

# **Governmental Cooperation Between China and Germany in the Field of Maglev Technology & Our Understanding of the Future Development of Maglev Technology**

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**Abstract:** As a project of successful cooperation between the governments and enterprises of China and Germany, the Shanghai Maglev Demonstration Line Project has been given great concern and much support by the governments of both countries in the whole process from the setting up of the project to its implementation. Encouraging achievements have been made in the cooperation in safety approval as well as in joint measurements on the Shanghai Maglev Line and TVE Test Line. The bilateral cooperation at the governmental level will play a very active role in the new and further-development plans and new application projects. The author presents some viewpoints about the application and development of the maglev technology on the basis of the construction of the Shanghai Maglev Line and the researches on the maglev system.

The world's first high-speed maglev commercial operation line which has been in its revenue service is the first commercialized application of the maglev technology as a new type ground rail transportation. The successful construction and operation of the Shanghai Maglev Demonstration Line enlightened us a great deal through its 15-month trial operation and nearly 6-month fully commercial operation. In the process of construction, we acquired both precious knowledge of the practical construction of the system and a rational understanding through profound and systematic research into the development and application of maglev technology. Meanwhile, the cooperation between the Ministry of Science and Technology of China and the Ministry of Transportation, Housing and Construction of Germany has provided significant support to the completion of Shanghai line.

## **1. Cooperation between the Ministry of Science and Technology of PR China and the Ministry of Transportation, Housing and Construction of Germany**

Shanghai Maglev Demonstration Line is a project of successful cooperation between the two governments and the enterprises from the two countries. Close attention has been paid by the two governments to the whole process from the setting up of the project to its implementation. In January 2001, with the active promotion and support of the two governments, SMTDC and the German Consortium of Transrapid Project signed Contract of Supply and Service for Shanghai Maglev Line

and Contract on Technical Transfer of Maglev Transrapid Hybrid Guideway System. In March 2001, the Shanghai project was started officially. On May 23, 2001 the Ministry of Science and Technology of China and the Ministry of Transportation, Housing and Construction of Germany signed the memorandum concerning the exchange and cooperation in the field of maglev technology in Beijing. On March 23, 2004 they signed the minutes of meeting of the talks on the same theme.

The cooperation between the two governments is focussed on Germany helping China achieve the success of Shanghai Maglev demonstration line with its many years' experience in the development, experiment and certification of maglev transportation; on jointly making use of the Transrapid test line in Emsland (TVE) and Shanghai Demonstration Line, to continue the further development and promotion of the technology; and on promoting the exchange and cooperation between the industrial circles of the two countries through the exchange and cooperation between the two governments.

In accordance with the principles of the memorandum, concrete bilateral cooperation and exchange has been organized by Energy and Transportation Division of Hi-tech Department of the Ministry of the Science and Technology of China and Maglev Project Investment Department of the Federal Ministry of Transportation, Housing and Construction of Germany. So far, eight working meetings have been held, at which both sides exchanged information about the construction of the Shanghai maglev project and the progress and development of maglev project. Some cooperative programs agreed on at the meetings include the cooperation in such fields as the safety certification and approval for the Maglev train trial operation on single track, noise measurement and comparison for TVE and Shanghai Demonstration line, the riding comfort measurement of the Shanghai Maglev train and the aerodynamic measurement of the vehicle intercrossing. The cooperation played a very significant role in undertaking the integrated assessment of the whole system and guaranteeing the safe operation of Shanghai Line.

### **1.1 Cooperation in the Safety Assessment and Approval of Shanghai Maglev Demonstration Line**

On June 28, 2002, within the framework of governmental cooperation between China and Germany in the field of maglev technology, leading officials in charge of maglev project from the Ministry of Science and Technology of China and the Federal Ministry of Transportation, Housing and Construction of Germany signed the "Agreement on Cooperation of Safety Assessment and Approval of Shanghai Maglev Project" in Shanghai. The theme of the cooperation is that the EBA assists Shanghai High-Speed Transrapid Project Construction Headquarters in the safety assessment and approval of Shanghai maglev project.

Under the concern of the Ministry of the Science and Technology of China and the Ministry of Transportation of Germany, Shanghai High Speed Transrapid Project Construction Headquarters and the EBA have actively performed the agreement and the work plans by holding regular work meetings and finishing a lot of effective work. The good cooperation between the two sides has played an important role in our understanding of the German maglev safety assessment and approval system, in our preliminary establishment of such a system in China's Maglev transportation & engineering project, and in the implementation of Shanghai maglev project. The cooperation also helps the German side to learn the progress of the Shanghai maglev project, especially the progress concerning the safety

assessment and approval and to prepare for the safety certification of the maglev projects in Germany. EBA provided a part of the German maglev legislation to Shanghai Maglev High-Speed Transrapid Construction Headquarters and assisted it in the examination of a batch of the safety assessment documents.

In the middle of December of 2002, the executive director of the German side assisted Shanghai Maglev High-Speed Transrapid Construction Headquarters to examine the application documents for the safety approval of the trial operation of the Shanghai Demonstration Line and gave a positive conclusion in the examination report. The above work played the role of helping Shanghai Maglev High-Speed Transrapid Construction Headquarters to ratify the safety approval of Shanghai Maglev Demonstration Line and to issue a licence of the single-track trial operation with passengers to the SMTDC.

In November of 2003, the two sides held the sixth work meeting in Shanghai and discussed in-depth such themes as the safety assessment of the Shanghai maglev system, stipulations of EBA in Assurance of Type Approval for vehicle and guideway switch, safety assessment of OCS, safe trial operation of OCS and concept of safety assessment. The German side gave us many important suggestions concerning the issue of temporary operation licence.

In April of 2004, the two sides held the seventh work meeting in Shanghai and discussed such issues as the solution to the restrictions on the double-track trial circular operation with passengers of Shanghai line, the safety approval of commercial operation, the supervision of safe trial operation as well as the progress of the approval of Munich line in Germany.

## **1. 2 Cooperative Measurements on Shanghai demonstration line and TVE test line**

During the governmental cooperation work meeting held in March of 2002, the two sides agreed to support the cooperative measurements of vehicle and guideway. At the meeting in November of 2002, both sides agreed to include the noise measurement, aerodynamic measurement and riding comfort measurement into the framework of the governmental cooperation.

### **A. Noise Level Measurement and Comparison**

In December 2002, just before the official demonstration operation, it was found from initial measurement that the noise emitted by the train on Shanghai Maglev guideway was higher than that measured on TVE, Germany. In order to clarify the reasons for the difference of noise measured, both sides organized a joint measurement team and worked out a research program for measuring and comparing the noise levels of TVE testing line and the Shanghai Maglev Line. In May, 2003, along TVE testing line measurements were carried out of the noise level in the vicinity of several typical guideway girders. In July, 2003, noise measurements were performed both inside the vehicle and along the guideway of the Shanghai Maglev Line, aiming at providing a vital basis for the future improvement.

### **B. Aerodynamic Measurement**

Vehicle intercrossing test, being one of the most important items of maglev vehicle type approval, has great bearing on the rationality of the requirements for the maglev vehicle designed loads and the center-to-center distance of the guideway. TVE testing line is single track guideway, so it is not entitled to carry out the test of intercrossing of two maglev vehicles. However, windwall test was carried out on TVE line and the value of air pressure fluctuation during the intercrossing of the vehicles was derived on the basis of the experience of the intercrossing of two high-speed

wheel-on-rail trains, but no test verification was available. The Shanghai Maglev Demonstration Line, being a double-track line, gives conditions for the test of intercrossing of the maglev vehicles.

By the time of June 2003, with the smooth commissioning of the line, the Shanghai Maglev Demonstration Line had the conditions for the test of the intercrossing of two maglev trains on the two tracks at a speed of 430 km/h. Thanks to the concern and support of the responsible persons in charge of the maglev technology R&D of the Chinese and German governments, experts were organized and a program for the vehicle intercrossing test was worked out. In July, while a measurement of noise level was being carried out, comprehensive measurements of the pressure waves during two-vehicle intercrossing and a measurement for the deformation of vehicle doors and windows relative to vehicle floor caused by vehicle intercrossing were performed at the same time. These measurements provided a reference basis for the successful passing the type approval of vehicles and for further optimization.

### C. Riding Comfort Measurement

In addition to the noise and aerodynamic measurements on the Shanghai Line, the Chinese and German measurement personnel conducted riding comfort measurements respectively and evaluated them in accordance with ISO 2631 standard. A unanimous result was obtained by the two sides, i.e. the riding comfort of the TR maglev vehicle operating on the Shanghai Demonstration Line had reached “Excellent” level.

## **2. We Acquired More Objective and Practical Knowledge of the Maglev Technology by Summing up the Experience of the Construction of the Shanghai Line and by Constantly Pursuing In-depth Research of the Technology.**

The original intention of the construction of the Shanghai Maglev Demonstration Line was to provide basis for decision-making for the long distance high-speed transportation lines, yet for the present time, no mature experience and technology suitable for application in long distance lines and no feasible and practical scheme for the reduction of construction costs and localization are available, and system perfection and accumulation of operation experience will be needed for the maglev technology to be applied in long-distance lines. Therefore the successful construction of the Shanghai line cannot account for the feasibility of its application in long-distance lines. In the light of our research on the situation of transportation development in our country, we proposed that a medium-distance line (about 200km) be built to further study of the a.m. problems. Only by doing so, will it be possible to realize the survival and development of high-speed maglev technology.

With regard to high-speed wheel-on-rail technology in China, it has also made considerable progress through R&D for localization in the past ten years. Almost at the same time when the Shanghai Maglev Demonstration Line was built, a section of railway totaling about 60 km long was established for high speed test purpose along the newly-built railway from Beijing to Qin Huang Dao, on which an operation test was carried out for a home-made train running at the max. speed higher than 300 km/h. Similarly, there has been on feasible plan for the time being for high-speed wheel-on-rail system’s application at long-distance lines. In spite of this, it is possible for the both types of the ground high-speed transportation systems to be applied in China and the importation and localization of both type of transportation are being studied. Recently work for technology importation

and localization for 200km/h-class train is underway, which will lay a foundation for the development of still higher speed trains.

Gradual realization of optimized designing and localization of production by making use of local resources in conjunction with compliance with local environmental conditions and operation requirements, the perfection of the system and reduction of cost, and the enhancement of the system survival ability in respect to environment and economy - these are the keys to the development and application of high-speed rail transit system in China.

At present the basis for the application of high-speed maglev transportation system is weak comparing with the high-speed wheel-on-rail system. Within a certain period of time, the development of maglev transportation will still need sustained support from the government instead of relying only on the market. The further development and application of Transrapid in Germany and the potential application projects in China and in the United States of America must have tremendous support from their respective governments. The bilateral cooperation at the governmental level will play a very active role in the new and further-development plans and new application projects.

Through studies we hold:

- 1) It conforms to the future development orientation of economic society i.e. a sustainable development strategy and an energy resource policy to transfer a big volume of passengers from the airplane and automobile to high-speed rail transportation which does not rely on oil;
- 2) Development of high-speed maglev transportation is beneficial to the technological upgrade and structural adjustment of domestic traditional manufacture industry, thus bringing about newly rising industries.
- 3) Maglev transportation being used as trunk line transportation between cities at a medium- and long-distance apart may give play to a max. degree to the one-city effect and the complementation of resources.
- 4) The successful construction of the Shanghai Maglev Demonstration Line helps the Chinese society to be more aware of the maglev system than other countries and face the important opportunity in developing maglev transportation.
- 5) The high-speed maglev transportation system employed in Shanghai Line is safe and technically applicable.
- 6) It is necessary to optimize the system and reduce its economic costs in order to further promote its application. In particular, it is also necessary to conduct researches of localization for improvement of environmental compatibility.

### **3. Implementation of Future Maglev Projects**

The application of maglev technology as an innovative ground high-speed transport technology is concentrated on the construction of transportation infrastructures, which should be implemented under the unified planning and support of the government and no one should expect sufficient market returns to be brought about before it has grown into a considerable scale. Therefore during the stage of technology development, it is impossible to complete technology perfection and optimization by relying on the investment from the enterprises. The development of high-speed maglev is now still at the stage of opening up market and striving for space to live in. It can be understood that some involved enterprises look forward to obtaining better commercial returns or wish to get return of

previous investment in R&D through one or two projects. On the contrary, such looking-forward or wish may probably become a hindrance to the advance of maglev transportation technology, or may cause the previous projects to be incapable of economic bearing or to be given up due to unreasonable economics.

In order to push ahead further researches and development of maglev technology both the Chinese government and German governments have worked out their respective R&D plans for system optimization and perfection by making full use of the existing Shanghai Demonstration Line and German Test Line. Both countries possess the good foundations for the development of maglev technology. It will conform to the common benefit of both sides to jointly make use of the existing conditions and resources to push forward to the further development of maglev technology. At present, the argumentation of the Munich Transrapid Project is underway in Germany while in China the argumentation of the extension of Shanghai Maglev Line is going on.

On March 23, 2004, the Minutes of Meeting of the new cooperation meeting was signed in Berlin by the representatives of the Ministry of Science and Technology of China and the Transportation Ministry of Germany. Both countries intend to cooperate in the respects of system optimization, cost optimization and the safety approval of application lines and in planning and executing new application projects.