Legislative Council Panel on Transport
Subcommittee on Matters Relating to Railways
29 March 2019

Incident of the new signalling system testing on Tsuen Wan Line on 18 March 2019

Introduction

Railway safety is of utmost importance. The Government and the MTR Corporation Limited (MTRCL) are both very concerned about the incident on 18 March 2019, where two trains collided near Central Station during one of the non-traffic hours scenario testing pertinent to the signalling system upgrade programme.

2. The Government has requested the MTRCL to conduct in-depth investigation of the incident and the Corporation has set up an investigation panel comprising local and overseas experts to look into and ascertain the cause of the incident. The initial report is expected to be ready in about three months. As a matter of prudence, the MTRCL has immediately suspended all the train tests pertinent to the signalling system upgrade programme, until the cause of the incident has been identified and the new signalling system is confirmed to be safe. Moreover, the Electrical and Mechanical Services Department (EMSD), as the regulator responsible for railway safety, will in parallel conduct professional and independent investigation in order to find out the cause of the incident and to ensure railway safety.

3. This paper briefs the Subcommittee on the process of signalling system upgrade, the incident and findings of the MTRCL's initial investigation.

Process of Signalling System Upgrading

4. In 2015, the MTRCL awarded a contract of $3.3 billion for upgrading the signalling systems of seven railway lines (Tsuen Wan Line, Island Line, Kwun Tong Line, Tseung Kwan O Line, Disneyland Resort Line, Tung Chung Line and the Airport Express).

5. The signalling system is essential to the safe operations of train services in the railway network. Railway lines are divided into blocks and

only one train is allowed in each of these blocks at one time in order to ensure trains are kept at a safe distance. The present signalling system of the above-mentioned seven existing railway lines adopts a fixed block concept[1]; while the new system, capitalised on a "Communications Based Train Control" technology (CBTC)[2], will adopt a moving block concept, which will enable the MTRCL to maintain a safe distance between trains while increasing train frequency and capacity.

6. The Corporation adopts a stringent approach at each and every stage of the upgrading programme, including the requirements specification, tendering, design, installation, simulation testing, on-site system testing, as well as scenario testing in order to ensure the safety and reliability of the new signalling system before it is put into service.

7. At the tendering stage, the Corporation adheres to a set of open and fair procedures to conduct the tendering exercise, following the Agreement on Government Procurement of the World Trade Organization. During the tendering process, the Corporation would study and assess in detail all tenders based on a number of factors including the tenderers' experience, size, and track records with a view to ensuring that the awardee has the required capabilities, skillsets, and experience to complete the work according to the contract terms.

8. The contract between the Corporation and the signalling system contractor has set out that the new signalling system requires the installation of zone-controller comprising the main, the stand-by, and the back-up computers with specifications on their performance and functions. Signalling systems are in general operated on main and stand-by sector computers. The MTRCL has specified in the contract that the contractor has to provide a back-up system in addition to the main and stand-by systems, with a view to further enhancing the reliability and availability of the new signalling system.

9. As stated in the contract, the signalling system contractor is responsible for designing the signalling system, developing the proprietary hardware and software, and carrying out simulation and on-site tests, to confirm and verify the safety and reliability of the system operations. As the end user of the system and the railway operator, the MTRCL would

[1] With the fixed block concept, if there is a train in a certain fixed block, the signalling system will send commands to the following train not to enter that block.

[2] The new signalling system uses wireless communication to transmit signals from trains such as location and speed of train to the control computer. The computer then works out the safety distance required between trains.

examine the tests conducted by the contractor, formulate various operation scenarios as derived from the operating experience in the past and carry out on-site testing.

10. Since 2015 when the MTRCL launched the signalling system upgrade programme on Tsuen Wan Line, the Corporation has been in close collaboration with the contractor at the design, installation, simulation and on-site testing stages by, for example, holding regular meetings with the contractor to exchange views on the design requirements, and sending staff to the contractor's simulation laboratory based in Toronto, Canada, to witness the simulation tests, etc.. The contractor is required to conduct simulation tests on different scenarios, according to the features of its proprietary software, the MTRCL's requirements, and the actual operation circumstances of the railway network in Hong Kong. After the contractor has finished all the simulation tests, obtained clearance according to its internal safety audits, and provided the MTRCL with the safety related documentation as specified in the contract, the contractor may then install the software in the on-site equipment and carry out on-site testing on the relevant lines.

11. The new signalling system adopts CBTC technology, which includes zone controller comprising three computers, namely the aforementioned main, stand-by and back-up computers. During the stage of simulation tests, the contractor has tested the three computers individually where each computer was able to function safely and independently. The contractor has also tested the scenarios involving switching between computers, including a scenario where the main and stand-by computers were switched to the back-up computer and upon the completion of such simulation tests, on-site test involving the operation of multiple trains has been conducted.

12. Since late 2016, the on-site tests of the new signalling system have been carried out in non-traffic hours at Tsuen Wan Line by sections. The testing was conducted prudently and incrementally by phases. The MTRCL first conducted on-site tests without trains, then moved on to conduct operational tests involving trains, the number of which would be increased incrementally. As of the tests scope, the MTRCL started with a smaller scope such as one to two signalling equipment, and gradually extend to tests of running trains within one station, then between two stations, and until early 2018, the commencement of full line testing. The whole signalling system upgrade programme and the on-going tests are implemented in accordance with stringent international standards.

13. In order to ensure the safety and reliability of the new signalling system before it is put into operation, the MTRCL has appointed an Independent Safety Assessor to continuously assess the system safety assurance work done by the contractor, and provide the safety endorsement document upon satisfactory assessment. On the other hand, the MTRCL has also appointed an external independent international consultant to provide opinions.

14. During the testing stage of the new signalling system, the EMSD has duly performed its role as the regulator and gatekeeper. Besides requesting the MTRCL to provide the safety certificates issued by the contractor which confirms the safety of the system before conducting testing, the EMSD also participated in and observed sampled safety tests conducted on-site by the MTRCL, to ensure compliance with relevant safety requirements. The sampled testing items that the EMSD participated in include testing on the safety protection function of the signalling system, emergency brake, over-speed protection, the complementary operation between trains and platform gates etc.. Upon the completion of testing of the new signalling system by the MTRCL, the EMSD will also conduct independent assessment (including requesting the MTRCL to conduct some further on-site testing), in order to confirm the safety and soundness of the new system, before approving the commissioning of the new signalling system for daily operation.

Details of the incident

15. At around 2:45 a.m. of 18 March, which was non-traffic hours, scenario testing was being conducted on the new signalling system on Tsuen Wan Line. An MTR train, entering the platform of Central Station through a crossover[3], collided with another train that was departing from Central Station for Admiralty Station through the crossover at the same time, causing damage to the second to fourth cars of the latter train. The diagram at **Annex 1** illustrates the scenario.

16. Two bogies of one of the damaged trains were derailed after the collision. As the MTRCL operations engineering staff assessed that it would take a longer time to remove the train from the main line, at 2:56 a.m. the MTRCL informed the Emergency Transport Coordination Centre of the Transport Department (TD) about the incident, and at 3:17 a.m. informed the TD that the incident would affect the traffic of Tsuen Wan Line on the day.

[3] A crossover is the track that connects two parallel rail tracks.

The MTRCL issued a "Red Alert" at 4 a.m.[4].

17. During 18 to 19 March, the MTRCL deployed around 120 operations engineering staff to work day-and-night with a view to moving the derailed train away from the main line. The train service between Central and Admiralty stations on the Tsuen Wan Line was suspended while service between Admiralty and Tsuen Wan stations was maintained at intervals of 3.5 minutes during peak hours. Passengers commuting between Admiralty and Central stations needed to take the Island Line, or other public transportation.

18. During the peak hours of the incident, the MTRCL deployed around 250 additional staff to the affected stations to provide assistance to passengers and implement crowd control measures. The stations were in order. From the time of the incident till the mid-night of 20 March, the MTRCL operations engineering staff spared no efforts in the recovery works, including detailed checking and repairing of the tracks and the relevant equipment, and moving of the trains away from the main line. Regular service of Tsuen Wan Line between Central and Admiralty Stations resumed on 20 March after confirmation of the safety and integrity of the train equipment.

19. The sequence of events is at **Annex 2**.

Contingency arrangements during the incident

Incident reporting and information dissemination

20. During the incident, the MTRCL timely notified the Fire Services Department (FSD), the EMSD and the TD, and issued a "Red Alert" which represented that a serious service disruption happened. The MTRCL also informed passengers about the service disruption on Tsuen Wan Line through the media, so that passengers could get prepared before going to work on the day.

21. During the period when train service was affected, the MTRCL updated passengers on the latest service arrangement and information about

[4] "Red Alert" is a signal to indicate that a serious railway service disruption has continued or is expected to continue for over 20 minutes, and emergency transport services from other operators are required. Upon being alerted, the TD will coordinate with other public transport operators to mobilise their resources, in order to provide appropriate supporting services as quickly as possible.

other means of transportation via its mobile apps, "Traffic News", at-stations and in-train broadcast, information placed at stations and at ground levels, and Passenger Information Display System located next to the entry gates. After resumption of train service, the Corporation also informed the public via its mobile apps and the media. From the start of the incident till the completion of recovery works, the Corporation regularly updated the media on the development of the incident, train service arrangements, and follow-up work.

22. Upon receiving the MTRCL's notification, taking into account the severity of the incident, ETCC of the TD upgraded its operation level to Level 3 (Joint steering mode operation)[5], led by directorate staff of the TD, and deployed additional staff to coordinate with other public transport operators and to provide emergency support. The ETCC has maintained close liaison with the MTRCL during the incident, and closely monitor the MTRCL's dissemination of information to passenger and management of passenger flow in stations. It also disseminated press releases through the media, and informed the public of the latest developments and traffic arrangements through its website and mobile application. The TD has also deployed staff to key affected stations (Tsim Sha Tsui, Admiralty, Central, Hong Kong and North Point) and major bus stops (including those at the Cross Harbour Tunnel toll plaza, Queensway and Des Voeux Road) to monitor the situation on-site. The EMSD also deployed staff to investigate the incident and monitor the repair work on-site.

Other transport services

23. Upon receiving the MTRCL's notification, the ETCC continued to closely liaise with franchised bus, tram and ferry operators on 18 and 19 March, requesting them to enhance services and deploy additional staff to assist passengers in queuing. With the TD's coordination, 39 routes of franchised bus, 23 additional trams and 6 additional Star Ferry enhanced its service during the incident to assist in picking up affected passengers. The ETCC also maintained close liaison with the MTRCL on the day, and

[5] Under normal circumstances, the ETCC, operating 24 hours a day, handles daily minor traffic accidents at Level 1. In the event of small-scale pre-planned activities, serious road or tunnel incidents, serious or widespread disruption of public transport services, the operation of the ETCC will operate at Level 2 and additional staff will be deployed. In the event of large-scale pre-planned activities, or serious incident requiring high-level steering and coordination across bureaux and departments, the ETCC will operate at Level 3, i.e. Joint steering mode operation. The TD will invite other departments such as the Police, the Highways Department, public transport operators, or key event organiser to the ETCC to handle the incident. The operation of the ETCC will be led and coordinated by Deputy Head (directorate staff).

disseminated information concerning the latest development of the incident and transportation arrangements to the public through media and mobile application. The TD also advised the public through radio to plan their trips well in advance, and consider other routing and transportations, in order to minimise the impact of the incident.

Recovery

24. When the train service was suspended on 18 March, the MTRCL operations engineering staff and operations contractor staff proceeded with their recovery work in full swing. Such task was very challenging as the incident happened inside a tunnel with limited space for manoeuvring. To ensure the recovery process was carried out safely, the operations engineering team could only move the derailed trains bit by bit with a view to moving it back on track. The team sought support from the FSD. Because of these constraints, the recovery time was longer than expected. At 11 p.m. of 19 March, the team successfully re-railed the two bogies of one of the damaged trains back on track. The recovery work of the on-site equipment was subsequently completed at around 1:15 a.m. of 20 March, and then the MTRCL moved the trains to the sidings at Admiralty Station and conducted safety inspection. Normal train service was resumed on the very same day. The EMSD has monitored the whole recovery process and conducted a series of safety tests together with the MTRCL before the resumption of service between Central and Admiralty Station, in order to ensure railway operation safety.

Ensuring the safety of the existing signalling system

25. The hardware and software of the new signalling system under testing are different from that of the existing signalling system. They are two separate systems. At the time of the incident, scenario testings of the new signalling system were being conducted on Tsuen Wan Line and the existing signalling system was completely segregated. All signalling equipment and train carrying signals were controlled by the new system at the material time. Hence, the incident was not related to the existing signalling system, and the incident of similar nature would not occur on the existing lines.

26. That said, during the non-traffic period on the day of the incident, the EMSD has conducted on-site inspection of the interlocking functions of the computer-controlled turnouts of the existing signalling system. The results show that the existing system continues to operate effectively. Railway and public safety are being protected.

Initial observation

27. The cause of the incident will be further investigated into and analysed by the investigation panel. On the day the incident, the MTRCL immediately held an urgent meeting with the contractor of the new signalling system, Alstom-Thales DUAT JV[6]. The contractor has also collected the system data during incident, and reproduced the incident scenario in the simulation laboratory in Toronto, Canada.

28. According to initial observations, as mentioned above, the new signalling system adopts CBTC technology with the zone controller comprising three computers namely the main, the stand-by, and the back-up computers. The incident occurred during scenario testing where the main and stand-by computers had both deliberately put to failure and automatically switched to the back-up computer in order to test the required contingency measures, recovery procedures and continuation of smooth operation after take-over by the back-up computer.

29. During such scenario testing, when the new signalling system had switched to the back-up computer, an MTR train at No. 2 platform of Central Station was authorised by the system to move to Admiralty via the crossover, and at the same time another train from Admiralty Station was also authorised by the system to move to No.1 platform of Central station via the crossover, and the two trains collided. After the incident, the contractor reproduced the incident scenario in the simulation laboratory in Toronto, Canada, and the same problem occurred when simulating the same scenario.

30. Under normal circumstances, the signalling system should have the position information of all the trains running in the network, and ensure a safe distance between trains. The system should not allow trains to run in conflicting routes (i.e. effectively the safety inter-locking function) to avoid any incident. This is the very fundamental design reflecting the safety operations of modern railway system. However, the preliminary findings show that at the time of conducting the scenario testing, after train control had been switched to the back-up system, the safety inter-locking function of the back-up system was not effective at the related section as it should have been in normal circumstances according to the design. Hence, both trains

[6] The contractor of the new signalling system is Alstom-Thales DUAT JV, a joint venture of Alstom Hong Kong Limited (Alstom) and Thales Transport & Security (Hong Kong) Limited (Thales). The headquarters of the two companies are in France. The new CBTC technology is provided by the technical department of Thales in Canada. The MTRCL awarded the contract of the signalling system upgrade project to this contractor in January 2015, with a total contract value of $3.3 billion.

entered the conflicting routes at the same time and collided. The MTRCL and the contractor will thoroughly investigate into the incident, covering the system structure, design, switching between computers, the integration of software and hardware, the system protection procedures, testing procedures, etc, to identify the cause of the incident.

Follow-up

31. The MTRCL always put the safety of passengers and colleagues at top priority. The MTRCL and the experts of the signalling system contractor will fully cooperate with the investigation panel to conduct in-depth investigation into the cause of the incident. The EMSD will also conduct professional and independent investigation at the same time, including the appointment of independent consultants to review the information and reports submitted by the MTRCL, its contractors and experts to ascertain the cause of the incident.

32. The MTRCL has informed the EMSD and announced that all train tests for the new signalling system during non-traffic hours will continue to be suspended. The MTRCL also reserves the right to take action against the signalling system contractor according to the contract and in the light of the investigation findings. Only when the MTRCL and the EMSD ascertain the cause of the incident and remedial work has been taken will the Government allow the MTRCL to resume testing of the new signalling system during non-traffic hours.

33. The MTRCL stresses that the new signalling system will have to undergo vigorous and numerous testing and be confirmed safe for operation by relevant Government departments before it will be put into service. The EMSD, together with other relevant Government departments, will conduct stringent and independent assessment on the new signalling system and approve the system to be put into service only after ensuring that the system operates safely and smoothly.

34. According to the "Service Performance Arrangements" under the MTR Fare Adjustment Mechanism, for any service disruption of 31 minutes or more due to system breakdown or other human factors, the MTRCL will set aside a certain amount to provide fare concession to passengers. The train service between Central and Admiralty stations on Tsuen Wan Line was temporarily suspended for two days (18 and 19 March), the MTRCL will set aside a corresponding amount. The Government will also follow up with the MTRCL seriously.

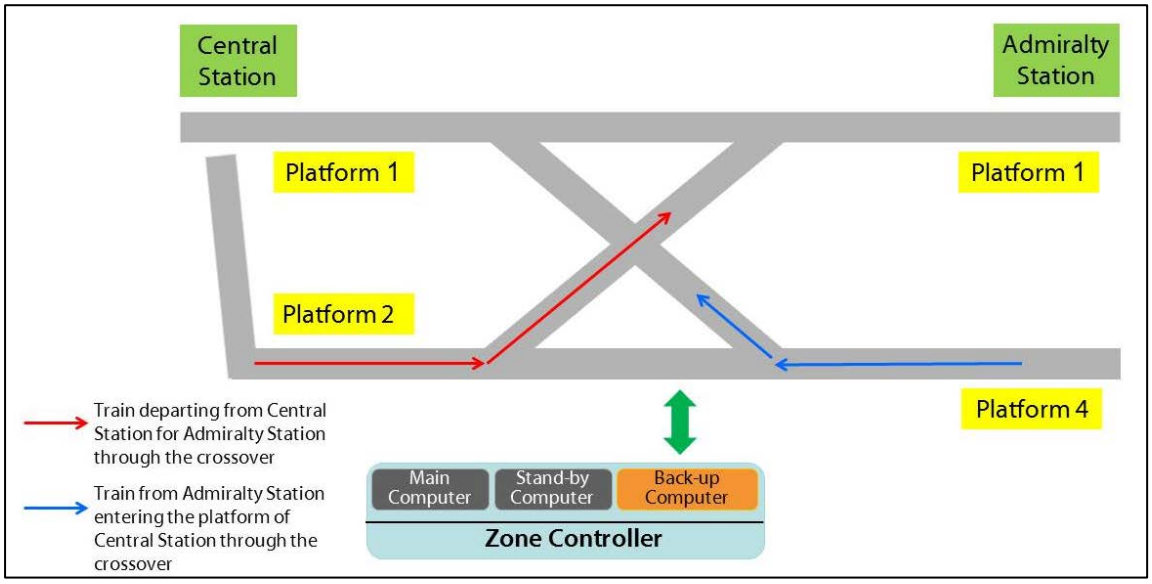
35. The MTRCL apologises for causing inconvenience to the public due to the incident, and appreciate their patience and cooperation.

Transport and Housing Bureau
MTRCL
March 2019

Annex 1

Incident of the new signalling system testing on Tsuen Wan Line on 18 March 2019

Illustration of the Scenario



Annex 2

Incident of the new signalling system testing on Tsuen Wan Line on 18 March 2019

Time	Issue
18 March 2019	
2:45 a.m.	Two trains collided nearer Central Station.
2:54 a.m.	Fire Services Department and Hong Kong Police Force were informed. The two drivers were sent to hospital for medical treatment or inspection, and were discharged in the morning of the same day.
2:56 a.m.	Transport Department (TD) was informed of the incident.
3:00 a.m.	Electrical and Mechanical Services Department was informed.
3:17 a.m.	TD was informed regarding the service disruption on Tsuen Wan Line on the day.
4:00 a.m.	"Red alert" issued by the MTRCL. Passengers were informed of the Tsuen Wan Line service disruption through Traffic News and media. Train service between Admiralty Station and Central Station of Tsuen Wan Line was temporarily suspended.
6:30 a.m.	Media briefing on the latest development and train service update.
11:30 a.m.	Media briefing on the latest development including the announcement of setting up an investigation panel to look into the cause of the incident.
2:00 p.m.	The MTRCL met the signalling system contractor and requested the latter to submit a report and facilitate the investigation.
5:00 p.m.	Media briefing on the initial observations after meeting with the contractor.
19 March 2019	
Whole day	Recovery works in progress.
6:30 a.m.	Media briefing on the recovery works progress and continued suspension of train service between Admiralty Station and Central Station for Tsuen Wan Line.
6:00 p.m.	Media briefing on the follow-up action of the Board of the MTRCL and explanation of the incident.
11:00 p.m.	Two bogies of one of the trains were re-railed.
20 March 2019	
0:00 a.m. to 1:15 a.m.	Recovery works in progress.
1:15 a.m.	The trains were moved to the sidings at Admiralty Station and safety inspection was conducted after recovery works completed.

Time	Issue
4:45 a.m.	Passengers was informed that the trains were moved away from the main line, recovery works were completed and the Tsuen Wan Line train service would resume on the day through Traffic News and media.
10:00 a.m.	Media briefing on the train operations after service resumption, and the processes and challenges of recovery works.