SCIENTIFIC AND ECONOMIC BREAKTHROUGH

China Announces Plan To Build 600 km/h Maglev

by Richard Freeman

Oct. 12—China Railway Rolling Stock Corporation announced in late September, a plan to build a 968 kilometer (600 mile) maglev line between the cities of Wuhan and Guangzhou, over which the maglev train will travel at the unheard-of speed of 600 km per hour (360 mph). This train line will be constructed over the next 24 to 30 months.

There is simultaneous discussion in China, of increasing the top speed of its maglev to 1,000 km/h, which is equivalent to the cruising speed of a commercial wide-bodied airliner, and eight times the speed of a motor vehicle.

The announcements indicate that China is taking the next necessary step for mankind's transportation.

This will depend on the revolutionary technology represented by maglev, which takes rail transport beyond the level of the "diesel-electric locomotive," which still predominates in many nations of the world, through the realm of fully electric high-speed rail, and beyond that into the realm of the use of the electromagnetic spectrum for lift, guidance and propulsion—a tremendous scientific leap. This is a reflection of the process through which discoveries of new physical principles create qualitative transformations in human knowledge, which are the basis for entirely new economic platforms.

China is using a method that supplements its scientific work: China uses national planning, in the manner of Alexander Hamilton and Franklin Roosevelt, bringing together thousands of scientists, research labs, universities, business, and high levels of the Chinese government to design and refine a plan. This might be called Hamiltonianism with Confucian characteristics, as it has been assimilated to the best of the 5,000 years of Chinese culture.

CC/MNXANL

A Fuxing high-speed train, Model CR400BF, arriving in Shanghai.

Countries with Most High-Speed Rail in Operation

Rank	Country	Km
1.	China	30,000
2.	Spain	3,100
3.	Germany	3,038
4.	Japan	2,765
5.	France	2,647
6.	Sweden	1,706
7.	United Kingdom	1,377
8.	Italy	1,350
9.	South Korea	1,048
10.	Turkey	745

Source: worldatlas.com, *EIR*

This method is exemplified by the development of China's high-speed rail system: China did not have a single kilometer of high speed rail in 2007; it now has 30,000 kilometers (18,000 miles), leapfrogging over other nations, so that it possesses two-thirds of the world's high-speed rail lines. While China leads, several other countries have also built high-speed rail, although much of their construction has lagged during the past decade (see box).

China is also working on the design of maglev freight trainsets, which could travel at 250 km/h (150 mph), and would upshift China's productive process.

A maglev train leaving Shanghai Pudong International Airport.

Transforming a Region

In 2016, the Chinese Ministry of Science and Technology started "18 national key research and development plans," which included the "China Railway Rolling Stock Corporation (CRRC) starting a special project to research high-speed railcars that reach speeds up to 600 km/h," the Sept. 5, 2017 *People's Daily* reported. The only system that has the technological capability to fulfill 600 km/h would be maglev.

China has experience with maglev. On Dec. 31, 2002, the Shanghai maglev train began operation, running 30.5 kilometers from Longyang Road Station in Shanghai to Pudong International Airport. The train has a rated top speed of 431 km/h (268 mph). The rail line was built by Germany's Transrapid (a joint venture of the German companies Siemens and Thyssen-Krupp). It is still offering regular service—and is now the only maglev line in commercial use anywhere in the world.

Proposed 968 km Wuhan-Guangzhou rail route.

Fourteen years later, in 2016, China set an objective of building a maglev using its own technology. It had acquired much technology from Transrapid, and then produced its own indigenous system, making myriad changes and technological improvements.

Now China seeks to achieve a much greater distance than 30.5 km. By selecting a 968 km route from Wuhan to Guangzhou, the Chinese made a critical choice. The travel between Wuhan and Guangzhou by car is 10-11 hours; by high-speed rail it is four hours; by maglev it would take approximately two hours.

But there is a further objective. The maglev would pass through one of the highest population-density areas in the world. Wuhan, a city of 11 million, is in Hubei province, in central China, whose population is 60 million. Departing Wuhan, the maglev route would pass due south through Hunan province, whose population is 67.5 million, and would terminate in Guangzhou (also known as Canton), a city of 13 million—and a former terminus of the old Silk Road—which is located in Guangdong province, China's most populous, with a population of 106 million people. Were Hubei, Hunan, and Guangdong provinces to constitute a country by themselves, the combined population of 233.5 million would make it the fifth most populous country in the world. A maglev train, traversing this region in a mere two hours, would make it possible to leave Guangzhou at 7 in the morning, and arrive in Wuhan at 9 am, for a full day of activity. It would allow this area to function as a unit. People could quickly and reliably get to educational, cultural, and other events in the region. With a maglev freight capability, travelling at 250 km/h, manufacturing productivity would explode. All of this would increase the potential relative population density of the entire region.

With a success on the Wuhan-Guangzhou route, China would export this maglev model to other parts of the country.

CC/N509FZ

A China-designed Fuxing (Rejuvenation) high-speed train, model CR400AF, departing Beijing. Its standard maximum speed is 400 km/h.

CRRC Building the Maglev

Maglev trains will be produced by China Railway Rolling Stock Corporation, known as CRRC, the world's biggest producer of locomotive trainsets, internal parts and related products. It is CRRC which produced China's High-Speed Rail network of 30,000 kilometers, which connects nearly all of the major cities of China. CRRC Qingdao Sifang, a division of CRRC, completed a 600 km/h first-pass, test maglev train this past May, following three years of research. Five potential designs must be narrowed down to a final one. Next year, a more advanced engineering prototype maglev train will roll off the production line. It will be tested at a test facility still to be constructed. If it performs well, and passes the rigorous and stringent test conditions, construction of the Wuhan-Guangzhou maglev line will be started.

This project is a keystone of China's 13th Five-Year National Plan for 2016-2020, and according to the *Wuhan Evening News* it is part of China's "Building Outline for the Construction of a Powerful Country" initiative.

Maglev: Leaving the 20th Century Behind, Entering the Era of Electromagnetism

Maglev represents the progression of rail travel, recording a notable upward arc in technology and science.

Much of the world's rail systems today, both passenger and freight, are powered by diesel-electric locomotives. Diesel-electric trains, for example, comprise a stunning 99% of the U.S. locomotive fleet. They are completely wasteful. A diesel-electric locomotive carries a diesel fuel tank ranging from 450 to 1000 gallons. The diesel engine combusts the diesel-petroleum fuel solely for the purpose of powering an onboard generator to produce electricity, which then powers the locomotive. Why do that? It could be done very simply, without the diesel engine, by transmitting outside electricity directly to the locomotive. And the diesel-electric locomotive is forced to drag along its own fuel, which degrades the speed, especially on an incline.

For these and related reasons, including design, a diesel-electric locomotive can hit a top speed of 230.5 km/h (132 mph), but usually, for safety, generally operates only in the range of 90-97 km/h (50-55 mph) for freight, and 113-120 km/h (70-75 mph) for passengers.

The braking system on a diesel-electric locomotive is also rather inefficient. It uses an air-pump compressor to direct compressed air as a force to push blocks onto train wheels, or pads onto discs, which combine with a "dynamic-braking system," to slow or halt train.

But even diesel-electric is more efficient than the substitution of long-haul trucking for rail, as is being done in the U.S. today.

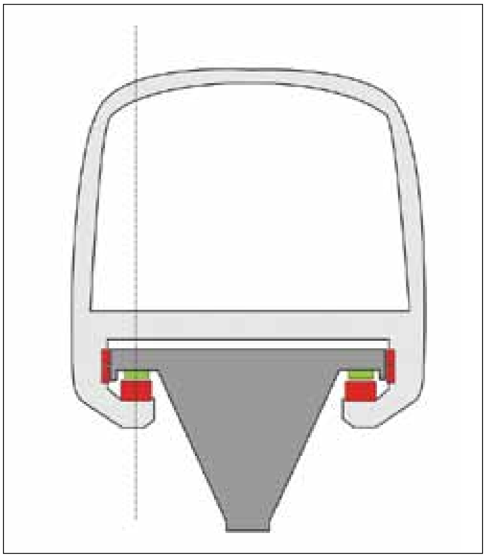
China's high-speed rail (HSR) system first made the big leap of moving directly to full electrification. The HSR train set does not have to lug around its own fuel. The electricity—produced, say, by a nuclear power plant—is transmitted by transmission lines to catenary wires which run above the path of the train. A pantograph device, attached to the top of the HSR train, extends upward to connect to the catenary and thus brings continuous electricity into the train. The electricity is transmitted directly to electric traction motors that power the wheels of each HSR car. Thus, instead of one or two locomotives at the front supplying all the motive power for a diesel-electric train, in high-speed rail, the motive power is supplied by the traction motors attached to bogies of each car, making the high-speed rail train more powerful. Further, electrified trains allow the use of regenerative braking, in which the motors are used as brakes and become generators that transform the motion of the train into electrical power that is then fed back into the lines.

Electric locomotives are quiet relative to diesel locomotives: there is no engine and exhaust noise and much less mechanical noise.

There is a three-fold greater energy efficiency: Diesel-powered trains transfer about 30-35 percent of the energy generated by combustion to the wheels, while supplying electricity from an overhead power line transfers about 95 percent of the energy to the wheels. It is estimated that it is 50 percent less expensive to power a train by electricity than by diesel.

For these reasons, the high-speed rail created a powerful force: China's widely-used electric high-speed-rail Fuxing Hao train, travelling with passengers at a cruising speed of 360 km/h (216 mph), transports those passengers *three times faster* than does a diesel-electric train. High-speed rail is making a worthy contribution to the economy.

But the revolution of magnetic levitation moves a bigger step up the ladder: it more fully explores, and flows from use of the electromagnetic spectrum.



In electromagnetic suspension systems (EMS), C-shaped arms extend downward from the trainset and wrap around a track-guideway equipped with magnets.

Maglev is bare of any wheels. It has neither moving parts, a catenary, a pantograph, or a traditional motor of any kind. How does it do that?

Of the two main streams of maglev, the Chinese use the electromagnetic suspension system (EMS), originally developed by Germany's Transrapid; the other main system is the electrodynamic suspension system used by the Japanese, and originally developed by the Americans James Powell and Gordon Danby.

In EMS systems, the trainset has, extending downward from the trainset itself, what are called "C-shaped" arms, which wrap around a track-guideway. At the bottom of the C-shaped arms are electro-magnets which wrap around and come just under the track-guideway. The track-guideway is also equipped with magnets (see diagram). Turning on the current activates the electromagnets on the C-arms and the guideway, causing attraction, which raises the C-arm towards the track-guideway, thus elevating the trainset. Electromagnetic attraction in the front of the trainset, and electromagnetic repulsion in the rear of the trainset, is then used for propulsion. Employing a synchronous long-stator, the trainset is moved forward, floating on an "electromagnetic cushion."

The system derives from use of the electromagnetic spectrum, replacing one physical object having to make contact with another physical object.

Cascading Benefits

The Chinese maglev, through removing steel wheel-on-rail contact, virtually eliminates frictional forces, which greatly increases speed. This idea is widely known.

The newly-affirmed plans to build a 600 km/h maglev system at the production facilities of CRRC Qingdao Sifang, and to build a test facility for testing during 2020, go much further in the use of science.

The October 4, 2019 *International Railway Journal*, in an article, "China to Build High-Speed Maglev Test Line," reports:

> The [Chinese] test train has a new generation of aluminum-alloy car body which is lightweight while having high strength, and is designed to mitigate aerodynamic resistance and lift. The train features foil windings for the electromagnets and precision casting for the levitation frame. CRRC has developed the levitation and guidance system, speed detection and location detection system as well as the control system. . . . The train has a 24 megavolt-ampere traction converter system and a high-speed and multi-section traction control system. The train will be fully automatic, for which CRRC has developed a new control system.

Most exciting and important, the *IRJ* reports:

> The train uses high-temperature superconducting magnetic levitation technology, which is designed to generate less heat, produce greater

traction, and achieve a higher maximum speed than other types of maglev train.

Superconductivity occurs when a material has a critical temperature below which the resistance drops abruptly to zero. In electrical transmission, that means that when a material is in a superconducting state, the electrical current can be transmitted with very little impedance. Originally, with metals, the temperatures below which they are superconductive, were below 30 Kelvin (–243.2°C). Zero Kelvin is called "absolute zero." But in high-temperature superconductivity, scientists have discovered materials that behave as superconductors at much higher temperatures, as high as 138 K. This means that superconducting magnets could reach superconductivity at higher temperatures, requiring less energy input to keep them cold, making them more efficient and less costly.

Superconducting magnets had not been used in EMS maglev systems before. The Chinese are breaking all the rules.


ASIA TIMES

HIGH-SPEED RAIL INFRASTRCTURE OCTOBER 2, 2019

At 30,000 kilometers, China already boasts the world's most extensive high-speed rail network. Photo: Xinhua

China laying tracks for 1,000km/h maglev trains

If technology proves to be viable, a 2,200-km trip from Wuhan to Guangzhou could be reduced to around two hours

By KG CHAN

China aims to again take the lead in the new global race to make

1,000 km/h Maglev

ZME Science reports, Oct 3, 2019, in an article entitled, "China Will Trial 1,000 Km/h 'Floating Trains' in 2020," that "according to *Changjiang Daily*, the official communications office for Wuhan province, a set of experimental tracks will be laid out early next year in the province that will pave the way for the world's fastest floating trains."

The article states that according to *Changjiang Daily*, a 200 km vacuum-tube test tract will be built, in which a maglev system will be tested that could achieve 1,000 km/h (600 mph) speeds. It is not clear whether this plan interconnects with the plan to be built by CRRC Qingdao Sifang, but even if it is separate or parallel, it is indicative of China's attempt to reach 1,000 km/h.

We Are Coming in Last

China is setting a new path.

Japan is the only other nation in the world that is building an operational maglev system. In 2014, Japan's Chuo Shinkansen (its maglev system) broke ground on its maglev line that is intended to connect Tokyo and Nagoya, a distance of 260 kilometers (159 miles), with a travelling time of 40 minutes. This is scheduled to be completed in 2027. Then the maglev line would be built outward from Nagoya to Osaka, so that the entire 400 kilometer (245 mile) trip between Tokyo and Osaka would take only 67 minutes. This project requires an extraordinary engineering feat: very excitingly, it will tunnel beneath the "Japanese Alps," the Nihon Arupusu.

France, by comparison, began its competent TGV high-speed rail project in the 1980s, and completed the second phase of the high-speed rail Chunnel link in 2007. But while it has done some construction, it has not done much to build out its system since then. It does not have a maglev system.

Germany built most of its high-speed rail ICE system during the 1980s and 1990s, but has not done much of significance to build out its system since then. Germany began planning for its pioneering Transrapid maglev system in the 1970s, and built its Emsland test track in 1987. In 2012, the Emsland track was shut down.

In the United States, 99% of all rail runs on a diesel-electric system, a system more appropriate for the 1950s than 2020. It has but 34 miles of genuine electrified high-speed rail; no maglev exists.

China, having built its 30,000 km high-speed rail network—which it is expanding—is pursuing a path opposite to the pessimism seen with respect to rail in the West. Its high-speed rail and maglev systems will set a standard for the Twenty-First Century. Why can't we do that here?