locomotives that push and pull at both ends. Therefore the smaller the number of passenger cars, the more motor power is wasted. Conversely, when the number of cars is increased, the motor power is insufficient.

Japan vs. Europe: Independent or Dependent

There are two types of HSR in the world: one European and the other Japanese. The HSR in Europe is designed to provide through services into the conventional rail networks. Running on tracks that have level crossings with roads, the European HSR is not immune from the risk of collision, with heavy trucks for example.

Sharing the same rail as bulky freight trains or commuter services pulled by heavy locomotives, the European HSR rolling stock is required to be collision-resistant. It is for that reason a locomotive must always be put on each end and passenger cars must be heavier.

To run on conventional rails, the European HSR must be equipped with multiple signal systems, one for the HSR and others for conventional trains. Thus for the HSR systems in France and Germany, a top priority comes down to enabling joint operations between the HSR and conventional rail, often to the detriment of the efficiency and the safety for the former.

In the case of Japan, when the *Tokaido Shinkansen* was first built, it adopted a standard gauge – different from the narrower gauge then – as now used for conventional rail. Hence tracks for the sole use of *Shinkansen* were introduced, mingling with neither conventional rail nor road traffic. The system itself is built to be as accident-preventive as possible.

Indeed, the *Tokaido Shinkansen* has carried a total of 4.9 billion passengers since its advent in 1964 and in this time there has not been a single accident, let alone casualties. Meanwhile, over time, the rolling stock has been made even lighter and faster, and the service more frequent, while its automated operation, constantly upgraded with no regard to conventional rail, is concentrated at the central command.

Introducing SCMAGLEV

JRC is also introducing a revolutionary new mode of transportation: the superconducting magnetic levitation system or SCMAGLEV. JRC, since its founding in 1987, has developed the SCMAGLEV and succeeded in making the system fully operation-ready.

An 18.4-km-long track, which will eventually be stretched and put into practical use to connect Tokyo, Nagoya and beyond, is already in place in Yamanashi Prefecture, central Japan, and has been used for test-running the new transit system since 1997.

As of April 22, 2010, the SCMAGLEV on that track has covered an

MLX01-901A

N700

Photos: Central Japan Railway Co.

accumulated distance of 783,000 km, longer than a return trip to the moon. It has carried more than 150,000 people. It holds a speed record for a manned train at 581.7 km/h. A government panel examining the practicalities of the SCMAGLEV has already acknowledged that the technological development had been perfected and that the system is ready for commercial application.

A substantial gap in technologies distinguishes the SCMAGLEV from the German system, called Transrapid, that runs in Shanghai. With superconductivity giving its magnets strong power, the SCMAGLEV levitates from the guideway by 100 mm, whereas Transrapid with normal conducting magnets levitates only 10 mm. As a consequence, Transrapid is able to couple a limited number of cars, five at the most, whereas the SCMAGLEV can be composed of as many as 16 cars, making the SCMAGLEV the only maglev system fit for intercity mass transportation.

The strong magnetic power afforded by superconductivity gives the SCMAGLEV a number of advantages. Its maximum operational cruising speed is 500 km/h whilst Transrapid can reach just 430 km/h. Transrapid takes 13.3 km to accelerate up to 430 km/h, while the SCMAGLEV takes only 3.9 km to reach the same speed. Moreover, each SCMAGLEV car weighs about 20 tons. Lighter than its counterpart by 30 tons, the SCMAGLEV consumes 74 Wh/km per seat at a speed of 500 km/h whereas Transrapid would burn 81 Wh/km even at the lower speed of 430 km/h. The SCMAGLEV excels at speed, acceleration, deceleration, and energy efficiency by a large margin.

Where & How?

Where and how are we going to sell the N700-I Bullet and SCMAGLEV? JRC has chosen the United States as its primary market because, given the diversity of transportation demands throughout the huge continent, it poses the greatest opportunity for both systems.

As to how, given the enormity of the initial investment for the high-speed transit system, the government should construct, own and manage the infrastructure, as has been the case with the US interstate highways. The private sector (or the private-public partnership) is to own and run the superstructures. In fact all HSR systems, with the exception of the *Tokaido Shinkansen* whose ridership is so sizeable that it needs no public backing, are sustained in one way or another by public involvement.

Government involvement will therefore be necessary on either a federal or state level. For that very reason, we thought it critically important that we partner with a group of trusted American individuals who are well versed in the US decision-making mechanisms, and networked widely across the government and business communities.

In providing turnkey, total systems solutions, only JRC can integrate all the necessary technologies and operational management know-how by organizing manufacturers. JRC will commit itself principally to consultation and coordination by providing local operators with service instructions, employee training and systems maintenance. It could also make symbolic equity investment into the operator as the seal of its commitment.

The enthusiasm of our US partners and our capacity as a total systems integrator, combined, will lead us to gain orders for our systems, the N700-I Bullet and/or SCMAGLEV.

It goes without saying that in the United States a combination between intra-region automotive transportation and inter-region, long-distance aerial transportation should constitute the mainstay. The systems we are going to introduce will best serve the mid-distance, intercity travel demands like those on the North-Eastern Corridor where the population density offers a sizable scale of ridership.

In order that the HSR systems do not mingle with freight traffic, investment should be made to build dedicated tracks exclusively for the HSR. Some regions appear promising on those grounds. JRC and its US-based partners are engaged in extensive discussions with the local communities to build such systems. We are now focusing our attention on the corridors in Florida (Tampa-Orlando-Miami), California and Nevada, and those in Texas for the N700-I Bullet.

For the Sake of the Alliance

I cannot conclude without laying out my vision for the SCMAGLEV.

Tokyo and Nagoya, the cities that the SCMAGLEV will link in only 40 minutes, are the same distance apart as Washington, D.C. and New York. When a distance that usually takes three hours to travel can be cut to just 40 minutes, a seismic shift will ensue. The SCMAGLEV will fundamentally change the way in which people live and work to such an extent that it could reinvent society per se.

My proposal is that the United States and Japan join and start working *now* to build this revolutionary system side-by-side to bring each nation's foremost artery dramatically closer. The two nations could embark on that journey and in sync usher in a whole new era, where the two nations, the Americans and the Japanese, are on the same leading edge of advancement, each enjoying new ways of life at the same time.

After all, the two countries are allies firmly bound by shared values and interests. The US-Japan alliance will be even more indispensable in coming decades in supplying common good: peace and prosperity in the Pacific and Indian oceans. It is hence to be hoped that working together concurrently on the SCMAGLEV on both sides of the Pacific will underpin the alliance even further. **JS**

Yoshiyuki Kasai is chairman of JRC. He entered Japanese National Railways upon graduating from the University of Tokyo in 1963. He played an instrumental role in the 1980s in privatizing the state-owned rail and creating its regional offspring, one of which is JRC. As president (1995-2004), he led JRC to its listing on the Tokyo Stock Exchange.