Annex A

Legislative Council Panel on Transport
Subcommittee on Matters Relating to Railways

Review of MTR's Rail Procurement and Maintenance Regime

Purpose

At the meeting of the Subcommittee on Matters Relating to Railways under the Legislative Council Panel on Transport held on 18 March 2011 which discussed "Recent Railway Incidents involving Rail Cracks", the MTR Corporation Limited (MTRCL) advised Members it had engaged rail technology experts from the Monash University – Institute of Railway Technology ("IRT") to conduct a comprehensive review of MTRCL's rail procurement, quality control, and inspection and maintenance regime with particular focus on rail cracks and breakages.

2. This paper briefs Members on the result of the review, improvement recommendations from IRT and MTRCL's action plan for implementation.

The IRT Review

3. The objective of the IRT review was to assess MTRCL's standards and procedures in relation to rail procurement, quality control, inspection and maintenance regime to determine areas where improvements could be made to minimise the occurrence of broken rails in the MTR network.

4. The scope of the review covered the following :

- MTRCL's procurement process for plain rail, switches and crossings and rail expansion joints;
- Control and quality assurance of manufacturers;
- Adequacy of MTRCL's inspection and maintenance regime, including site welding procedures;
- Technology currently used by MTRCL in non-destructive testing of rail defects; and
- Management of broken and defective rails by MTRCL.

5. The Executive Summary of the review report is at the Annex.

Summary of findings

6. In the review, IRT assessed current MTRCL standards against relevant international standards as well as current best practices from comparable railway operators around the world.

7. It was found that the standards adopted by MTRCL in its rail procurement, quality control, inspection and maintenance regime are generally adequate as they make reference to appropriate international standards. While the maintenance techniques used are seen to be equivalent to those in other railways, the frequency of inspections in the MTR network, particularly through rail-mounted ultrasonic testing, is generally more frequent than found in other railways.

Procurement Process

8. MTRCL makes reference to European standard EN13674-1 in its procurement of rails from existing suppliers. IRT finds the standard is appropriate for ensuring the supply of plain rail, and plain rails used in the manufacture of switches and crossings is fit for purpose for the current loading characteristics of the MTR network. IRT recommends any new suppliers also be required to demonstrate they meet the qualifying requirements of the European standard.

9. For the procurement of cast crossings, MTRCL references International Union of Railways standard UIC866 as this was the applicable standard when the railway lines were designed and specified. While this is considered adequate, IRT considers the new European standard EN15689, available since 2009, provides more stringent testing requirements and recommends MTRCL to adopt this new European standard to improve the manufacture of such crossings.

10. At present, there is no international standard for the production of tri-metal welds for crossings. Nevertheless, a new European standard EN14587-3 is expected to be published next year (2012) which will control the production quality of tri-metal welds. As three of the 14 broken rail cases recorded in the MTR network since 2008 involved tri-metal welds, IRT recommends MTRCL to adopt the new European standard EN14587-3. MTRCL can make early plans for adoption by making reference to the draft version that is available now.

Control and Quality Assurance

11. When accepting materials for dispatch from manufacturers' premises, MTRCL representatives review and approve the supplied documentation for all materials and make site visits to conduct physical checks. IRT finds the MTRCL system to be appropriate and robust. Test certificates also show that rails supplied for the MTR network meet required chemical and mechanical properties. As an improvement, IRT suggests MTRCL should fully inspect incoming materials to check that component/batch numbers marked on the materials match those on the consignment notes. MTRCL will also enhance its incoming goods inspection in Hong Kong to check for any damage which may have occurred during shipping.

Inspection and Maintenance

12. MTRCL's rail inspection regime involving visual inspection and non-destructive testing etc is found to be consistent with the regime in comparable railway systems. IRT notes the frequency of inspections in the MTR network, particularly in rail-mounted ultrasonic testing, is generally more frequent than comparable railways.

13. As design and construction of the early MTR lines generally referenced standards used by British Railways, MTRCL's procedures for the approval of aluminothermic welding processes adopted British Railways Board Standard BR522. As is the common practice in rail systems around the world, MTRCL staff are trained and certified by the suppliers of the aluminothermic welding materials. IRT points out that European standard EN14730 provides for a more comprehensive approach to the approval of welding processes, qualification of welding personnel and acceptance of welds as well as assessment independent of the materials supplier. As five of the 14 broken rail cases recorded in the MTR network since 2008 involved aluminothermic welds, IRT recommends MTRCL to adopt the EN14730 standard to bring improvement in the site welding procedure and possible reduction in the risk of weld defects leading to rail breakage.

14. The training and qualification of personnel carrying out non-destructive testing is based on the American ASNT SNT-TC-1A system which is a widely used standard for non-destructive testing in railway operations worldwide. IRT considers that additional assurance can be provided to the skills of testing personnel for MTRCL to move, as

some non-railway industries have done, to a system based on the ISO9712 standard which provides for independent examination and certification of non-destructive testing personnel.

Non-destructive Testing (NDT) Technology

15. IRT considers the NDT equipment and processes used by MTRCL in rail inspection, including ultrasonic testing, magnetic particle testing and dye penetrant testing, are typical of the technology used by other railways in the world.

Management of Broken and Defective Rails

16. Rails are made of steel. As with any metal, the possibility of cracks developing is a natural phenomenon. However, as rails are securely fastened onto track support structures with steel clips which are located two feet apart, even in the event of a breakage, the steel clips will keep the rail firmly in place, preventing movement and ensuring continued safe train operations.

17. The MTRCL has in place stringent procedures for the inspection and maintenance of rails. Regular inspections, including ultrasonic rail testing, visual inspection and dye penetrant testing are conducted as part of the routine maintenance regime. The aim is to identify irregularities and rail cracks/breakages in their early stages of development so that preventive maintenance or replacement of the rail can be conducted in a timely manner. This serves to minimise the chance of cracks/breakages occurring in passenger service hours and causing delays as a result of temporary repairs having to be carried out.

18. IRT also notes the occurrence of defects in rails is an inevitable consequence of the physical loads applied on them and it is possible for defects to develop into a rail breakage. Rail breakages do not necessarily result in serious incidents. If railway operators have a set of appropriate management systems in place, the maintenance of railway safety and minimisation of service disruption can be ensured.

19. MTRCL's responses to rail breakages, including the application of speed restrictions and temporary clamps or "fishplates" prior to full repair, are found to be in line with those used by other railways. On reviewing MTRCL's handling of the 14 rail breakage cases from January

2008 to February 2011, IRT finds they were all properly managed with no negative outcome arising. For a few specific rail defect types, IRT considers MTRCL can, as a proactive measure, review and enhance their categorisation and action, such as size measurement and reportable limits, based on the risk they pose.

Recommendations and Follow-up Action

Recommendation	**Action**
20. Any new rail suppliers be required to comply with European standard EN13674-1.	Already a standing practice in rail procurement contracts with existing suppliers. Any new suppliers in future will also be required to demonstrate they meet the qualifying requirements of the European standard.
21. Adopt new European standard EN15689 to improve the manufacture and testing of finished cast crossings.	With immediate effect, requirement will be written into all future procurement contracts for cast crossings.
22. Adoption of new European standard EN14587-3 (to be published in 2012) to better control the quality of tri-metal welds.	With immediate effect, will make reference to the draft standard now available to require qualification under EN14587-3 for all future procurement contracts for tri-metal welds.
23. Enhance inspection of incoming materials to Hong Kong to check that component/batch numbers marked on the materials match those on the consignment notes as well as check for any damage which may have occurred during shipping.	With immediate effect, included in procedure for inspection and receipt of materials.

24. Train and certify welders according to European standard EN14730.	Adopted. Preparation for certification in progress. Targeted completion of training and certification by third quarter of 2012.
25. Train and qualify NDT personnel according to a system of independent examination and certification based on the ISO9712 standard.	Adopted. Target to have the system ready for implementation in about one year.
26. Review and enhance categorisation and action, such as size measurement and reportable limits, for a few specific rail defect types.	Adopted. Review commenced in August 2011, targeted completion by first quarter of 2012.

Conclusion

27. It is noted that the IRT review concludes the standards adopted by MTRCL in its rail procurement, quality control, inspection and maintenance regime are generally adequate as they make reference to appropriate international standards. Maintenance techniques are equivalent to those used elsewhere and inspection is performed at similar or higher frequencies.

28. In striving for continuous improvement, MTRCL undertakes to adopt the recommendations proposed by IRT to enable further enhancement of the Corporation's rail management regime. Relevant procedures are being renewed as appropriate and preparation for certification under the new standards is underway.

29. MTRCL is committed to implementing its stringent regime for the inspection and maintenance of rail assets. The Corporation will continue to explore new standards, practices and technologies as they become available in the market to make continuous improvements, ensuring the people of Hong Kong continue to enjoy a safe, reliable and efficient railway service.

MTR Corporation
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INSTITUTE OF RAILWAY TECHNOLOGY

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REVIEW OF RAIL PROCUREMENT AND MAINTENANCE PROCESSES AT MTR CORPORATION IN RELATION TO RECENT BROKEN RAILS

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EXECUTIVE SUMMARY

MTR Corporation engaged the Institute of Railway Technology (IRT) at Monash University, Melbourne, Australia to conduct a comprehensive review of MTR's rail procurement, quality control, inspection and maintenance regime with particular focus on rail cracks and breakages following a number of broken rail occurrences within the network.

MTR supplied IRT with a large number of documents related to the above topics. In addition to these IRT obtained relevant international standards, from a variety of standards organisations, as well as procedures from a range of railway operators around the world.

IRT has compared the current MTR standards against these other standards in order to determine whether or not MTR currently represents best practice and if it makes use of the latest available technology, procedures and specifications for its rail management.

The procurement standards that MTR use for plain rail generally reference appropriate international (usually European) product standards. Rail to these specifications are entirely appropriate for use within the MTR network as they are designed for networks of similar loading characteristics. These standards are generally used by railway operators within Europe. Review of the standards demonstrates that the European standards are generally more prescriptive and rigorous than the available alternatives. The MTR standards are therefore adequate for ensuring supply of rail that is fit for purpose. For any new suppliers that may be considered, MTR should require them to meet the qualifying requirements in the European standard.

The standards that MTR use for procuring switch and crossing (S&C) components also generally make reference to appropriate international standards, particularly with reference to the plain rail components, where the relevant European standards are specified. Again these are entirely appropriate for use within MTR. In relation to the supply of cast crossings, MTR use the relevant UIC standard. It is recommended that for future procurement of cast crossings, reference is made to the European standard (EN15689) instead as this is more comprehensive. For the supply and approval of tri metal welds there is currently no specification identified for the quality required. Since 3 recent broken rails were associated with this component this is an important area. MTR is recommended to require suppliers to achieve the specification set out in the (currently provisional) European standard EN14587 as this provides a detailed set of requirements.

MTR supplied IRT with a wide range of documentation related to the acceptance procedures and methods by which material are approved for dispatch. Minutes of site visits provide a comprehensive record of all items approved for dispatch to MTR and MTR representatives are carefully reviewing both the supplied documentation and conducting physical checks of the material before shipment. It is concluded that the MTR system is appropriate and robust.

A review of test certificates identified the rails supplied to MTR all meet the required chemical and mechanical properties and as these will not change during shipment, further metallurgical testing on receipt of goods in Hong Kong is valueless; though MTR should fully inspect incoming materials to check that the component numbers / batch numbers physically marked on the materials match those on the consignment notes.

Inspection of rail by visual, non-destructive testing and other methods, identification and reporting of defect conditions, remedial actions and maintenance activities are key aspects of rail management for all railways. MTR's method of rail management is consistent with that used in comparable systems and its frequency of inspections, particularly rail mounted ultrasonic testing are generally more frequent than comparable railways.

MTR has procedures for the production of aluminothermic welds and training and certification of its welders. The current European standard for aluminothermic welding of rails (EN14730) provides for a more comprehensive approach to the approval of welding processes (Part 1), and qualification of welding personnel, approval of contractors and acceptance of welds (Part 2). MTR's current procedures are based on British Railways Board standards which have now become obsolete and MTR should consider updating its standards in line with EN14730.

Of the 5 broken rails arising from aluminothermic welding, 3 were from defects located in a position in the rail difficult to test, 1 originated from a detectable defect but was installed prior to testing within 48 hours being mandated. For the remaining failure it is not clear if the defect would have been detectable or not. Thus one (possibly two) of the weld failures would have been prevented by inspection within 48 hours. Improvement in the welding procedure would have reduced the risk in all 5 cases.

The system in use by MTR for the training and qualification of NDT personnel is based upon the ASNT SNT-TC-1A system. This is an in-house based system. This ASNT based in house system or similar systems are used in many railway operations worldwide. For some industries however, it is no longer considered

adequate and are they are moving to a system of independent examination and certification based upon the ISO9712 standard.

The NDT technology in use at MTR is typical of the type and range of equipment and processes used by other railways worldwide. The ultrasonic test vehicle in use is a modern system with a standard set of rail testing probes. The system is used in other railways and is comparable / equivalent to a number of other systems that IRT is familiar with.

Of the 4 broken rails that IRT has identified to be non-detectable, it is believed that the most appropriate method of reducing risk from these type of failures is to improve upon the relevant welding procedures.

Occurrence of defects in rails is an inevitable consequence of the physical loads applied on them and it is possible for these defects to develop into a breakage of the rail. Whilst undesirable, it is a relatively normal part of railway operations and does not necessarily result in a serious incident such as a derailment. It is therefore necessary for railways to have a system to manage these occurrences such that safety is maintained and operational disruption of the system is minimised.

The risk and consequence based philosophy behind MTR's rail defect management guidelines is comparable to that of other railways around the world though direct comparisons are difficult due to differing operational characteristics. It is evident though that for a few defect types, MTR's categorisation and action is not as onerous as other railways and these should be reviewed based on the risk they pose.

Railways around the world suffer from broken rails and have developed standards for managing the risk. The most common response is to apply a speed restriction and apply a temporary clamp to hold the broken ends of the rails, prior to full repair of break. MTR's actions are in line with those used by other metro systems and mainline railways. In each of the 14 broken rail cases occurring in MTR since January 2008, the breakages were managed and no negative outcome arose, other than in some but not all cases, minor disruptions to service.