MEMO

DATE: March 3, 2005

TO: Transportation and Communications Committee

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SUBJECT: The Shanghai Experience

SUMMARY:
Two SCAG staff were previously authorized to attend the 2004 Maglev Conference in Shanghai, China on October 26-28, 2004. The attached report summarizes their experience and offers substantial detail on Maglev-related topics including the operating Shanghai Maglev Line. A slide-show presentation will be given to further explain the significance of this trip and how their experience can be applied to benefit SCAG's Deployment Program.

BACKGROUND:
2004 Maglev Conference, Shanghai, China

The 2004 Maglev Conference was held in Shanghai, China from October 26-28, 2004. The 18th International Conference proceedings focused on Magnetic Levitated Systems. Papers were presented from 14 countries to approximately 300 people who attended the conference. The Institute of Electrical Engineering, the Chinese Academy of Sciences, and the National MAGLEV Transportation Engineering R&D Center organized the conference. The National Natural Science Foundation of China, Transrapid International, Shanghai Maglev Transportation Development Co., Ltd., and MAX BOGL Construction Company supported the conference.

The papers presented were on the following topics:
- High Speed Maglev Developments and Projects
- Urban Maglev Developments and Projects
- New Ideas
- Power Supply
- Vehicle, Guideway and Infrastructure
- Safety, Operation Control and Maintenance
- Propulsion and Linear Motors
- Magnetic Levitation and Guidance
- On Board Energy Supply and Energy Transfer
- Magnetic Bearings

Shanghai Maglev Project

Most of the above topics presented were centered on the Shanghai Maglev project, which links Pudong International Airport with the financial district at the Long Yang Road Subway Station. Project completion took four years from starting the planning study to operation of the line. The project, which

started construction on March 1, 2001, was a joint effort of the Chinese Government and German Transrapid International Company.

The first Maglev vehicle, composed of three sections, successfully completed its trial run on a single track on December 31, 2002. The second track was completed in 2003. Testing on two, five, and eight vehicle sections was conducted, and a maximum speed of 310 mph (501 km/h) was successfully achieved on a five-section vehicle train. Testing on intercrossing of two trains was at a maximum speed of 267 mph (430 km/h). Commercial operation on the 19 mile, double track line between Pudong International Airport and Long Yang Road Subway Station started in January 2004. Today, the system operates with three five-section vehicles and 10-minute headways. One way trip time is 7.5 minutes, and daily operation is 9 hours. By August 2004, the Shanghai Maglev line had carried 1.45 million passengers. In 2004 with the completion of Phase I construction, the Pudong Airport carried approximately 20 million annual passengers. The expansion of the Pudong Airport during Phase II construction, which is underway, is expected to double this capacity. The population of the City of Shanghai is approximately 8 million people and the population of the region of Shanghai is approximately 14 million.

The Shanghai Maglev line was constructed at a cost of $1.2 billion (RMB 9.943 billion). So far no data has been released relating to the maintenance and operation of the line. The Shanghai Maglev line is the first commercially operated Maglev line in the world and it carries passengers in cars that offer two classes of service: the VIP section has leather reclining seats with trays, and four seats per row; the Ordinary sections have cloth, non-reclining seats, and six seats per row.

Shanghai Transrapid Development Company in conjunction with Shanghai International Trade Company and the Shanghai Pudong International Airport Import/Export Corporation were the contractual parties in charge of implementing the Shanghai Maglev project. The Contractors group was composed of Transrapid International, Siemens, and ThyssenKrupp.

Many of the papers presented concentrated on technical analysis of the system design, guideways, operation control, propulsion and power supply, operation and maintenance, safety and environmental assessment. Overall, the analysis concluded that the entire system is reliable, and the technical performances of the equipment meet the requirements of operation of the performance standards set up by the German Federal Railway Authority and the Shanghai Transrapid Development Company. The Shanghai Maglev line has proven that the ground passenger transportation technologies can travel at 310 mph, that the technology is mature, reliable, safe and environmentally friendly and that it can be put into operation in other parts of the world such as in the SCAG region.

Additional Shanghai Maglev Technical and Operational Considerations

- **Station Area:** The area where Long Yang road subway station is located is the administrative and cultural center of the new Pudong area of Shanghai. It is also a proposed transportation center and three Metro lines are planned to join there, which will make it possible for the passengers to transfer conveniently and directly to the Maglev Line.
- **Feasibility Study:** A pre-feasibility study was prepared by the municipal planning authority of the City of Shanghai. On June 30, 2002 an agreement on a joint preparation of a feasibility study for the demonstration and operation of a high-speed maglev system line was signed between the City of Shanghai and Transrapid International. The intended result of the study was the planning and design of the Shanghai Maglev demonstration project.

- **Station length:** 660 feet (200-meters) at each end of the line with maximum capacity of one 8-section vehicle (667 ft long, 794 seated passengers). The station has two double moving sidewalks.
- **Vehicle Configurations:** Currently a five-section vehicle is in operation for a total length of 420 feet, and seating passenger capacity of 464.
- **Acceleration:** The Maglev train can accelerate to 185 mph in 1minute and 37 seconds or 2.6 miles. It can reach a top speed of 310 mph in 4 minutes.
- **Guideway size and spacing:** Each guideway is 9.2 feet (2.8-meters) wide and 16.73 feet (5.1 meters) apart from the centerlines of each guideway.
- **Guideway Columns:** The distance between the pillars supporting the guideway is 82 feet (25 meters). Steel girders of 147.6 feet (45-meters) span are also used in the Shanghai Line for the crossover switches. The eight bendable steel switches were delivered from Germany. Column size is 5 ft x 6 ft.
- **Ridership:** The Shanghai Maglev line carried 1.45 million passengers by August 2004.
- **Power Consumption:** No information on power consumption was provided.
- **Operation and Maintenance:** 82 employees are responsible for the operation and maintenance under the Shanghai Maglev Transportation Development Co. Ltd.
- **Operating Costs:** No information on the assessment of the operating costs.
- **Maintenance Station:** Approximately 1.9 mile long connection with three crossovers connecting to the maintenance facility close to Pudong International Airport station.
- **Signage:** There are a significant amount of signs about the project and services, at the airport, subway rail stations, and the Urban Planning Museum. There are video monitors in each subway rail vehicle.
- **Security:** Security x-ray scanning machines are at the Long Yang station for baggage check.
- **Ticketing System:** All ticket machines are fully automated with automated control at the entrances and the exits.

Future Shanghai Maglev Development Projects

China's long range vision includes building 5,000 miles of a high-speed rail ground passenger network. At present the Shanghai Transportation Development Company is conducting feasibility study on the extension of the existing Maglev line to Hangzhou, a distance of 101 miles southwest of Shanghai. Also, China has proposed building a high-speed rail line from Shanghai to Beijing, approximately 900 miles. The final decision on the technology to be used for the Beijing to Shanghai project is subject to the result of the Shanghai to Hangzhou project. Some papers presented at the conference suggested that the Maglev technology should be adapted to the Shanghai-Beijing line, and others suggested that both Maglev and steel-on-wheel rail technologies are needed in China.

High Speed Surface Transportation (HSST) Slow-Speed Maglev

There were some papers discussing the Japanese HSST slow-speed Maglev, which will be operating in March 2005 for the opening of the World Exposition. The Maglev line, called the Tobu Kyuryo line, in the northeastern suburbs of the city of Nagoya, will connect to the town of Fujigaoka, a highly urbanized area, and then to the town of Yakusa. The HSST Maglev system was selected over steel wheel rail because Maglev can operate more efficiently at a high gradient slope of 6%. The line will be six miles long and is expected to reach a maximum speed of 62 mph, with a forecasted ridership of 30,000 passengers per day. The line is double track with nine stations and will take 15 minutes to travel end-to-end. The HSST Maglev train vehicles are manufactured by Chuba HSST Maglev technology in Japan, and are being constructed under Japanese standards. HSST magnetically levitated train research and development began thirty years ago by Japan Airlines.

In 1989, The Chubu HSST Development Corporation was established to develop the first one mile testing track in Nagoya for full commercial testing application of new generation vehicles. In 2000, a quasi-public corporation was formed in order to construct and operate the Tobu-Kyuryo line. The total estimated project budget was $770 million.

The infrastructure is being constructed primarily on an elevated guideway above existing public roadways with approximately 0.8 mile of tunnel. The fleet will consist of eight three-car trains operated by normal conductive Magnetic levitation, an automatic train control system. The construction of the guideway and the vehicles started in April 2002. The prototype of a 3-car train was manufactured, and performance verification tests at track were conducted in October 2002. The total passenger capacity is 104 seated and 140 standing, for a total of 244 passengers per train. The Tobu-Kyuryo line will be the first commercial slow speed magnetic levitation vehicle system to be operated in an urban area.

Strategic Considerations and Issues

There were papers presented discussing the use of Maglev for freight transportation and its advantages for a fast, safe, and reliable mode of operation. Some papers focused on further development and optimization for the near future on guideway and guideway equipment, vehicles, propulsion and power supply, operation control systems, and standardization and simplification of the Maglev system deployment. Also, economic optimization and cost reduction for the investment costs and operation including the maintenance costs were discussed.

Lessons Learned from the Shanghai Project

The most valuable achievements obtained from the construction of Shanghai Line was stated as the development of the hybrid guideway structure system and its manufacturing technology, including design of the alignment, design and manufacture of the guideway girders, control of the settlement and development of special bearings for the guideway, etc. The intellectual property rights of all these unique technologies belong to the Chinese.

Summary and Conclusion

The 2004 Maglev Conference was very successful in delivering information, data, technical analysis and application on the deployment of High-Speed Maglev system. SCAG staff gained first hand experience on Maglev operation by conducting field trips and riding the Shanghai Maglev line. SCAG made a presentation on the need for an Interregional Maglev system to reduce roadway congestion and to provide ground access to the regional airports in the SCAG region. The SCAG presentation was received very well and provided discussion among members of the conference. Several attendees were interested in SCAG's "system" concept and the connection and utilization of regional airports. Also of particular interest was SCAG's financial plan to incorporate public and private partnerships.

Also, the proceedings provided great new information on Maglev technology, and its applications and attributes. It was proven and concluded that Maglev is fast, safe, reliable quiet, comfortable and environmentally friendly. The successful construction and operation of the Shanghai Maglev project solved many important problems concerning the practical application of the high-speed Maglev transportation system. It has created an active foundation for Maglev deployment in the United States and

the SCAG region. As an international transportation industry in general, Maglev is still in the early stages; however, significant future growth in the technology and deployment of Maglev is expected throughout the world. China has indicated they are very interested in expanding Maglev corridors, Japan will soon have slow-speed Maglev technology in operation, Germany is developing new Maglev lines and the United States has several Maglev projects underway. The technology is expected to dramatically transform ground transportation capabilities and services.