RTRI - Incubating New Generation of High Speed Railroad for the 21st Century

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1. Introduction

RTRI(Railway Technical Research Institute) was formed in 1987 as part of restructuring the Japanese National Railways(JNR) which was privatized and divided into 7 Japan Railways (JR) companies. The Railway Technical Research Institute, and the Railway Labor Science Institute, which belonged to the JNR headquarters, merged into one railway research center. Originally, the forerunner of the RTRI was established back in 1907 and it was a railway supplies testing station that specialized in civil engineering materials but later diversified into research and development(R&D) of railway technologies. In 1949 management of the organization was transferred to the Japanese National Railways (JNR), and it was attached to JNR headquarter where it played a major role later in the success of Shinkansen project.

The founding aim of RTRI reflects the new management strategies of the JR companies into the 21st century ; 1) to develop basic technology and research applications, 2) to promote technology transfer to JR companies, 3) to promote the Maglev(magnetic levitation) system with the technology inherited from JNR, and 4) to study safety measures.

Ever since its establishment, RTRI has been faithfully pursuing its founding principles and has undertaken not only R&D but also technical consultancy to help JR companies with various technical problems and advancements(refer to Table. 1)

In order to meet social and railways communities' expectation such as the JR companies, and to continue development into the 21st century, RTRI revised the medium-to-long-term basic program which defines the basic direction of RTRI's R&D and business activities. Furthermore, RTRI is planning to restructure its organi-

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Table 1 Historical background of RTRI

12-10-1986	• establishment of the Railway Technical Research Institute authorized by the Ministry of Transport
4-1-1987	• RTRI inherited the R&D arm of the Japanese National Railways upon division and privatization
6-25-1990	• basic R&D plan for Maglev and construction of the Yamanashi Test Line authorized by the Ministry of Transport
11-28-1990	• construction of the Yamanashi test line started
3-22-1991	• medium and long-term basic program announced
1-22-1993	• Maglev vehicle "MLU002N" completed • braking test plant completed
3-29-1993	• small-scale, low-noise wind tunnel completed
2-24-1994	• Maglev vehicle "MLU002N" attained 431km/h
6-1-1994	• construction of large-scale, low-noise wind tunnel started
1-17-1995	• the great earthquake hit the south area of Hyogo prefecture, RTRI supported the recovery of the railways
1-26-1995	• manned Maglev vehicle "MLU002N" attained 411km/h
7-16-1995	• the first train set of test vehicle "MLX01" completed and delivered to the train depot for Yamanashi test line
11-13-1995	• agreement on the collaborative research between SNCF and RTRI made
6-5-1996	• large-scale, low-noise wind tunnel at Maihara-cho completed
7-1-1996	• Railway Technology Promotion Center, Yamanashi Maglev Test Center and Intellectual Properties Center opened
10-3-1997	• manned Maglev vehicle "MLX01" attained 451km/h at Yamanashi test line
12-12-1997	• Maglev vehicle "MLX01" attained 531km/h (the world best speed) at Yamanashi test line
12-24-1997	• Maglev vehicle "MLX01" attained 550km/h (the goal maximum speed) at Yamanashi test line
4-14-1999	• manned Maglev vehicle "MLX01" (5-car unit) attained 552km/h at Yamanashi test line

zation to carry out the revised program systematically and continuously.

2. Research & Development

RTRI focuses its R&D efforts basically on the following seven fields to contribute to the railway business of the JR companies and to meet the expectation of Japanese society, i.e.

(1) development of Maglev systems
(2) speed increase of the Shinkansen and narrow gauge lines
(3) improvement of maintenance technology
(4) improvement of urban transportation
(5) R&D requested by the JR companies
(6) basic research for the future development of railway technologies
(7) promotion of business activities such as engineering, systems integration, etc.

Beside these basic R&D programs, RTRI is also facing urgent demands to improve disaster prevention technologies as represented by the revision of seismic design standards following the Great Hanshin Earthquake which caused tremendous damage to the railway infrastructures.

2.1 Maglev R&D

Maglev, a super-high-speed transport system with non-adhesive drive system that is indepen-

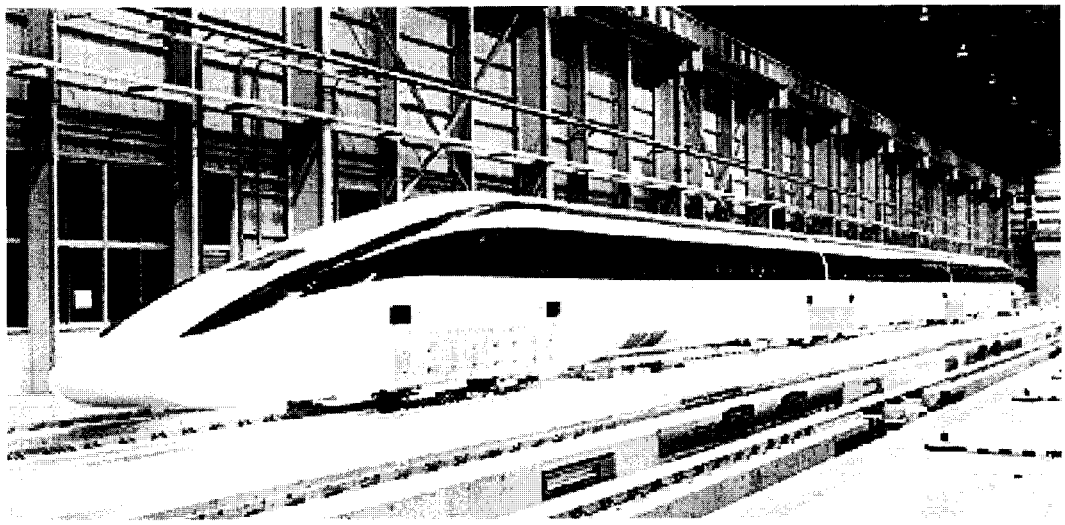

Fig. 1 Maglev vehicle MLX01 head car, aero-wedge

dent of wheel-and-rail frictional forces has been a long-standing dream of railway engineers. A combination of superconducting magnets and linear motor technology realizes super high-speed running, safety, reliability, low environmental impact and minimum maintenance. Research and development of Maglev has been underway at RTRI ever since 1970 and after fundamental tests in the laboratory to verify the feasibility of high-speed running at 500km/h, the construction of a 7-km test track started at Miyazaki Prefecture in 1975, the manned two-car vehicle "MLU001" registered a speed of 400.8 km/h in 1987 and the later vehicle "MLU002N" debuted in 1993 attained 431km/h in 1994. In 1999, a manned maglev vehicle "MLX01" (5-car unit) (Fig. 1) succeeded in attining 552km/h at Yamanashi Test Line. (Fig. 2-3)

RTRI is currently advancing R&D programs on Maglev system with the goals as shown in table 2 and will implement test running, bench tests and

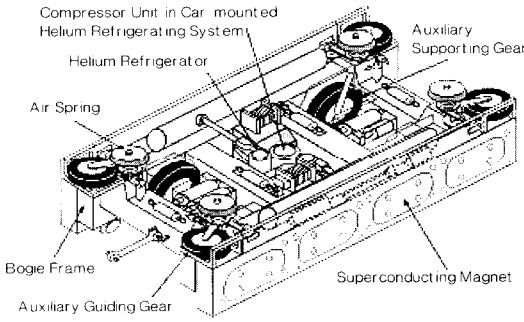

Fig. 2 Bogie of MLX01

Table 2 R&D goals for maglev systems

maximum speed	confirm stable running at 550km/h on the test line to realize a maximum operational speed of 500km/h
transport capacity	establish a highly punctual operation system capable of transporting 10,000 passengers one way per hour during peak hours
profitability	establish a profitable system by reducing construction, management, and production costs

Fig. 3 Test center of the Yamanashi maglev test line

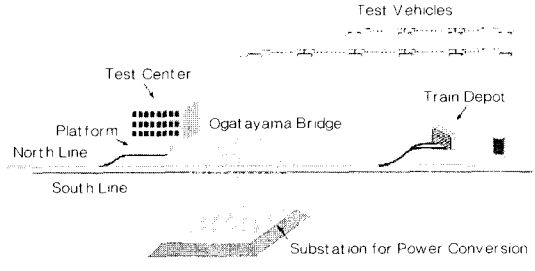

Fig. 4 Yamanashi maglev test line - installations

a number of simulations at the Miyazaki Test Track and the Priority Section of the Yamanashi Test Line with a definite schedule for commercial operation by the end of fiscal year of 1999

2. 2 Speed Increase of the Shinkansen and Narrow Gauge Lines

To increase the speed of conventional railways, including Shinkansen and narrow gauge lines, RTRI has focused on the implementation of 270km/h commercial operation on Shinkansen lines. RTRI is now aiming at 350km/h operation and making strenuous efforts to counter noise and vibration on the standard gauge and 250km/h on the narrow gauge. In the meantime, the introduction of newly developed titling train systems and new brake systems (Fig. 5) ensures a steady increase in speed on narrow gauge lines. In addition, the active suspension system (Fig. 6) is effective in increasing the ride comfort.

3. Organization and Institute Activities

3. 1 Organization

RTRI has a staff of about 600 and maintain an active exchange of personnel with seven JR companies. In order to become an open research organization, RTRI is involved with many international activities such as works with the International Union of Railways (UIC) and European Rail Research Institute (ERRI). Its research facilities are located over the land of about 405,000m^2 with the working budget of ¥51 billion for 1995.

3. 2 Institute Activities

Besides aforementioned R&D activities, RTRI has various technical activities such as

· Testing & Research ; undertake research

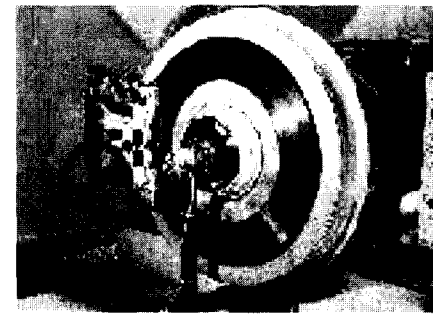

Fig. 5 New brake systems

Fig. 6 Active suspension systems

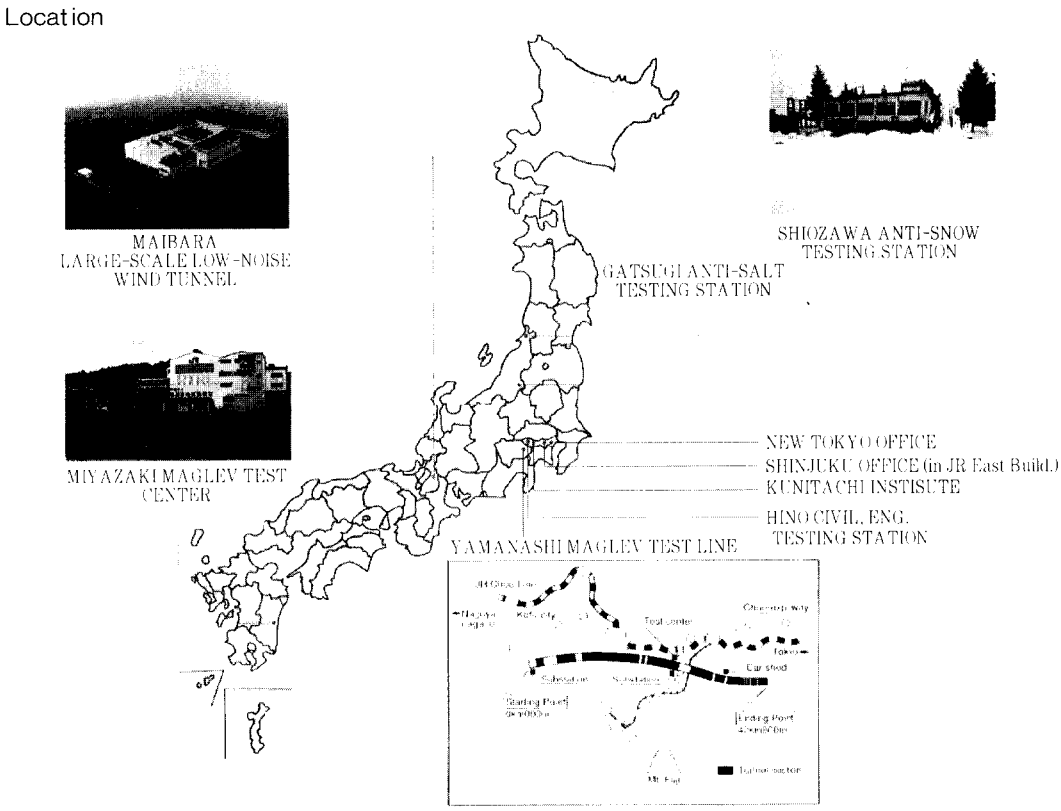

Fig. 7 Locations of research facilities of RTRI

and development on the magnetic levitation sys-tem, on Shinkansen and narrow-gauge line and on basic technologies

- Surveys & Investigations ; study high-technology advances in superconducting technology, etc and evaluate the R&D status of European railways which are being revitalized to strengthen the future role of railways
- Railway Technology Standardization ; promote research on technical standards for railway structures and related committee activities involving outside specialists to prepare draft design standards
- Information Service ; build-up a database on books, materials and statistics related to railway technology to aid the retrieval of railway literature, etc.
- Publication&Workshops ; publish research results and developments. Sponsors symposiums and workshops to disseminate knowledge of new railway technologies and promote related educations
- Technical Diagnosis&Guidance ; offer technical diagnosis and guidance services to Japan Railways (JR) companies to improve safety, reduce costs and improve technology
- Contract Studies ; execute studies under contracts with the government, local governing bodies, public corporations, instittu-

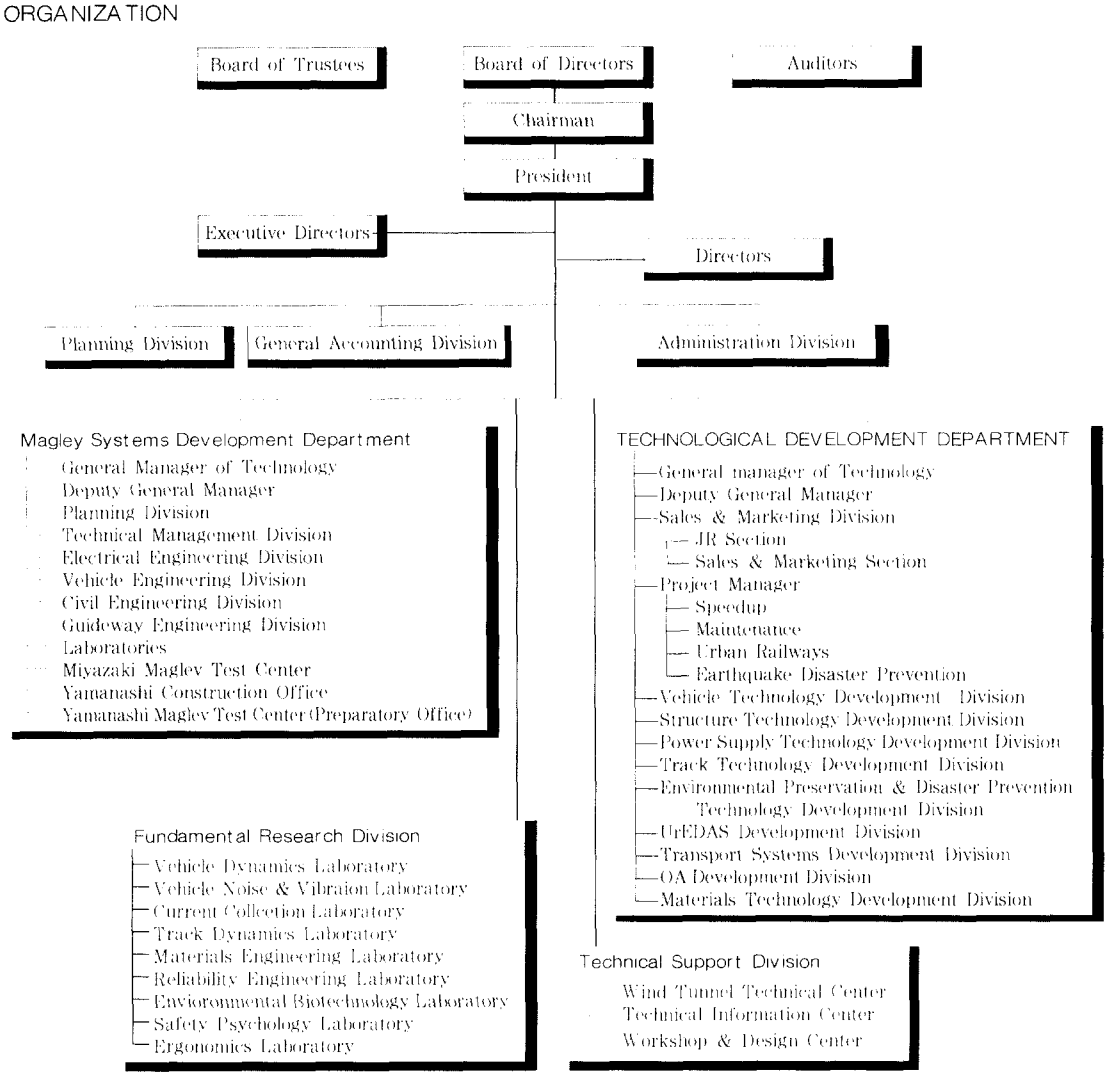

Fig. 8 Organization chart of RTRI

tions, railway companies and various private companies

- **Inspection of Railway structures** : inspect completed railway strutures built under Railway Business Law by companies designated by the Japanese Minister of Transport
- **Overseas Technical Cooperation** : Provide technical guidance for developing countries and technical cooperation with foreign countries to upgrade railway technology

As the inventor of High Speed Rail in the 20th century, RTRI is now devoting its effort for the development of new high-speed rail system for the upcoming 21st century and it is also expected to play a leading role in R&D of future railways.