

Achievements of Shanghai Maglev Demonstration Operation Line and the Maglev Development Strategy

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1. Overview

Shanghai Maglev Demonstration Operation 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. System commissioning on both tracks was completed in the year of 2003, realizing automatic cyclic turn-round operation of 2 vehicles and 3 vehicles on both tracks, the intercrossing of 2 vehicles at the maximum speed of 430 km/h, the cyclic operation of train formation of 2, 5 and 8 sections and the maximum speed of 501 km/h for a 5-section vehicle formation in an experimental run. Commercial operation began in April of 2004. In the period from the trial run with passengers to August 31, 2004, the maglev line has carried a total of 1.45 million passengers and fulfilled a safe mileage of 1.02 million km.

The practice of Shanghai Maglev Line has proved the German Conventional conductive Transrapid system is technically mature, safe and usable. If the cost is further optimized it is economically competitive with the high-speed wheel-on-rail transportation system.

2. Achievements of Shanghai Maglev Line

The practice of construction and operation of Shanghai Maglev Line is the first commercial application of the high-speed maglev transportation technology in the world. It is a quantum leap from experiment towards engineering application.

1) Formation of a High-speed Rail Technology Satisfying the System Requirements and Application Conditions

Due to the fact that Shanghai is situated on the soft ground in the coast, the plan of using steel girders recommended by the German side is not suitable to be adopted for application on a large scale. By fully utilizing the local resources, we succeeded in developing a new type pre-stressed hybrid girder guideway system on the basis of the German straight hybrid girder, the cost of which is lower than the steel girder system. In the meantime, we overcame a series of technical difficulties such as the creeping of concrete, the girder deformation due to temperature variation, the river-crossing of guideway and the uneven settlement of foundation on soft ground, etc. We made researches and manufactured the machine tools for processing the hybrid girders, mastered the technology for designing and manufacturing the high-speed maglev guideway system and aquired a complete set of patented technology, including the guideway technology and special bearings for guideway girders.

2) Mature Technology of the System Equipment

Vehicle, control system and propulsion system were supplied by the German side in the mode of complete plant. After stringent operation tests it has been proved that the whole system is reliable and the technical performances of the equipment can fundamentally meet the requirements of operation. The fully-automatic multi-vehicle turn-around operation mode adopted by Shanghai Maglev Line is the most advanced guideway transportation operation mode in the world. The redundant design and

configuration of vehicle and the whole system are reliable. Failure of any individual on-board electronic component will not influence the normal operation of the maglev train.

3) Established a Stringent Mechanism of Safety Assessment and Approval and Safe Operation Supervision

As the first high-speed maglev commercial operation line, system safety is of paramount importance. We made reference of the management experience of European advanced countries and combine it with the actual conditions of Shanghai Project. With the support of the Transportation Ministry of Germany, Shanghai High-Speed Transrapid Project Construction Headquarters carried out the safety assessment and approval for the entire system. During the process, we gradually established a safety assessment and approval system and set up a special team.

German experts from authoritative maglev safety assessment institutions were invited to Shanghai to carry out the safety assessment of components/ subsystems/ the whole system in 3 phases. Under the cooperative frame of the governments of China and Germany, safety assessment officials from EBA of the Transportation Ministry of Germany came to help us assess and evaluate the assessment process. More than 300 safety assessment documents have been formed up to the present. Authorized by the Municipal Government of Shanghai, Shanghai High-Speed Transrapid Project Construction Headquarters issued a license of trail operation with passengers to Shanghai Maglev Line.

In order to guarantee the operational safety, Shanghai Maglev Transportation Development Co., Ltd. (SMTDC) established an operation safety supervision mechanism after the beginning of the formal commercial operation and entrusted the task to Shanghai Maglev Transportation Engineering R & D Center, which is the operation safety supervision unit independent of the operational department and shoulders the responsibility of safety supervision and inspection work. Emphasis is laid on the supervision of the formation and implementation of the relevant operation rules and regulations and the discovery of the possible and potential problems in the operation.

No safety problems influencing the safety of vehicle operation have ever happened to the maglev vehicles up to the present.

4) Realized the General Objective of Project Control

In the field of quality, the system has been operating safely and steadily and in general the project construction quality reached Class A after being assessed and evaluated by the third-party organization. Project progress was always in a controllable state. In the course of the construction, all construction milestones were managed strictly and checked at all levels. In spite of the occurrence of some unforeseeable problems, the construction investment was controlled at the range of budget. Total budget estimate approved by the responsible department is RMB 10.0299 billion. At the end of April, 2004, the final estimate examined and approved by the company board of directors is RMB 9.943 billion. On such basis, we once compared the cost of maglev with those of other rail transportation lines in Shanghai only to find that the construction cost per kilometer of Shanghai maglev demonstration line is about half of cost of the Metro lines and a little lower than the cost of light rail line (Shanghai Pearl Line).

5) Accumulated Operation and Maintenance Experience

Operation personnel of the Chinese side were trained by making use of the opportunities of equipment installation and the commissioning by the German side. After the project final acceptance, all job posts were taken by the Chinese staff and we have reached the target that the Chinese personnel do the operation and system maintenance independently. Those German experts still remaining on site are fulfilling their warranty task stipulated by the Contract.

Besides, the software of maintenance management system developed by SMTDC has been put into trial operation and it will facilitate the realization of all-computer management of system maintenance.

3. Considerations about the Maglev Development Strategy

1) High-speed Maglev Transportation is the Transportation Technology of the 21st Century

Speed is the eternal theme of mankind in the probe of transportation technology. Looking back to the developing history of the existing transportation modes, the new and developing transportation mode appears inevitably as a corner stone of the economic development or structural change. The requirement of the latter is the motive force for the development, maturity and perfection of the transportation technology. The high-speed maglev transportation is now at the stage of gradual maturity and perfection, however, the true entry into the market needs perfection in the respects of the system optimization, improvement of environment compatibility and cost reduction.

The high-speed maglev system is the only safe and economic big-volume ground passenger transportation means in the operating speed range of 400~500 km/h in the present world. It is possible to realize a 3-hour comfortable commercial return trip in a day between center cities of medium- and long-distance of 800 ~ 1500 km. It is also possible to realize a quick travel of 0.5 ~ 1 hour within an economic circle of 200 ~ 300 km, resulting in “same-city” effect within an economic circle. The true national conditions of China such as the requirement of China’s rapid economic development, a big population, limited territory, shortage of natural resources and the prominent energy and environment problems decide the fact that China must seek for a big-volume high-speed, energy-saving, environment protective and safe passenger transportation system which is suitable for China’s national conditions and the sustainable developing strategy. The high-speed maglev transportation is an important and selectable developing direction. It is possible to become a new-type transportation system of the 21st century, and the 6th transportation type after the car, ship, train, airplane and the tube transportation, filling in the speed gap between the train and airplane. The practice of Shanghai Maglev Line has laid a new foundation for such a development and created a rare chance.

2) Economic Feasibility is Another Necessary Condition for Commercialization of the Maglev Transportation Technology

The practice of Shanghai Maglev Line has proved that the maglev technology is mature, safe and applicable. It is only the first step for the commercialization of the maglev technology. We must be clearly aware that the maglev transportation is a service directly facing the public and the economic feasibility is another necessary condition for its commercialization. The economic feasibility involves the contents of project construction cost, the national economic evaluation and the operation and maintenance cost etc. As to the great masses, the direct reflection is the ticket price. Only the cost of unit seat/km is lowered to the level which is competitive with those of the other transportation means, can the maglev transportation have its true vitality and competitive power for promotion and application.

Therefore, the maglev colleagues should work together to perfect the maglev technology and reduce the cost, striving to achieve the following targets: within a distance of 200 ~ 300 km, cost per seat/km should be lowered to that of a car so as to become one of the inter-city transportation means; within a distance of 300 ~ 1000 km, the cost per seat/km should be lower than that of airplane to realize an effective diversion of air passenger flow.

3) Further Enhance the Adaptability of System Technology

There is much room for improvement if the existing maglev system is put into market application. If the system technology wants to become a transportation tool for all, it should adapt to different climate conditions, geological conditions and service requirements of different regions, and the transportation capacity should also be increased. For example, there is a big difference in temperature, humidity, geology and landforms between the south and the north of China. The riding comfort and safety should satisfy the passenger requirements when a maglev vehicle runs from one climate feature to another. Consequently, it imposes a higher requirement on the system performance and technical adaptability. Besides, the present noise level inside and outside the vehicle must be further reduced and enough attention be paid to the study of effective measures for improvement. In all these respects,

cooperation and joint research must be strengthened to push forward the development and application of the maglev technology.

4. Conclusion

At present, the realistic problems for sustainable development are facing us, such as the problems of natural resources, energy and environment. We must take consideration of these problems and adapt to our national conditions when planning a comprehensive national transportation system for sustainable development. The high-speed maglev technology is the product of the combination of traditional electrical and mechanical products and modern information and control technology. Along with the continuous development of science and technology, the technical performances, environment compatibility and economic features should get a bigger improvement. We believe that the high-speed maglev transportation will become an important constituent of the ground transportation of the 21st century.

Meanwhile, as a new-type transportation mode, the maglev technology is still in its perfecting period. It will experience a long period of cyclic process of improvement and verification through practice in the fields of economic feasibility and technical adaptability before it is put into large-scale commercial application.

I myself firmly believe that along with the continuous development of the technology, the continuous accumulation of operation experience and the continuous system optimization and cost reduction, the maglev system is possible to survive and develop on the international market.