Transrapid Maglev System – Fields of Application

Dr. H.-Ch. Atzpodien
ThyssenKrupp Technologies, Essen, Germany

1 INTRODUCTION

The development of the Transrapid System was carried out to offer a more effective and attractive means of transport with the potential to close the gap between modern railway and air transport. The basic idea was to expand the field of application for track bound systems. Mainly the following arguments were discussed:

- substitution of road traffic and short haul air traffic (higher safety, less energy consumption and minimization of the impacts on environment)
- increase of transport volumes of railway feeder lines (integration of the maglev system in railway stations and airports to achieve interconnectivity)

In the last decades, however, in Germany priority was given to a gradual technical improvement of the wheel on rail system to achieve a remarkable change of the modal split. It has to be recognized, that despite of optimistic expectations the trend of a falling market share of the railway is still ongoing. To reverse this trend, it is vital, to make track bound systems attractive by offering an excellent standard of safety and service to the passengers as well as enabling adequate returns for the operator. The fulfilment of these requirements and subsequently a successful turnaround towards an increasing market share is possible, if the following features are available and applicable:

- short headways; highest punctuality and safety
- good adaptability allowing close bundling with existing infrastructure (highways, railway tracks) as well as cost effective track design due to favourable alignment parameters and simple adjustment of the guide way elevation to local requirements
- fully automated operation and maintenance
- application of automated gateways and ticketing by smart cards.

The Transrapid system design and development was based on respective requirements and its characteristics fulfil these requirements in their entirety. Consequently an integration of Transrapid lines in a transport network leads to its improvement with respect to attractiveness and economic efficiency.

2 PRESENT STATE OF DEVELOPMENT

2.1 Shanghai Transrapid

In the year 2000 the Chinese government decided to build the world's first Transrapid line for commercial operation. It connects the international Airport with the financial and commercial centre Pudong. The construction started in march 2001and only 22 month later the maiden trip of the first vehicle took place with participation of top level representatives of the Chinese and the German governments and industry. After successful commissioning and safety assessment the "Shanghai Maglev Line" is operated in revenue service by Shanghai Maglev Transportation Development Co., Ltd since 1st of May 2004.

Due to the distinct advantages for the passenger as

- headways of 10 to 20 minutes
- duration of the trip <8minutes
- stations placed close to the airport gates and the Pudong subway station
- on highest level further increasing punctuality of 99.94 % calculated from start of operation and 99.98 % in 2005 (e.g. only 6 respectively 2 of 10000 runs are more than 5 minutes late)
- excellent ride comfort at operational speeds up to 430 km/h
- highest standard of safety (fully automated operation with safe-life speed enforcement and route integrity).

The Shanghai Maglev Line is a favoured means of transport.

This is verified by the remarkable development of the rider ship of approximately

- 2 million in 2004
- 3 million in 2005
- 4.5 million expected in 2006
- 10 million visitors/passengers forecasted for the year 2010.

More than 20 million passengers/visitors p. a were registered at Pudong International Airport which was built mid of the nineties. An impressive further growth is expected in the near future.

In other words:

Already 2 years after the start of commercial operation approximately every 4th airport visitor/passenger prefers Transrapid instead of taxi, bus or car. The "Shanghai Maglev Demonstration Line" plays already an essential role in the transport network of Shanghai. In addition this line demonstrates the capability of Transrapid for applications on short and long distance routes with speeds up to 500 km/h.

During the commissioning period and the first year of operation, the know-how to operate and maintain the entire system has been successfully transferred to the Chinese operator SMTDC, so that actually the entire work is carried out autonomous ; only repair and delivery of spare parts are ordered from the producers.

The operational experience verifies, that the excellent service and safety to the passengers combined with technical and operational features such as

- fully automated and free of wear and tear operation
- ease of handling and good maintainability
- high reliability of the electric and electronic units
- the operational stability of the mechanical structures
- adequate energy consumption

enable a comparatively high economic efficiency of the Shanghai Maglev Line Transrapid.

2.2 AIRAPID , the Transrapid link between Munich airport and the downtown main station

In the Year 2000, under the leadership of the Federal Government and the German Rail a pre-feasibility phase has been initiated by several German States. Five application projects have been identified and were subject to further analysis. The projects were reviewed according to common feasibility Standards. The aim was to select the most favourable one in order to start the legal planning process for implementation.

In autumn 2001 the BMG (Bayerische Magnetbahnvorbereitungsgesellschaft) was founded and at the end of 2001 the legal planning process for the Transrapid link between Munich Airport and the downtown main station – distance 37 kilometres – was initiated.

In 2005 German Railway took over the responsibility for the final planning procedure and is designated to manage realization and operation of the so-called AIRAPID.

Motivated by the results of the feasibility studies, the German Federal Ministry of Transport decided to sponsor the further development of Transrapid for its integration in transport networks, especially for its application as link between airports and city centres as well as regional transport services between big cities.

Main objectives are:

- development of Technical Standards for the Maglev System to serve as basis for the approval
- cooperation with the People's Republic of China and the United States of America to create uniform safety and approval standards
- optimization of the electromagnetic levitation system
- operation and maintenance of the Emsland Transrapid Test Facility
- identification of realizable cost reduction potentials
- execution and evaluation of feasibility studies for national applications

The respective activities are still ongoing. Final results are expected after qualification and verification tests on the Emsland Test Facility in 2007 and 2008.

To verify the economic feasibility of the AIRAPID a detailed analysis of life cycle costs has been carried out. It includes a technical and economic comparison with a fast commuter train FCT (160 km/h), operated on a double track with similar alignment. Using the data of the AIRAPID as reference (100%), the results can be summarized as follows:

- expected traffic volume of the FCT is approx. 40 % lower
- achievable ticket prize of the FCT is approx. 50 % lower
- system investment of FCT is approx. 35 % lower

– maintenance costs of the FCT are approx. 50 % higher
– energy costs of the FCT are approx. 70 % lower
– operating costs are similar

Taking into account an evaluation period of 30 years of revenue service under the assumption of

– an escalation of 3 % p.a. for maintenance costs, energy costs, operating costs for reinvestments and not annually required expenses for a general overhaul
– an increase of the income of 1.5 % p.a. the profit of the AIRAPID works out at approx. 2 billion €.

Based on the same LCC calculation model, the FCT generates an operational loss of approximately 200 million €.

Generally speaking:
The result of the life-cycle-cost-analysis demonstrates clearly, that both systems need the sponsorship of the public institutions to build the system. However after start of revenue service, AIRAPID generates a profit of more than 2 billion € and on the other hand the FCT needs additional order payments from public institutions to the operator to finance the deficit of approximately 200 million €.

3 CONCLUSION

Transrapid still carries a vision that is to move on ground level faster, safer, and as compatible as possible with the environment. Since decades, this vision keeps people going in order to implement projects all over the world. After convincing demonstration of the technical features and outstanding environmental behaviour of the Transrapid technology on the Test facility in Emsland, we had to accept the challenge to achieve economic characteristics, enabling adequate returns for the operator, despite extremely low production figures of first short distance applications. Thanks to the long term strategy and support of the government of the Federal Republic of Germany and the companies involved a continuous system optimization process was carried out. However, only due to the decision-making of the government of the People's Republic of China and the personal engagement of Commander in Chief Dr. Wu Xiangming and his team, we got the opportunity to build the first Transrapid application line and to verify decisive parameters in revenue service. These results and the specific market conditions of the link between Munich airport and the downtown main station were input to a life-cycle-cost analysis. The results demonstrate the competitiveness of the Transrapid technology in this first and new field of application for short distance links. The superiority of Transrapid in application projects with the priority on travelling time, economic efficiency and environmental behaviour is demonstrated. In these fields of application of track-bound transportation Transrapid is on the leading edge worldwide.

4 REFERENCES

Jänsch, Eberhard., Rogg, Dieter., Witt, Michael 2006. Technical and economic comparison of high-speed-rail and maglev systems, RTR Railway Technical Review Issue 1/ 2006 Volume 46.