Editor's Desk

Collision on Shigaraki Kogen Railway on 14 May 1991

The 14.7-km single-track Shigaraki Kogen Railway (SKR) from Kibukawa to Shigaraki near Kyoto used to be a JNR branch line. Shigaraki Town is famous for ceramics but the line suffered from low demand and JNR decided to close it. In February 1987, the local authorities founded a joint-stock company called Shigaraki Kogen (Highland) Railway Co. Ltd., to take over the line in July 1987, soon after JNR privatization.

On 14 May 1991, Shigaraki was crowded with people visiting 'The World Ceramic Festival.' At 1014, a four-car DMU train was about to start from Shigaraki for Kibukawa but the duty stationmaster could not turn the departure signal to green. The control panel showed another train approaching, but he could not understand the situation, because he knew there was no approaching train. The next arrival was a JR West special train from Osaka but it should still have been at Kibukawa Station. He consulted SKR's operations manager and a signalling engineer, but they could not turn the signal to green either. Finally, the operations manager decided to let the train go by non-blocking operation and got into the cab with an extra driver to act as pilot. The SKR train left Shigaraki 11 minutes late with the signal still showing red in defiance of the duty stationmaster's opinion.

The JR West special train from Osaka left Kibukawa Station at 1018. The two trains were scheduled to pass at Onodani, the intermediate signal station. When the JR West train arrived at Onodani at 1030, the SKR train was not there and the departure signal showed green, allowing the JR West train to proceed. The JR West driver passed Onodani, believing that the SKR train was still at Shigaraki for some reason. As he rounded a sharp curve, he found the SKR train coming head on. The two trains collided at 1035, killing 42 people including the SKR train driver and other staff (see photograph on page 20). The JR West driver was severely injured but survived. More than 600 people were injured.

The police, Ministry of Transport, SKR, and JR West investigated the accident separately. The main questions were: 1. Why the Shigaraki departure signal could not be turned to green when there was no train on the section? 2. Why the SKR operations manager permitted the train departure despite the red signal? To start non-blocking operation, he should have sent somebody to Onodani to confirm that there was no train between the two stations. Why did he neglect this crucial procedure? 3. Why the Onodani departure signal remained green after the SKR train violated the red departure signal at Shigaraki? A device called the Faulty Departure Detector (FDD) at the foot of the signal should have automatically detected the red signal violation and changed the Onodani departure signal to red, but it had not worked at all.

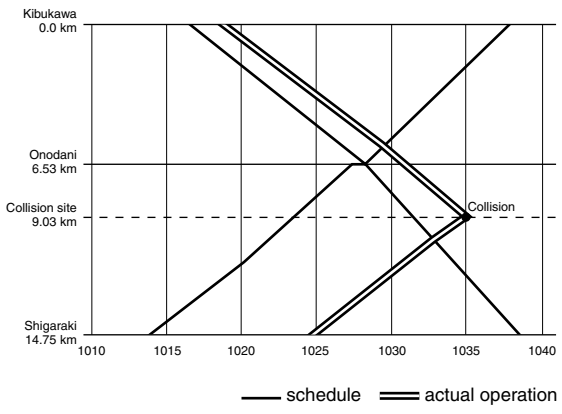
The investigation revealed the following: 1. The decision of the SKR operations manager to allow the train departure was wrong and illegal. However, there had been a similar case 10 days earlier in which the FDD had worked properly, preventing the opposite train from entering the same section. This precedent may have made the operations manager overconfident about the FDD. 2. The FDD did not work because of faulty wiring by a signal engineer who was wrongly inspecting relays under the supervision of the track and signalling manager as the train departed. 3. The reason why the Shigaraki departure signal could not be turned to green was complex. JR West did not like delayed SKR trains affecting its operations on the Kusatsu Line, so in 1990, it installed a special device called a Direction Priority Lever (DDL) on the control panel at the Kameyama CTC Centre, controlling the Kusatsu and Kansai lines. By using the DDL, JR West dispatchers could lock the SKR departure signals at red in order to give priority to Shigaraki-bound trains. JR West insisted that SKR had been duly informed, but SKR claimed it had never received any notice.

In March 2000, Otsu District Court ruled that the duty stationmaster, signal engineer and SKR track and signalling manager were guilty of professional negligence resulting in death and injury. In a 1999 civil trial seeking damages, Osaka District Court ordered both SKR and JR West to jointly pay ¥500 million to the victims. JR West immediately filed an appeal to the High Court.

This accident prompted reviews of the existing accident investigation procedures, leading to the establishment of the ARAIC. ■

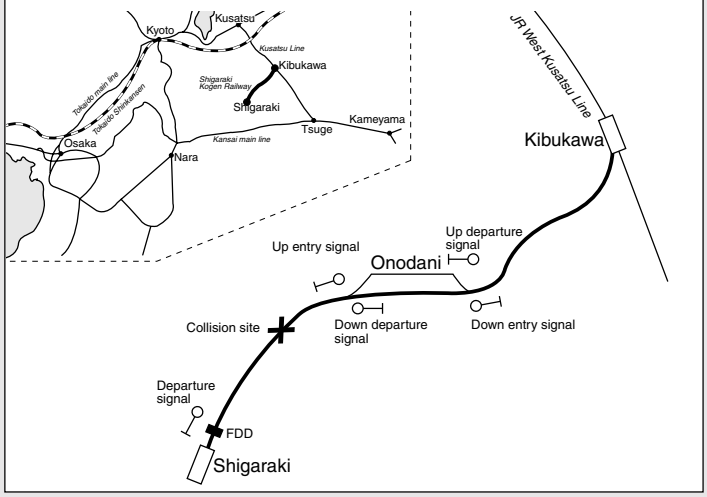
T. Suga

SKR Train Diagram on Accident Day



(Adapted from *Shigaraki Kogen Railway Accident* by Ryoichi Amitani, 1997.)

Shigaraki Kogen Railway Track and Signal Layout



Derailment and Collision at Naka Meguro on Hibiya Subway Line, Tokyo on 8 March 2000

At 0901 on 8 March 2000, when a southbound Hibiya Line eight-car EMU owned by Teito Rapid Transit Authority (TRTA, a Tokyo metro operator) was approaching Naka Meguro Station at 12 to 13 km/h, the two axles of the front bogie of the last car suddenly derailed. A trackside lead rail installed for setting off track maintenance vehicles caused the derailed 8th car to slew further right, hitting the 5th and 6th cars of a northbound eight-car EMU (owned by Tobu Railway). The southbound TRTA EMU stopped a few seconds after the collision when the conductor applied the emergency brake; the northbound Tobu EMU stopped automatically because the brake air pipe was broken between the 5th and 6th cars. The 8th car of the southbound train and the 5th and 6th cars of the northbound train were severely damaged, killing five passengers and injuring 63 others (see photograph on page 21).

The derailment of the southbound train occurred at a difficult location on a transition curve after a sharp curve with a radius of 160 m and a steeply rising grade at 35 per mill. The track gauge is 1067 mm and there was no anti-derailment guardrail.

The TRTA Hibiya Line was completed in the 1960s as one of the earliest examples of through operations with suburban private railways. It is connected to Tobu Railway's Isezaki Line at Kita Senju (north end) and to Tokyu Corporation's Toyoko Line at Naka Meguro (south end). There are many sharp curves, because the line was built under public roads as much as possible to avoid expensive land acquisitions. Consequently, to allow smooth passage of trains on curves, the length of cars is limited to 18 m rather than the normal 20 m.

The accident shook the public, because it occurred on a heavily used urban line close to the centre of Tokyo. The Railway Accident Investigation Working Group (RAIWG)—an advisory body to the Director General of the Railway Bureau at the Ministry of Land, Infrastructure and Transport—was immediately called and started intensive studies. The investigation included track inspection at the accident site, rolling stock inspection, measurement of the static and dynamic wheel loads and lateral thrust at the derailment site, simulation of derailment conditions, hearings from relevant parties, such as TRTA track engineers, rolling stock maintenance engineers, manufacturers, etc.

After 21 meetings, a 107-page final report was published in October 2000. The report noted that multiple factors caused the southbound train to derail at this particular spot. They included:

- Unbalanced static wheel load, causing extremely decreased wheel load and increased lateral thrust to outer wheels running on curve
- Increased coefficient of rail–wheel friction due to setting of rail lubricator, causing undesirable increased lateral thrust
- Track irregularity, especially twist and diminishing cant, causing decreased outer wheel load
- Performance of axle suspension possibly contributing to undesirably decreased outer wheel load
- Combination of wheel and rail profiles, leading to increased lateral thrust
- Low-speed running at 12–13 km/h, preventing increase of outer wheel load by centrifugal force
- High air suspension rigidity against bogie rotation causing increased lateral thrust

The report concluded that these factors had been compounded to such a degree that the flanges of the outer wheels rode up over the rail head to finally derail. It also examined the structure of the damaged rolling stock and the conditions of the lead rails to set off track maintenance vehicles.

To prevent similar accidents, the report proposed stricter control of static wheel load; proper management of track regularity, especially flatness; appropriate management of rail profile after grinding; increase of flange angle from current 60° to 65° or 70°; and installation of anti-derailment guardrails at sharp curves. The report also proposed further studies on improved methods for measuring static wheel load, improved rolling stock performance at curves, better track design at sharp curves, and new rolling stock impact design to minimize passenger injuries. ■

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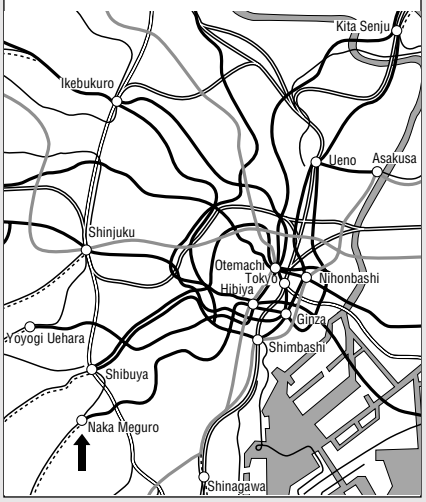
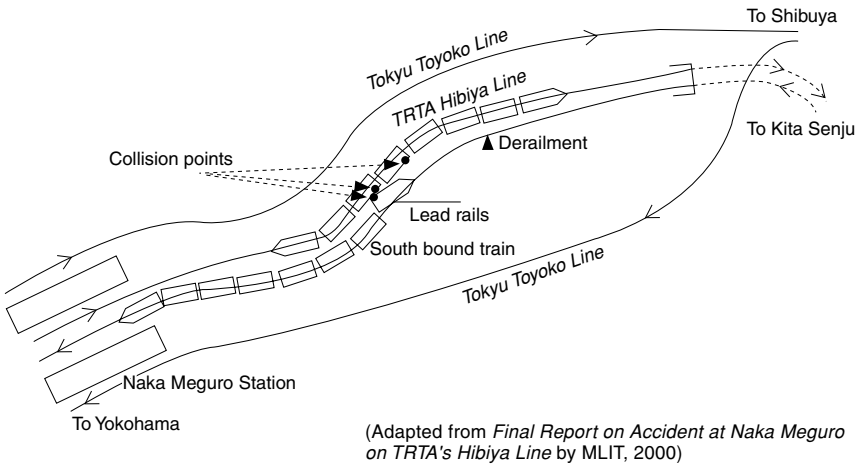
Tokyo Subway Network in 1999



Site of TRTA Train Derailment and Collision



(Adapted from *Final Report on Accident at Naka Meguro on TRTA's Hibiya Line* by MLIT, 2000)