

Status of Korea's Urban Maglev Program

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Byung Chun Shin, Doh Young Park, Suhyun Baik, Heung-Sik Kang

Center for Urban Maglev Program, Korea Institute of Machinery and Materials, Daejeon, Korea

bcshin@kimm.re.kr, dypark@kimm.re.kr, shbaik@kimm.re.kr, kan21@kimm.re.kr

ABSTRACT: This paper discusses the status of Korea's Urban Maglev Program which is the final stage of a series of R&D projects on the low-to-medium speed maglev transit system development. The goals of the program are to develop a competitive transit maglev system and to operate the developed system on the 6.1 km demonstration line on revenue service basis. Once the Urban Maglev Program is completed in 2012, the developed system will be the world's third maglev system for revenue service and the second urban version to run for commercial operation.

1 INTRODUCTION

Korea's Urban Maglev Program (UMP) started in December 2006. The total program budget is expected to be 450 million US Dollars, including contributions from the private sector, Incheon International Airport and City of Incheon. The competitive urban transit maglev vehicle has been under development and a 6.1 km urban maglev demonstration line will be constructed at Incheon International Airport by 2011. The maglev trains will start revenue service from 2013. The program including the vehicle development and line construction will be discussed in this paper.

2 KOREA'S MAGLEV DEVELOPMENT HISTORY

A R&D project for a low-to-medium speed maglev system started in 1989 by Korea Institute of Machinery and Materials (KIMM) with the financial support from the Ministry of Science and Technology. The development was focused at the maglev vehicle with electromagnetic suspension (EMS) and linear induction motor (LIM) propulsion.

In 1997, 1.1km long test track was constructed in KIMM, which was extended to 1.3 km in 2002. The guideway has 6 % slope and the minimum radius of 60 meters. It also has a parallel moving type track switch. The pilot Urban Transit Maglev trainset (UTM-01) with two vehicles was developed in 1998.

Figure 1 shows the 1.3 km test track in KIMM and figure 2 UTM-01 vehicle.

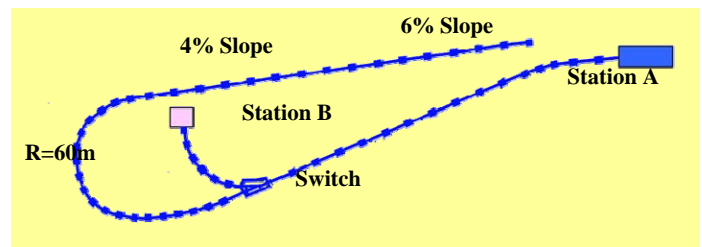


Figure 1. Test Track in KIMM (1.3 km)



Figure 2. UTM-01 Vehicle

From 2003, Hyundai-Rotem, Korea's railcar manufacturing company, continued maglev development project to develop UTM-02 by the financial support from Ministry of Commerce, Industry and Energy. UTM-02 was developed to provide a shuttle service on the 1 km long single track between Expo Park and National Science

Museum in Daejeon. The line was constructed by upgrading a section of existing Expo'93 Maglev track. Figure 3 shows UTM-02 and figure 4 Expo Park – National Science Museum line.



Figure 3. UTM-02 Trainset

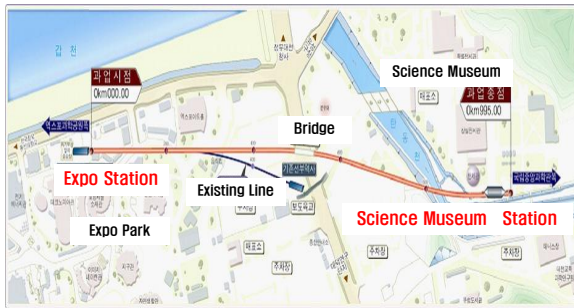


Figure 4. EXPO-Science Museum Shuttle Line

3 URBAN MAGLEV PROGRAM

In 2006, the Ministry of Land, Transportation and Maritime Affairs (MLTM) initiated Urban Maglev Program to finalize the previous maglev R&D projects and to demonstrate the developed system for revenue service. The Center for Urban Maglev Program (CUMP) was set up to lead the program that is funded by MLTM with assistance from Ministry of Education, Science and Technology (MEST) and Ministry of Knowledge Economy (MKE) through Korea Institute of Construction & Transportation Technology Evaluation and Planning (KICTEP) and also by matching funds from the participating companies.

The total program budget is expected to be 450 million US Dollars, including contributions from the private sector, Incheon International Airport and City of Incheon. The program will be completed by 2012, and the time schedule is shown in Table 1.

The program is composed of three Core Projects; Systems Engineering, Vehicle Development, and Demonstration Line Construction. The Core Projects

are managed by KIMM, Hyundai-Rotem and Korea Rail Network Authority, respectively.

Table 1. Program Schedule

		07	08	09	10	11	12
R&D for Technical Improvements	Systems Engineering	[Bar]					
	Vehicles (including performance test)	[Bar]					
	Guideway Facilities	[Bar]					
Demonstration Line Construction	Site Selection	[Bar]					
	Line Design	[Bar]					
	Construction / Systems Integration			[Bar]	[Bar]	[Bar]	[Bar]
	T & C*						[Bar]

*: Test & Commissioning

3.1 Core Project 1: Systems Engineering

The objective of Core Project 1 is to support management and integration of sub-systems for the successful implementation of Urban Maglev Program. Also, the interface management for system integration and the system management plan have been applied. Systems Engineering has five sub-projects; System Integration, Systems Engineering Process Definition and Requirement Management, Analysis of RAMS and LCC, Test and Evaluation, and Legislation/ Amendment of Regulations.

3.2 Core Project 2: Vehicle Development

The objectives of Core Project 2 are to develop and commercialize three consists of driverless urban maglev vehicles of maximum speed of 110 km/h and to perform the comprehensive vehicle test. Vehicle Development has three sub-projects; Development and Production of Urban Maglev Vehicle, Performance Improvement of Levitation and Propulsion System, and Safety and Stability of Vehicle Considering Interaction with Guideway.

Figures 5 and 6 show the outline dimensions of the new UMP maglev vehicles. The frontal shape is designed to imitate the shape of traditional celadon porcelain. Figure 7 shows the view of virtual operation of the maglev train in service after 2013. The design specifications of the maglev vehicle are listed in Table 2.

3.3 Core Project 3: Demonstration Line Construction

The objectives of this Core Project are to construct the 6.1km demonstration maglev line and Test &

Commissioning for safety verification and stabilization of running performance.

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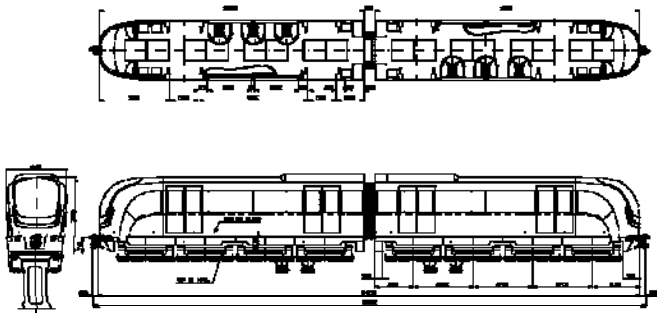


Figure 5. Outline Dimension

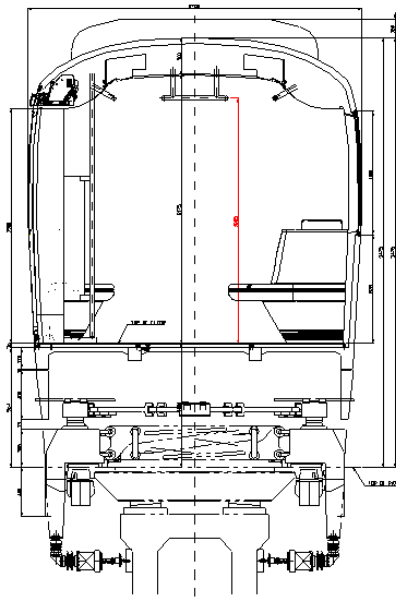


Figure 6. Cross-sectional Dimension



Figure 7. View of Virtual Operation of UMP Maglev Train on Demonstration Line

3.4 Core Project 3: Line Construction

The objectives of this Core Project are to construct the 6.1km demonstration maglev line and Test &

Table 2. Train Specifications

Train Configuration	2 Cars, Permanently Coupled (Mc1+Mc2)
Vehicle Dimensions	12.0 (L) x 2.7 (W) x 3.45 (H) m
Vehicle Weight	Tare : 20 ton/car Laden : 26.5 ton/car
Passenger Capacity	93 persons/car [Standing: 5 persons/m ²]
Number of Bogies	4 per Car
Propulsion System	LIM + VVVF Inverter
Levitation System	ElectroMagnetic Suspension Type, 8 mm air gap
Brake System	Blending of Regenerative & Mechanical Brake
Power Supply	1,500 VDC
Max. Design Speed	110 km/h
Max. Operating Speed	80 - 100 km/h
Max. Acceleration	4.0 km/h/s
Max. Deceleration	4.0 km/h/s in Service, 4.5 km/h/s in Emergency
Ride Index	below 2.0 of UIC
Max. Gradient	70 ‰
Min. Curve Radius	50 mR

For the commercial service of Urban Maglev Systems, both the improvement of maglev guideway technology and the less costly rapid construction technology in urban area are important. Also, the development of high speed articulated maglev switch having less than 25 second switching time is required.

Hence, Core Project 3 is composed of three sub-projects; Line Construction, Improvement of Maglev Guideway Structure, and Development of High Speed Articulated Maglev Switch.

4 DEMONSTRATION LINE

In 2007, the consortium of Incheon International Airport and Incheon city was selected to hold the maglev Demonstration Line after tough competition with 3 other major cities in Korea. As the first phase of total 3 phases (57km in total), the 6.1 km long Demonstration Line starting from the Transportation Center of Incheon International Airport will be constructed. The Demonstration Line will end at Yong U area where the second Airport Express (AREX) Line will have the final station. The Line will have six stations, where the first station (101 Station) will be located inside the Transportation Center of Incheon International Airport. In addition

to the six stations, there will be a maintenance depot. Figure 8 shows the Demonstration Line.



Figure 8. Demonstration Line

The second station, 102 Station, will be located close to the second passenger terminal (planned), the third station (103 Station) at International Business Center that is the business district with office buildings, shops, and a hotel. Figure 9 shows the preliminary designs of stations 102 and 103. All stations will be aesthetically appealing without compromising comfort and convenience of the passengers.



(a) 102 Station



(b) 103 Station

Figure 9. 102 and 103 Stations

The area where the fourth station (104 Station) will be located is Fashion Island that will be developed to

host the shops and companies in fashion business. The fifth station (105 Station) will be located at Water Park where a resort facility for water activities will be constructed. Passengers arriving at the final station (106 Station) will be able to transfer to the second Airport Express Line. 106 Station will be close to where yacht competition will take place for 2014 Asian Games.

The pillar of guideway will be selected from the three design candidates shown in figure 10.

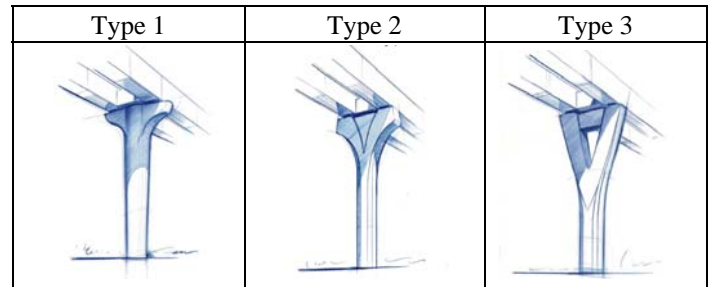


Figure 10. Pillar Designs

Construction will start from 2009 after the detailed line design is completed in 2008. Basic design for Signaling System, Communications System, and Power Supply System will also be completed in 2008.

5 SUMMARY

The Urban Maglev Program is a unique type of R&D project in the sense that it is a combination of R&D project and construction project. In the first stage of the program, R&D activities to improve performance of existing maglev train will be performed. In the next phase, the vehicles of commercialization model (two cars per consist) will be built and put to various tests on the 1.3km test track in KIMM. Construction of the 6.1 km Demonstration Line will be completed by 2011. The developed maglev trains will undergo a series of final tests on the Demonstration Line.

Following the Demonstration Line, the second and third phase constructions are planned to extend the Demonstration Line. The successful operation of Incheon International Airport Line following Linimo in Japan will prove that a low-to-medium speed maglev system based on EMS technology is more than ready to compete with other light rail systems.

6 REFERENCES

- B. C. Shin, "Korea's Urban Maglev Program," Korea Policy Review, August 2007, pp. 58-59.
- "Maglev demonstration line," International Railway Gazette, May 2008, p. 29