



China's rail revolution

ABB technologies are helping transform China's rail network into the fastest and most technologically advanced high-speed railway system in the world

CÉCILE FÉLON, FRÉDÉRIC RAMELLA, HARRY ZÜGER – Rail is perhaps the principal means of transporting large numbers of people and goods in China. However, for many decades rail journeys tended to be long and very uncomfortable. In addition, the geographical vastness of the country meant millions simply had no access to any form of rail travel. Then along came decades of strong economic growth that brought with it a desire to open the country up to further development and trade. While this growth has created a middle class who is considerably wealthier than the generations before, the downside is that many have abandoned the bicycle in favor of the car. The result is serious traffic congestion and an increase in China's already fast-growing greenhouse gas emissions.

In addressing these issues, the Chinese government has been generously funding the upgrade of conventional railway lines, and the construction of tens of thousands of kilometers of high-speed passenger lines since 2004. Many home-grown and imported technologies, some of which have come from ABB, are employed to supply a rail network that will be the envy of many countries when it is completed. ABB is the leading supplier of power products – in particular traction transformers and switchgear – to the Chinese electric locomotive segment. The company's strengths and technology leadership are well recognized by its partners in the global rail industry and are fully demonstrated in a variety of projects discussed in this article.



Over the years, countries such as Japan, Italy, France, Germany, Spain and South Korea have developed incredibly speedy train networks. This list can now be extended with the addition of China. In fact as of December 2009, China can boast the fastest express train in the world on what is considered the longest high-speed track on the planet at 1,068 km. The train runs from the central city of Wuhan, through the provinces of Hunan and Hubei and down to Guangzhou at the south coast at a top speed of 350 km/h, transforming a 10.5 hour journey into one that takes no more than three hours!

This is but one example that demonstrates the continuing success of China's ambitious and rapid high-speed rail development program. As the country's economy and population continue to expand, the need to spread economic development is an important goal that is best achieved if a proper and speedy rail network is in place. When the major rail lines are completed by 2020, it will become the largest, fastest and most technologically advanced high-speed railway system in the world.

According to China's "Middle and Long Term Railway Network Development

Plan" the total operating rail network will exceed 120,000 km by 2020, and the percentage of double tracks and electrified railways will surpass 50 and 60 percent respectively. China will complete construction of four north-south and four east-west passenger lines, as well as intercity passenger rail networks connecting developed and densely populated

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areas, with the total length of high-speed passenger lines topping 18,000 km by 2020. Almost three-quarters of this or 13,000 km (8,000 km of which will be 350 km/h lines) is expected to be completed by 2012 [1].

China's high-speed trains use a wide range of domestic and imported tech-

nologies from around the world. For its part, ABB has supplied and will continue to supply advanced power solutions to support China's vigorous railway and urban metro construction efforts.

Transforming rail transport

To begin with, equipment, such as ABB's well-known and innovative traction transformer, has been installed in many of China's locomotives and electric multiple unit (EMU) trains. These transformers are high capacity, compact and light-weight, and are highly resistant to mechanical impact and heat resistance, which in turn makes them very reliable. As essential components of a train, the transformers also contribute to the energy efficiency of rail transportation.

ABB traction transformers first entered the Chinese railway market in 2004 when they were selected for Bombardier's Regina trains, more popularly known in China as CRH1A and CRH1B¹. ABB delivered traction transformers for the CRH1A and CRH1B² EMU trains that

Footnotes

- 1 CRH refers to high-speed trains. The number succeeding these three letters is a reference to the company supplying the train, and in this case "1" represents Bombardier Transportation while "3", for example, indicates the train was manufactured by Siemens. The letter(s) or number(s) that follow – A and B in this instance – refer to the different versions of a train.
- 2 Most CRH1 trains were allocated to the Guangshen Railway to replace all locomotive-hauled trains between Guangzhou and Shenzhen in Guangdong Province. Some are also used on the Shanghai–Nanjing rail line.



can reach speeds of up to 250 km/h (155 mph) in regular service. In September 2009, Bombardier Sifang Power won a further contract to supply the Chinese

In 2009, ABB was contracted by Datong Electric Locomotive Co. Ltd. (DELCO) to assemble traction transformers for the CRH2 (a modified E2-1000 series Shinkansen design from Japan) and to manufacture traction transformers for the CRH5 EMU trains (manufactured by Alstom and Changchun Railway Vehicles). Also in 2009, ABB was contracted to upgrade the traction transformer design for the Ka-

wasaki-derived CRH2-380, an EMU train capable of speeds of up to 380 km/h.

Growth in freight transportation

A growing economy requires better and faster rail freight transportation if such growth is to be sustained. To meet this demand, the Ministry of Railways has also been enhancing its railway freight transportation capacity by increasing and upgrading its entire freight network, with of course the support of ABB → 3.

In 2005, Alstom and DELCO signed a 350 million euro contract to manufacture a total of 180 electric 8-axle locomotives HXD2⁶. This type of locomotive, used by the Daqin railway company Ltd., transports coal to power plants and factories around China. The first HXD2, also known as BoBo, was completed in December 2006 and arrived in TianJing in

January 2007. Also in 2007, these two companies signed another contract worth 1.2 billion euros for the delivery of 500 HXD2B electric 6-axle locomotives. The HXD2B locomotive, also called CoCo in China, was designed by Alstom.

The traction transformers for both the HXD2 and HXD2B locomotives were supplied by ABB to Alstom, in a repeat of what have been past and successful ABB/Alstom collaborations → 4. And finally, ABB will also supply traction transformers for Alstom's HXD2C electric locomotives in the near future.

Switching into gear

Traction transformers are not the only power products supplied by ABB. For the Wuhan-Guangzhou high-speed rail project, ABB supplied a series of other products, including its 27.5 kV ZX1.5-R and 10 kV ZX0 GIS switchgear, as well as the SAFE-series SF₆ insulated switchgear that are used in the railway signal system power supply → 5. The ZX1.5-R GIS switchgear are modular and flexible single busbar two-phase panels and were specially designed at ABB China's medium-voltage technical center to address the highly specific railway power supply requirements of China's electrified high-speed railways. Manufactured by ABB Xiamen Switchgear Co. Ltd., ZX1.5-R GIS switchgear use up to 70 percent less space than other conventional products. Insulation is provided by SF₆, which is well known for its remarkable physical characteristics, especially its excellent insulating capacity. With fewer maintenance requirements, customers are able to lower their total investment and operating costs. Their deployment in substations will help provide safe and reliable power along the entire rail line.

ABB's well-known and innovative traction transformer has been installed in many of China's locomotives and electric multiple unit (EMU) trains.

Ministry of Railways with 80 Zefiro 380 very high-speed (VHS) trains³ → 1. A total of 1,120 rail cars will be built for China's 6,000 km of new high-speed railways and ABB will supply the traction transformers for all these trains.

ABB traction transformers can also be found on some of Siemens Mobility Velaro high-speed platforms (trains) → 2. Known as the CRH3-380, these trains are capable of service speeds of up to 380 km/h and can be seen on the Beijing-Tianjin⁴, Wuhan-Guangzhou and Zhengzhou-Xi'an dedicated passenger lines. The transformers were supplied by ABB Datong Traction Transformers Co. Ltd.⁵ (CNDAT), after being awarded the contract by Tangshan Railway Vehicle Co. Ltd. (TRC) and Changchun Railway Vehicle Co. Ltd. (CRC), two of the main train makers in China's railway market.

Footnotes

- ³ The Zefiro 380 very high-speed (VHS) trains are based on Bombardier's Regina family
- ⁴ The first three 380 km/h EMU trains went into operation on the Beijing-Tianjin dedicated passenger line prior to the opening of the Olympic Games in Beijing in 2008.
- ⁵ ABB Datong traction transformer Co. Ltd. (CNDAT) was founded in 2005 and is a joint venture between ABB (China) Ltd. and Datong Electric Locomotive Co. Ltd.
- ⁶ Until now, the HXD2 locomotive has been considered the best – in terms of power (10,000 kW) and speed (maximum of 120 km/h) – heavy-load freight train in China.

3 Some passenger and freight railway facts and figures for China

- Some 33,300 freight trains running everyday transported approximately 3.3 billion tons of merchandise in 2007.
- Each year, the transport of goods, such as coal, iron and food increases by about 200 million tons
- In 2008, 68 new projects were started to develop 11,306 km of (freight and passenger) railway.
- At the end of 2008, there were 18,437 locomotives in China, including 6,305 electrical locomotives.
- At the end of 2009, the length of the rail network in China was 86,000 km. By 2012, it is expected to increase to 110,000 km.

As well as traction transformers, ABB supplied its 27.5 kV ZX1.5-R and 10 kV ZX0 GIS switchgear, as well as the SAFE-series SF₆ insulated switchgear for the Wuhan-Guangzhou high-speed rail project.

4 Alstom's HXD2B electric locomotive. Source Alstom Transport pictures press



The very same switchgear are also used in the Zhengzhou-Xi'an express passenger line, which spans 485 km and is capable of supporting a top speed of 350 km/h. The travel time between the two cities, Zhengzhou in central Henan and Xi'an in the northwestern Shaanxi province, has been slashed from six hours to less than two. The line, part of a major east-west railway artery between Xuzhou in Jiangsu province and Lanzhou in Gansu went into operation in February 2010 [2]. In addition to the Wuhan-Guangzhou and Zhengzhou-Xi'an express passenger line projects, ABB has also participated in the Wuhan-Hefei, Shanghai-Hangzhou, Shanghai-Nanjing, Ningbo-Taizhou-Wenzhou, Wenzhou-Fuzhou, Fuzhou-Xiamen and Guangzhou-Shenzhen-HongKong line projects. In the urban metro sector, ABB has contributed to metro and light rail construction projects in Beijing, Shanghai, Guangzhou, Shenzhen, Nanjing and Changchun.

Sharing knowledge

In January of this year, ABB announced it would set up the ABB Electrified Railway Training Center in cooperation with Beijing Jiaotong University⁷ → 6. The center, complete with advanced railway traction power equipment donated by ABB, will support the development of the high-speed electrified railway industry in China by providing teaching, scientific research and training facilities for both the technical personnel employed by the Ministry of Railways, and teachers and students of the university. It will also organize ex-

change activities to share leading rail technology with other institutes.

According to the agreement, ABB will donate advanced railway traction power equipment, including gas-insulated switchgear, vacuum circuit breakers, insulated ring main units and models of box-type substations specially designed for railway use. In addition, ABB's senior technicians will provide training on a regular basis. After its establishment, the center, affiliated to the Electric Traction Education Department, will serve as the university's engineering research center.

Pierre Comptdaer, vice-president of ABB China, said that "ABB ... closely cooperates with a number of nationwide universities. Working with the country's leading universities not only bolsters innovation at ABB, but also helps to cultivate new talent for the development of many industries." Chen Feng, vice-president of Beijing Jiaotong University, added that "Cooperation on electrified railway training ... promotes vocational training while improving our ability to conduct leading edge research. The training center will allow us to ... support the rapid development of China's railway construction."

Footnote

⁷ Beijing Jiaotong University, under the jurisdiction of the Ministry of Education, is an official training school of the Ministry of Railways and is famous for its innovations in railway technology.

5 ABB's ZX1.5-R gas insulated medium-voltage switchgear for railway application



This is not the first collaboration between ABB and a Chinese university. In fact, ABB has consistently supported education in China to ensure the availability of highly skilled technicians. For example, in 2008 the company set up the ABB Power Technology Education Center in Tongji University and supplied it with a complete set of transformer substation and feeder automation products as well as primary products, such as medium-voltage switchgear, a ring main unit (RMU) and outdoor products, to encourage more advanced teaching and research. In addition, ABB also cooperates with Tsing-Hua University, North China Electric Power University, Tianjin Univer-

The ABB Electrified Railway Training Center, in cooperation with Beijing Jiaotong University, will support the development of the high-speed electrified railway industry in China.

sity, Shanghai Jiaotong University and Chongqing University on various research projects.

Being connected

By improving connections, China's high-speed rail network will no doubt make travel available to ever larger numbers of

6 ABB and Beijing Jiaotong University set up the Electrified Railway training center



Pierre Comptdaer, Vice President of ABB China (left), Chen Feng, Vice President of Beijing Jiaotong University (right)

people. In fact, high-speed rail is likely to be just as fast as air travel at half the price! According to Si Xianmin, chairman of China Southern Airlines, the largest domestic airline by fleet size, "High-speed rail has three advantages over air travel: it is more convenient, more punctual and has a better safety record. This could help erode the airlines' market shares." [3] In addition, a good rail network may help spread economic development more quickly and evenly around the country.

The success of ABB in the Chinese Railway market is based on the close cooperation between ABB Sécheron and ABB Datong → 7. While ABB Sécheron is the global leader in design, research and development, marketing and sales as well as service of power products for the rail sector, ABB Datong focuses on the production of traction transformers for the Chinese market. ABB is currently positioning itself in the Chinese EMU market to become the supplier of choice of power products and systems for China's increasing number of commuter trains.

7 The International Railway Industry Standards (IRIS)

ABB Sécheron, ABB's center of excellence for power products for the rail sector and ABB Datong Traction Transformers Co. Ltd. are both certified by the International Railway Industry Standards (IRIS). IRIS is an internationally recognized standard for the evaluation of railway industry management systems. It was developed by UNIFE, the Independent Association of European Railway Industries, and is supported by system integrators, equipment manufacturers and operators such as Bombardier Transportation, Siemens Mobility, Alstom Transport and Ansaldo Breda. An interview with the Director General of UNIFE, Michael Clausecker, can be found on pages 8 to 13 of this issue of ABB Review.



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