

# Experience in operation and maintenance of Shanghai Maglev Demonstration Line and further application of maglev in China

Wu Xiangming

*National Maglev Transportation Engineering R & D Center, Shanghai, P.R.China*

**ABSTRACT:** This paper systematically sums up the operation and maintenance of Shanghai Maglev Demonstration Line and the experience gained since it was open to traffic. It also describes the research achievements and the prospect of further maglev project in China.

## 1 GENERAL

Shanghai Maglev Demonstration Line (hereinafter referred to as “Shanghai Maglev Line”) began its construction on March 1, 2001. With the joint efforts of the Chinese and German experts and the arduous work of 22 months of both parties, the first maglev vehicle composed of 3 sections succeeded in its trial run on a single track on December 31, 2002. Following over 12-month system commissioning, Shanghai Maglev line was officially put into trial revenue service as of May 1, 2004, running 9 hours per day in the initial period and currently 14 hours. From its trial run on a single track on December 31, 2002 to the end of May 2006, the maglev train has been in stable and safe running for more than 1250 days in total. It has covered over 2.5 million km and carried passengers of approx. 7 million person times by 60,000 runs. During this period, there is neither occurrence of accidents related to operation safety or incidents of passengers being forced to get off or long intervals during operation nor occurrence of passenger complaints against our faults, which fully exhibits the reliability of maglev system and its flexibility in operation patterns. During the period of trial operation, the maglev train had run with the highest speed of 430 km/h in the multiple modes including cyclic operation on double track, shuttle operation separately on double track and shuttle operation on a single track, fulfilling 99.91 % of the time table and 99.81 of punctuality. Even in the bad weather with thick snow of 40 millimeter or wind speed of 31.7 meter per second, it still ran safely at full speed on the hour. Up to the present, more than one hundred foreign leaders have experienced the highest speed of the ground transportation on the earth and affirmed the new high speed maglev technology. In April 2006, Shanghai Maglev Line Project passed national acceptance and was officially put into commercial operation.

The practice of operation of Shanghai Maglev Line demonstrates that conventional conductive high speed maglev technology is generally mature and will have a promising future with further technical improvement and cost optimization.

## 2 EXAMINATION AND MEASUREMENT OF OPERATION PARAMETER

In combination with operation and maintenance, we have conducted series of examination and measurement. The relatively significant items of the data are now introduced as follows:

- **Guideway settlement after construction**  
The guideway system is based on the pre-stressed reinforced concrete hybrid girder that was developed by fully utilizing the local resources and in full consideration of the soft ground of the alluvial plain at the entrance of Yangtse River. Its settlement tends to be stable after over three-year operation. The mean settlement value after construction is 16.8 mm and individual maximum value is 65.2 mm. There are only 23 points where the difference between the settlements of adjacent pillars exceeds 5.5 mm, accounting for 1.9 % of the total points. The pre-equipped adjustable bearings can be used very conveniently to adjust the guideway system and maintain stable operation of the system.
- **Noise inside the vehicle**  
The noise inside the vehicle is 81 decibel as the vehicle runs at the speed of 430 km/h. This value proves that under the present sound insulation condition inside the vehicle it is unacceptable for the passengers to travel a long trip at the speed of 500 km/h in such environment. Therefore we have searched for the main acoustic transmission

paths and will make further improvements in this regard to the maglev train used on Shanghai-Hangzhou Maglev Line.

- Ride comfort

The majority of ride comfort indexes of TR high speed maglev train fall below 2.0, which means “super comfort” (< 300 km/h) and “very comfort” (300 - 400 km/h) inside the vehicle. Operation experience tells us that whether or not the anti rolling equipment of the vehicle is in good condition has big effect on ride comfort. To maintain good ride comfort, besides strengthening maintenance, we also hope that the manufactures can make related research and take improvement measures.

### 3 RULES AND REGULATIONS ON OPERATION MANAGEMENT

To strengthen the operation and maintenance management of Shanghai Maglev Line and ensure safe operation, Shanghai Maglev Transportation Development Co. Ltd has written 13 new manuals of rules and regulations for operation and maintenance on the basis of the rules and regulations for commercial operation and maintenance written in the initial period of trial operation and the accumulated experience since commissioning. The thirteen manuals are “Operation Guidelines”, “Rules for Operation and Maintenance”, “Safety Management Rules”, “Safety in Working” “Incident Management Manual”, “Manual for the Personnel in Control Center”, “Manual for Communication and Information Exchange”, “Manual for Safety Management of Special Vehicles”, “Maintenance Management Manual”, “Manual for personnel in the station”, “Management Manual for Emergency Plan”, “Manual for On-board Personnel” and “Manual for Management of Training”. In addition, to better guarantee safe and stable operation of Shanghai Maglev Line and reduce failure rate, we have also compiled “Procedures for Rapidly Handling 26 Typical Failures” and “Procedures for Organizing Operation under Abnormal Operation Situation”, which improves the response time in the case of system failure and guarantees punctuality of the train.

### 4 OUTLOOK

The practice of Shanghai Maglev Line has proved that the high-speed maglev technology is generally mature, safe and applicable and indeed features energy-saving, environment friendly and land saving and etc. However, its applicability on medium and long distance line has to be further verified. The

system economic efficiency is still a major obstacle preventing it from further extension and application. In fact, the Berlin-Hamburg Maglev Project was forced to be given up as a result of the unfavorable economic effects.

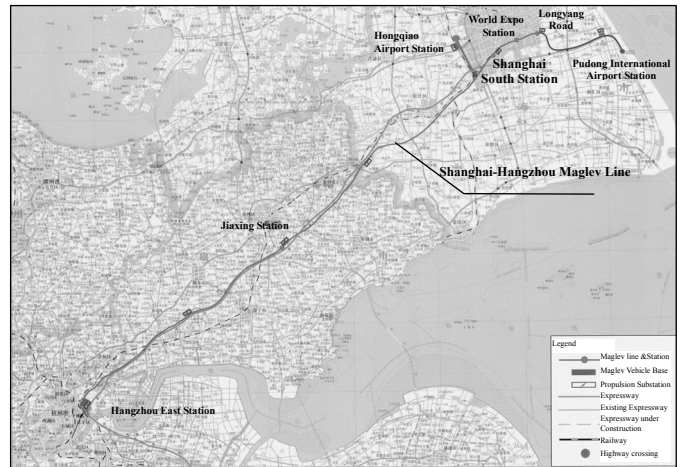


Figure 1: Schematic map of Shanghai-Hangzhou Maglev Line

To seek further development of high speed maglev technology, entrusted by the relevant authority of P.R. China, SMTC has made sincere and friendly discussion with the German industry. In October 2005, SMTC reached common understanding with Siemens AG and ThyssenKrupp GmbH respectively that “economic efficiency of high speed maglev technology shall be a prerequisite to any commercial application of this technology in China” and signed a memorandum of understanding. On the basis of the above results, Proposal for Shanghai-Hangzhou Maglev Project was approved by the Chinese government and feasibility study was agreed to be conducted.

In the following I would like to introduce to you the related information of Shanghai-Hangzhou Maglev Project.

Shanghai-Hangzhou Maglev Project is to extend and develop Shanghai Maglev Line. It begins at Longyang Road Station of the existing line, runs westward via World Expo Station, Shanghai South Station, Hongqiao Airport Station and Jiaxing Station to Hangzhou East Station, the terminal. Approx. 197 km main line will be built. There may be 3 optional operation patterns, namely between Pudong International Airport and Hangzhou East Station, between Hongqiao Airport Station to Hangzhou East Station and between Hongqiao Airport Station and Pudong Airport Station. To save land and reduce environmental burden, the new line will run along the existing railway and highway.

In consideration of factors such as operation cost, energy consumption and environmental effect, the maximum running speed of the train is specified to be 450 km/h in the intercity section and 200 km/h in

the urban area. The design standards of horizontal profile, longitudinal profile, and infrastructure shall meet the technical requirements of the demonstrative speed of 500 km/h.

Shanghai-Hangzhou Maglev Project shall be a leap of the development of maglev technology on the basis of Shanghai Maglev Line. It is crucial to further verify the applicability and economic efficiency of high speed maglev technology on medium and long line. It will not only create “same city effect” within the three areas of Hangzhou, Jiaxing and Shanghai to enable resources sharing, but be able to extend its scope of its utility as a new operation mode in which the high speed train runs into urban area will be developed on the section of the line in Shanghai area.

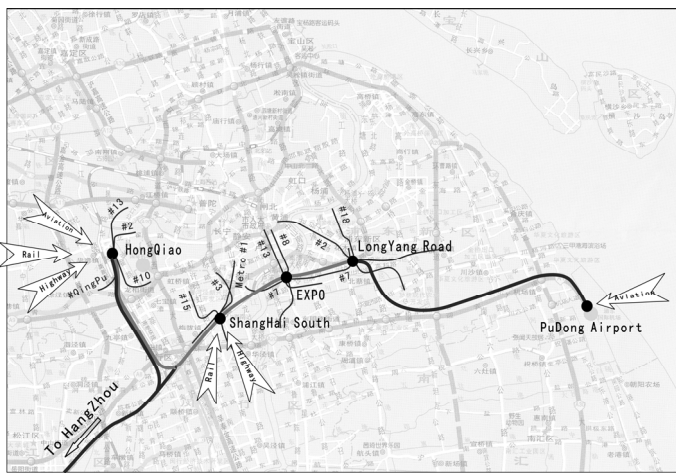


Figure 2: Station layout in the urban area of Shanghai for Shanghai-Hangzhou Maglev Line

I sincerely hope that the Chinese and German sides will continue their friendly cooperation on the basis of mutual benefit and in pursuit of win-win results so as to show to the whole world the advantages of high speed maglev technology through Shanghai-Hangzhou Maglev Project.