

**Legislative Council Panel on Transport
Subcommittee on Matters Relating to Railways**

Recent Railway Incidents involving MTR Rail Cracks

The Subcommittee on Matters Relating to Railways under the Legislative Council Panel on Transport discussed the recent railway incidents involving rail cracks at its special meeting held on 21 February 2011. This paper sets out the Government's assessment of the findings of the investigations by MTR Corporation Limited ("MTRCL") on the three rail breakage incidents which occurred in January and February 2011.

Background

East Rail Line Incident on 13 January 2011

2. In the morning of 13 January 2011, before start of the traffic hours, a breakage was identified by MTRCL at a rail section near Fo Tan Station of the East Rail Line. Emergency repair work was subsequently completed with application of steel plates to the incident rail for reinforcement. The incident rail was replaced after the traffic hours of the day.

Tung Chung Line Incident on 19 January 2011

3. In the morning of 19 January 2011, a breakage was identified by MTRCL at a rail section near Sunny Bay Station of the Tung Chung Line. Emergency repair work was subsequently completed with application of steel plates to the incident rail for reinforcement. The incident rail was replaced after the traffic hours of the day.

Tsuen Wan Line Incident on 10 February 2011

4. In the morning of 10 February 2011, a breakage was identified by MTRCL at a rail of the Tsuen Wan Line near Admiralty Station. MTRCL carried out emergency repair work with application of steel plates to the incident rail section. The incident rail was replaced after the traffic hours of the day.

5. In each incident, train operation was maintained by MTRCL without compromising safety by lowering of train speed, emergency repair and close monitoring of operation conditions.

6. All incident rail sections were sent to the City University of Hong Kong (“CityU”) by MTRCL with rail samples sent to a laboratory in USA for analysis to ascertain the exact causes of each incident. The Electrical and Mechanical Services Department (“EMSD”) has engaged a material science expert to oversee the CityU laboratory analysis process to ensure that the examination process and methodologies are appropriate.

Findings of MTRCL’s Investigation

7. The CityU laboratory took forward the investigations by examining the rail fracture surfaces and the hardness of each rail section. The fracture surfaces and cross sections were examined by using a scanning electron microscope and energy dispersive x-ray micro-analysis. For each incident, an accurate chemical analysis was also conducted by a laboratory in USA to determine the chemical composition of the rail.

8. According to the investigation reports prepared by the CityU incorporating the laboratory results on chemical composition, the results and findings are as follows -

(a) *East Rail Line Incident on 13 January 2011*

The portion of broken rail was part of an assembly of an insulated rail joint (“IRJ”) which was mechanically connected with plastic-coated steel plates and bolts. The result of laboratory testing and analysis revealed that the rail material was normal. The breakage was due to a bolt of smaller diameter being temporarily used for fixing the IRJ. When trains passed over the IRJ, there was increased stress concentration on the rail causing the breakage.

(b) *Tung Chung Line Incident on 19 January 2011*

The result of laboratory testing and analysis revealed that the rail material was normal. However, there existed a steel pipe passing under the broken rail across the track and its proximity to the rail bottom had been inducing corrosion and

intermittent arcing. Operation of the rail under this condition had led to localised loss of material at the bottom and from there the initiation of a crack. Propagation of the crack had resulted in breakage of the rail section.

(c) *Tsuen Wan Line Incident on 10 February 2011*

The result of laboratory testing and analysis revealed that the rail material was normal. The bottom of the weld which protruding below the rail bottom surface bridged up the rails. Whilst the size of the weld protrusion was within the limit specified by the supplier, this operating condition, compounded by track curvature, gave rise to high stress at the rail/weld interface where a crack was initiated causing the rail breakage.

Government's Assessment

9. The material science expert engaged by EMSD has overseen the examination processes at the CityU and agreed that the test methodologies were appropriate. The expert also examined each incident rail sample and concurred with the laboratory findings. EMSD has reviewed the laboratory analysis reports submitted by MTRCL and generally agreed with the findings.

10. For the East Rail Line incident, a temporary bolt of smaller diameter was installed on 5 January 2011 for fixing the incident IRJ prior to the rail breakage on 13 January 2011. Investigation revealed that replacement of the temporary bolt and the IRJ rail sections were scheduled after the end of passenger service on 23 January 2011. The long lead time in completing the final repair is far too long and not acceptable.

11. The Tung Chung Line incident is an isolated incident as remarked in the CityU report. We note that MTRCL has issued an instruction on the implementation of piping installation work to avoid similar occurrences in future.

12. For the Tsuen Wan Line incident, the weld protrusion had bridged up the incident rail section and made the rail more susceptible to high stress exerted by the wheel load. There is room for improvement in work process management in respect of rail installation.

Remedial Measures

13. In the light of the investigation results, the Government proposes the following remedial measures -

(a) *East Rail Line Incident on 13 January 2011*

Although MTRCL had taken temporary corrective actions in an attempt to make good the IRJ fixture, its pace was not fast enough. The incident could have been prevented should MTRCL have been prompt enough in fixing the IRJ with bolt of standard size. Along this line, any temporary measures must be rectified as soon as possible to minimise potential risk. The MTRCL should take the incident as a lesson learnt on crisis management.

MTRCL has replaced the incident rail together with the IRJ on 14 January 2011. MTRCL has conducted fleet check for the MTR network and identified seven other IRJs on the East Rail Line and one on the Island Line with a smaller bolt, where the standard diameter bolt cannot fit. No cracks were found in the rails. As an immediate measure, MTRCL has completed re-drilling of the eight identified IRJs and replacement with standard bolts on 11 March 2011. MTRCL has committed to replacing all the eight IRJs together with the rail concerned by end April 2011. EMSD has urged MTRCL to expedite the replacement programme as far as practicable. Pending completion of the work programme, MTRCL has deployed patrolmen to closely monitor the IRJs and rails before replacement and EMSD will continue to monitor the replacement of the IRJs concerned.

(b) *Tung Chung Line Incident on 19 January 2011*

EMSD reckons that thorough fleet check is essential for prevention of similar rail crack occurrences taking into account the nature of the incident scene. EMSD has advised MTRCL to conduct fleet check on all operating rails that were manufactured by Tata Group (formerly 'British Steel' and 'Corus') and it was confirmed that there was no abnormality. As the incident scene exhibited a transition of

non-ballasted track to ballasted track at the tunnel portal, EMSD has also advised MTRCL to be vigilant on that site condition that could have been increasing the stress on the incident rail. MTRCL followed the instruction of EMSD to conduct inspection of the tracks at the inlet and outlet of tunnel portals for all heavy rail operating lines. MTRCL confirmed that there was no abnormality and that ballasts were adequate at each location to cope with the change of civil structure rigidity at the transition section.

EMSD followed up with MTRCL on piping installations in the MTR infrastructure. MTRCL conducted fleet inspection on all cross track installations and confirmed that there was no other metallic pipe hampering physical integrity of the rail in the MTR network. As a remedial measure, MTRCL replaced the metal pipe by a non-metallic one. Whilst endorsing that being an effective remedy, EMSD considers that it is an absolute requirement that for any works involving piping across the track, the pipe should be segregated and electrically insulated from the rail for avoidance of similar occurrences. MTRCL has issued an instruction in this regard.

(c) *Tsuen Wan Line Incident on 10 February 2011*

The incident rail had been installed on continuous rail pad. It is proposed that continuous rail pad should be avoided at the bottom of the weld seam to ensure uniform support of the rail.

The CityU noted that the incident rail was at a turn of 370m radius. EMSD had checked the design standard governing railway engineering works of MTRCL and noted that such track curvature is relatively high. In this light, EMSD considered that MTRCL should be more vigilant on the rail condition of sharp bending tracks which are more susceptible to concentrated stress by traffic loads.

Conclusion

14. In conclusion, in each of the incidents, MTRCL immediately made temporary repair and reinforcement to the rails, MTRCL also lowered train speed and monitored operation conditions closely. As such, EMSD considers that railway safety was not compromised. Having reviewed the investigation reports submitted by MTRCL, EMSD has asked that improvement measures in the areas of track work process management in respect of rail installation, preparedness for prompt and effective emergency repair and conformance to design standards for works be undertaken. EMSD will continue to follow up with MTRCL on timely implementation of these measures as appropriate. EMSD also notes that MTRCL will make public the number of rail breakage cases.

15. MTRCL has engaged the Institute of Railway Technology of the Monash University for a 4-month study on rail procurement, quality control, inspection and maintenance of rails pertaining to the risks of rail cracks and breakages. EMSD has separately commissioned a permanent way expert to scrutinise the Monash University's study and to ensure that appropriate methodologies, breadth and depth are covered in the review.

Transport and Housing Bureau
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