The Status of the development and the running tests of the JR-Maglev

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Abstract

The running test of the JR-Maglev has been conducted for six years in order to confirm long-term reliability and durability. In addition, the developments of technologies for cost reduction and improvement of aerodynamic characteristics have been carrying on. New type vehicles, which are adopted the results of the developments to improve these technical subjects, will be introduced to the Yamanashi Maglev Test line in this summer. New shape sidewalls with improved ground coils and high efficient power converters for cost reduction, will be introduced to the test line in this autumn. This paper deals with the status of the running tests on the test line and the developments of technology to be carried out.

1. Schedule and status

1.1 Outline of the test schedule

The JR-Maglev has been developed for the innovative transportation system of the next generation, which adopts an electro-dynamic levitation system and synchronous motors with superconducting magnets. This system is expected to be applied to the artery between Tokyo and Osaka, the biggest cities in Japan.

Fig. 1. The JR-Maglev

Running tests on the Yamanashi Maglev Test Line (YMTL) started in April 1997. The first period of the test was three years. The schedule of the first three-year test is shown in Table 1.

Table 1. Schedule of the first three-year period

1997	1998	1999	2000
Basic Running Tests			
	General Function Tests		
	Reliability Verification Tests Other Verification Tests		

At the end of the three-year test period, the technical practicability evaluation committee of the Ministry of Transport of Japan concluded, “the JR-Maglev has the practicability for ultra-high speed mass transportation system.” The committee also pointed out the necessity of further running tests for the following purposes:

Table 2. Another five-year test plan

Fiscal Year*	2000	2001	2002	2003	2004
Evaluation of Durability and Reliability	High Speed Running Test				
Improvement of Cost Performance	Ground Coils			Confirmation on Test Line	
	Power Converter			Confirmation on Test Line	
	Power Supply System			Confirmation on Test Line	
	Guideway Construction			Confirmation on Test Line	
Improvement of Aerodynamic Characteristics	Design and Construction of New Vehicles			Confirmation on Test Line	
	Data Collection				

*Japanese fiscal year: April to March

(1) Confirmation of long-term durability and reliability
(2) Cost reduction of its construction and operation
(3) Improvement of the aerodynamics of vehicles for environmental impacts

According to these recommendations, another five-year test was planed to improve these technical issues as shown in Table 2. The JR-Maglev is in the third year in this test plan, and running test is being conducted on around 150 days a year.

1.2 Durability and reliability

Cumulative distance traveled exceeds 200,000 km on February 20, 2002. Fig. 2 and Table 3 show the progress of the traveled distance since the beginning of the running test and results of traveled distance, respectively. These show the stability of the JR-Maglev system.

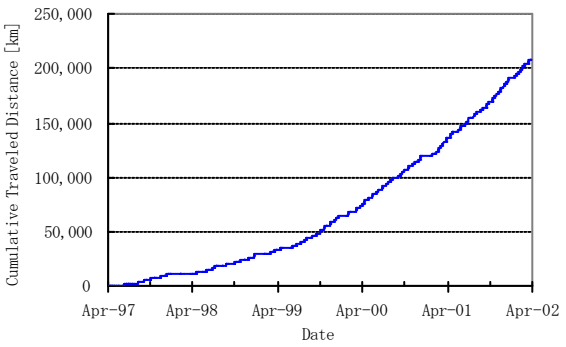


Fig. 2. Cumulative traveling distance

Table 3. Results of traveled distance (as of March 31, 2002)

	Results	Notes
Cumulative traveled distance	208,658 km	From the beginning of the test
Maximum traveled distance a fiscal year	72,689 km	From April 2001 to March 2002
Maximum traveled distance a day	1,100 km	December 4, 2001

1.3 Trial ride

Though the running tests have been mostly conducted with manned operation, the trial rides for VIPs have been held since May 1998, and the trial rides for public applicants have been held since August 1999. More than 30,000 people enjoyed the ride of the JR-Maglev at 450 km/h so far. Fig .3 and Table 4 show the data of passengers.

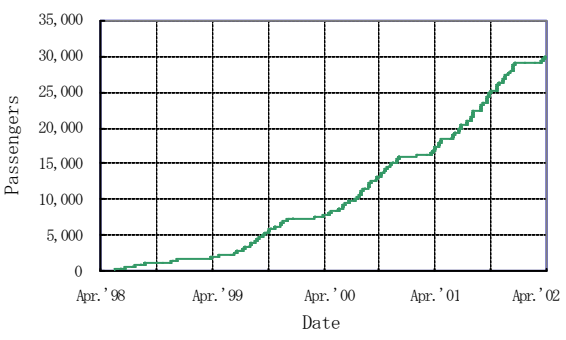


Fig. 3. Cumulative number of passengers

Table 4. Passengers of the JR-Maglev

	Passengers	Notes
Number in FY 2001	13,074	From April 2001 to March 2002
Cumulative Number	30,496	As of March 31, 2002

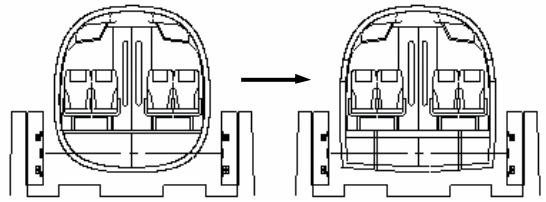
2. New technologies

According to the recommendation of the committee mentioned above, various kinds of technical developments have been progressed for the improvements of this maglev system for the revenue service. Through these developments, some new technologies will be introduced to the YMTL in this year, which will contribute to acquire important data for the further completion of this system. The followings are some examples of them.

2.1 Vehicles

Two new vehicles will be introduced to the test line in this summer. One is a leading car, and the other is a middle car. The leading car is shown in Fig .4. Its nose is made as long as possible experimentally in order to verify the effect of its length to the aerodynamics. To reduce low-frequency air vibration, these new vehicles have nearly rectangular cross section as shown in Fig. 5, which is different from that of the conventional vehicles (round cross section).

Fig. 4. New type leading car (MLX01-901)



Conventional vehicles (Round cross sections) New vehicles (Rectangular cross sections)

Fig. 5. Variation of cross section of vehicles

2.2 Sidewalls

The YMTL has three types of sidewalls, which are different in the structure and the way to attach ground coils. They have different merits and demerits respectively. A new type sidewall, which has reversed 'T' shape shown in Fig .6, will be introduced to the YMTL in this autumn. It has merits of conventional types and excels them in weight, cost, easiness of installation and maintainability.

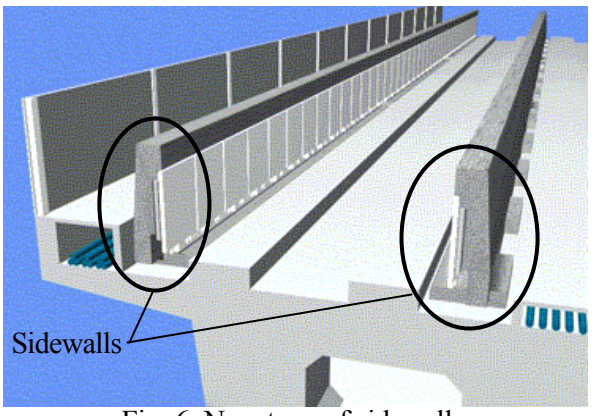


Fig. 6. New type of sidewalls

2.3 Ground coils

A new type of propulsion coils for a single layered arrangement is under development on the contrary to those in the double-layered arrangement now being used on the YMTL. It can realize cost reduction in manufacturing and installation because it is possible to reduce the number of the coil types and to make the size smaller. This type will be also easy to maintain. This new coils will be installed on the new sidewalls mentioned above.

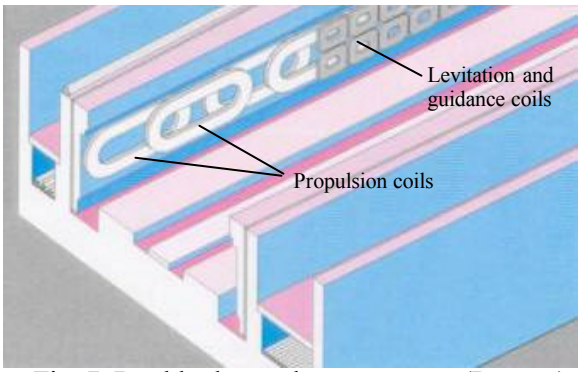


Fig. 7. Double-layered arrangement (Present)

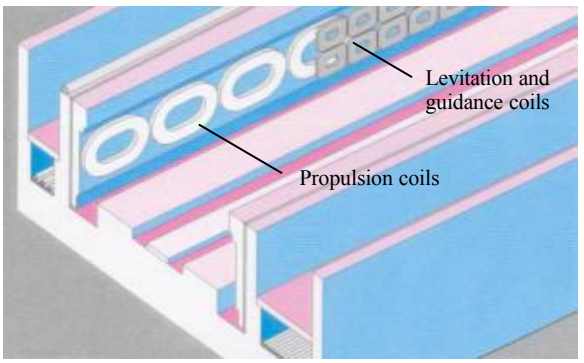


Fig. 8. Single-layered arrangement (New)

2.4 High efficient converters

Power converters, which are in a substation and have been used Gate Turn Off thyristors on the YMTL, drive vehicles and their efficiency affects the operational cost. A part of the converters will be replaced with a unit used a new generation power devices Injection Enhanced Gate Transistors (IEGTs) in order to verify the improvement of the efficiency. IEGTs have good characteristics to simplify the peripheral devices such as snubber circuits and cooling systems. Consequently, it is expected to reduce the manufacturing cost and the volume of the converters.

2.5 Feeding system

A staggered triplex system is adopted to the YMTL as shown in Fig. 9. Although the system has an advantage of redundancy, it is expensive because three same systems are required.

A new duplex feeding system is under development in order to improve cost performance. The previous duplex feeding system, which was applied to the Miyazaki test track, didn't have redundancy. The new duplex feeding system, however, can realize continuous train operation even if one of the feeding systems fails.

Last year, running tests simulating one type of the new duplex feeding system had been conducted on the YMTL. The system needs to stop a current for propulsion momentarily at the boundary between the feeding sections. Fig. 10 shows the moment when a vehicle crosses the boundary between 2A's. During the time that the section switch A1 is opened and A2 is closed, current stop interval is required essentially.

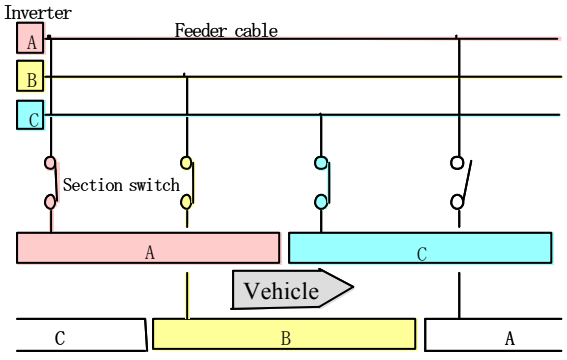


Fig. 9. Conventional staggered triplex system

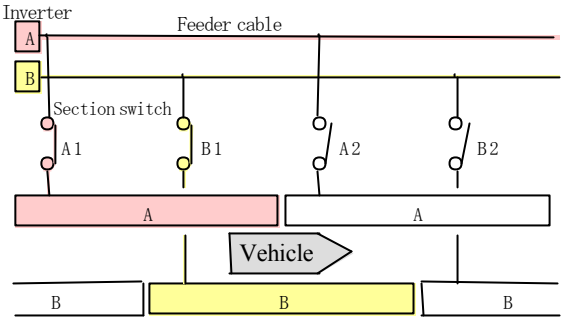


Fig. 10. A new duplex system

3. Conclusion

The running tests of JR-Maglev, which is expected to be an ultra-high-speed transportation system in the near future, are being carried out without serious problems. Various technical developments have also made a steady progress to improve the system. Some of these new technologies will be introduced to the YMTL in 2002 and will be verified their performance through the running tests. They will improve the characteristics of the JR- Maglev for the revenue service.

These technical developments are partly subsidized by the Japanese government.

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