

**Report of the
Independent Monitoring Panel
on
MTRCL's Review of Asset Management
and Maintenance Regime**

21 June 2023

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Executive Summary

1. Following the Tsuen Wan Line train incident on 13 November 2022 and the Tseung Kwan O Line train incident on 5 December 2022, the MTR Corporation Limited (MTRCL) Board of Directors requested the MTRCL management to conduct a comprehensive review of its asset management and maintenance regime to ensure that the management of railway assets is maintained at a high standard. MTRCL announced on 23 December 2022 the appointment of an Expert Panel to conduct the comprehensive review, while the Government established the Independent Monitoring Panel (IMP) to closely monitor MTRCL's review to ensure that it is comprehensive, in-depth, sound and thorough.

2. The MTRCL's review and the IMP's work focus on the asset management and maintenance regime of MTRCL's railway transport operations in Hong Kong, under the Hong Kong Transport Services (HKTS) business unit. The IMP conducted seven meetings with MTRCL to closely monitor the progress of MTRCL's review. It also reviewed MTRCL's submissions on various topics under the asset management and maintenance regime to ensure the completeness and thoroughness of the review findings and the recommended follow-up actions. It was an interactive process in which the IMP would formulate its views and recommendations on MTRCL's asset management and maintenance regime upon reviewing MTRCL's submissions, and MTRCL would incorporate the IMP's views in its review and develop its review findings and responses.

3. On asset management, the Asset Management System (AMS) currently implemented by the HKTS of MTRCL has been accredited to the International Organisation for Standardisation (ISO) 55001 standard since 2015. The IMP observed room for improvement in terms of documentation and integration of the management systems, asset registration and digitalisation, operational risk management structure and

hazard identification, and staff awareness and Just Culture, and recommended that MTRCL should –

- (a) conduct a thorough review to revamp the AMS documentation for better organisation, alignment and integration of the management systems and associated documentations under HKTS;
- (b) establish the necessary infrastructure to support asset digitalisation to enable the transformation from labour-led maintenance to technology-led maintenance;
- (c) streamline and rationalise its various risk-related committees and working groups to facilitate information flow and enhance accountability and responsibility;
- (d) put further emphasis on identifying and mitigating high-consequence low-frequency risk items to further enhance service reliability;
- (e) make good use of frontline wisdom and identify potential hazards through brainstorming workshops and site walks with frontline maintenance staff; and
- (f) formulate a Just Policy to further cultivate the Just Culture to be supported by learning and reporting culture that would facilitate the monitoring and analysis of asset conditions and performances.

4. On maintenance regime, an effective and comprehensive maintenance regime is crucial for maintaining a safe, reliable and efficient railway service. Over the years, the required maintenance efforts have increased substantially over the life of railway assets, increasing patronage and passenger expectation, and expanding railway network. However, resource constraints, manpower and non-traffic hour (NTH) maintenance window in particular, had made the maintenance work more challenging

and more innovative solutions were needed. The IMP recommended that MTRCL should –

- (a) enhance resilience in its manpower plan to cater for unscheduled work, and report the manpower situation of MTRCL's railway operation and maintenance to the Government regularly;
- (b) explore the application of technology to widen the NTH maintenance window and improve work efficiency;
- (c) strengthen the control of Release of Concession (ROC) with enhanced checks and balances;
- (d) set up a dedicated quality assurance team within HKTS to further enhance the system and process approach in the quality assurance process, and the quality assurance team should liaise with the Government on matters pertaining to the maintenance regime;
- (e) explore the feasibility of conducting Reliability-Centred Maintenance (RCM) studies for major critical systems to optimise resource deployment in maintenance work and conduct regular review to streamline maintenance schedules;
- (f) enhance its contractor and supplier management, including the use of innovation and technology and digitalisation for more effective work supervision; and
- (g) increase the resources put into asset upkeep and replacement, which is conducive to minimising the manpower and NTH required for maintenance.

5. The findings and recommendations of the IMP have been incorporated into MTRCL's review to the IMP's satisfaction. The IMP acknowledged that MTRCL has spared no time in enhancing its asset management and maintenance regime and that it is already implementing some of the proposed improvement measures progressively before the conclusion of the review. The IMP looks forward to MTRCL's timely implementation of the follow-up measures, with performance measurements and evaluations to track their effectiveness so as to make timely adjustments as necessary. Both MTRCL and the Government should put more resources, especially manpower, to take forward the enhancement measures formulated in this review exercise, and to support the ever-expanding railway network. With the concerted effort of the railway operator and regulator, Hong Kong's railway service shall continue to shine in the international arena and be recognised for its safety, reliability and efficiency.

1 Introduction

Background

1.1 Railway is an important part of public transport in Hong Kong, with an average patronage of over four million passenger trips per day, accounting for about 40% of the daily passenger trips made by public transport modes. With Hong Kong’s “railway as backbone” public transport policy, a highly efficient and reliable railway network not only facilitates the daily commute of the public but also brings economic benefits and strengthens community ties. As the railway service provider in Hong Kong, the MTR Corporation Limited (MTRCL) is duty-bound to provide safe, reliable and high-quality railway service as the top priority, and it should also set a “Hong Kong Standard” for the global railway community.

1.2 Amidst the continuous expansion of the railway network in recent years, the number of service disruptions of 31 minutes or above caused by factors within the control of MTRCL has largely remained stable¹. However, the two major incidents in end-2022, namely the Tsuen Wan Line train incident on 13 November 2022²

¹ The number of service disruptions in recent years is largely stable after discounting the teething issues related to the East Rail Line new signalling system in 2021. When the new signalling system and new 9-car trains for the East Rail Line were commissioned progressively in February 2021, there were a number of teething issues that caused service delays. The situation improved in the second half of 2021.

² A train hit a dislodged metallic protection barrier on the trackside when it was approaching Yau Ma Tei station. The investigation revealed that the incident barrier was not registered in MTRCL’s asset management system. MTRCL published the investigation report on the incident on 12 January 2023, which can be accessed at - https://www.mtr.com.hk/archive/corporate/en/press_release/PR-23-004-E.pdf

and the Tseung Kwan O Line train incident on 5 December 2022³, revealed room for improvement in respect of MTRCL's asset management and maintenance regime.

- 1.3 On 5 December 2022, the MTRCL Board of Directors requested the MTRCL management to conduct a comprehensive review of its asset management and maintenance regime to ensure that the management of railway assets is maintained at a high standard. MTRCL announced on 23 December 2022 the appointment of an Expert Panel to conduct the comprehensive review. MTRCL also commissioned an engineering and asset management consultant, SYSTRA, to assist the Expert Panel with the review.

The Independent Monitoring Panel

- 1.4 To ensure that the MTRCL's review is comprehensive, in-depth, sound and thorough, the Government announced on 23 December 2022 the establishment of the Independent Monitoring Panel (IMP) to closely monitor MTRCL's review and ensure the appropriateness of its scope, review methodology and procedures, follow-up recommendations and implementation plans. The membership and terms of reference of the IMP can be found in **Appendix**.

³ A train was brought to a stop by the fault-protection mechanism because of an abnormal extension of the gangway between the sixth and seventh cars when it was approaching Tseung Kwan O station. The investigation revealed that a collar for holding the energy absorption device within the semi-permanent coupler assembly was unscrewed, causing the device to dislodge internally and the gangway between the train cars to extend abnormally. MTRCL published the investigation report on the Tseung Kwan O Line train incident on 3 February 2023, which can be accessed at -

https://www.mtr.com.hk/archive/corporate/en/press_release/PR-23-007-E.pdf

- 1.5 While MTRCL is involved in a wide range of business activities, the scope of MTRCL's review and the IMP's work is confined to the asset management and maintenance regime of MTRCL's railway transport operations in Hong Kong, under the Hong Kong Transport Services (HKTS) business unit⁴.
- 1.6 During the course of the IMP's work, MTRCL was requested to review major service disruption incidents in recent years to distil insights for improvements. Apart from reviewing relevant documents and existing practices, MTRCL was also requested to engage shop floor and frontline maintenance staff to tap frontline wisdom.
- 1.7 The IMP conducted seven meetings with MTRCL to closely monitor the progress of MTRCL's review. It also reviewed MTRCL's submissions on various topics under the asset management and maintenance regime to ensure the completeness and thoroughness of the review findings and recommended follow-up actions. In addition to the submissions by MTRCL, the IMP also requested additional information from MTRCL and the Electrical and Mechanical Services Department to support the review of the IMP. It was an interactive process in which the IMP would formulate its views and recommendations on MTRCL's asset management and maintenance regime upon reviewing MTRCL's submissions, and MTRCL would incorporate the IMP's views in its review and develop its review findings and responses.

⁴ The HKTS is headed by the Hong Kong Transport Services Director. It is a new business unit formed in the corporate restructuring in 2021, combining the previous Operations Division and the Commercial and Marketing Division of MTRCL. The Operations Director is the head of the Operations Division under HKTS.

Acknowledgement

- 1.8 The IMP would like to acknowledge with gratitude the full cooperation of the MTRCL during the course of its work.

- 1.9 The findings and recommendations of the IMP have been incorporated into MTRCL's review to the IMP's satisfaction. The follow-up actions and implementation plans put forward in MTRCL's review were formulated through interactive discussions between the IMP and MTRCL. The IMP also acknowledged that MTRCL has spared no time in enhancing its asset management and maintenance regime and that it is already implementing some of the proposed improvement measures progressively before the conclusion of the review.

2 Asset Management

Overview

- 2.1 Asset Management System (AMS) is a management system that systematically develops, operates, maintains, upgrades and disposes of assets in an organisation for optimisation of costs, risks, service, performance and sustainability. This ensures that the organisation is capable to achieve its objectives with the assets it owns. The AMS provides improved risk control and gives assurance that the asset management objectives are achievable on a consistent basis.
- 2.2 The AMS currently implemented by the HKTS of MTRCL has been accredited to the International Organisation for Standardisation (ISO) 55001 standard since 2015. The AMS is part of the Integrated Management System (IMS) of MTRCL, which also consists of the Safety Management System, Quality Management System, and Environmental Management System.
- 2.3 After the launch of the new corporate strategy, “Transforming the Future”, by MTRCL in September 2020, the “Hong Kong Transport Services Asset Management Strategy 2022 – 2027” was developed. As documented in the Strategy, the goal of asset management in HKTS is to maximise the value of the railway assets and minimise risk in delivering their intended purpose. Effective asset management is critical for ensuring the long-term operational stability of its railway assets.

IMP's Findings

(a) Documentation and Integration of Management Systems

- 2.4 The purpose and inter-relation of various instruments and manuals relating to asset management, including various components of the IMS and its sub-systems, should be well defined in order to present a comprehensive, clear and consistent direction for implementation. Periodic reviews and updates of the instruments and manuals are also important for ensuring the effective execution of the AMS and identifying improvement opportunities.
- 2.5 With the HKTS business unit established in July 2021, the HKTS Asset Management Manual has been updated to reflect the new organisational structure and commitment of top management to asset management. The authorisation of the Manual should be updated to reflect the same.
- 2.6 The IMP observed room for improvement in terms of documentation, cross-referencing and integration of the various systems. For example, the Asset Management Manual made no reference to the Safety Management Manual but the Safety Management Manual contained a section on asset management. The objective of that section is to review regularly the condition and capability of assets, including their safety performance, to ensure they are up to the required standards and meet statutory requirements. It also manages safety risks arising from the introduction, operation, maintenance and disposal of capital assets and finds opportunities for continuous improvement of safety performance. Better-defined inter-relationship of the documents and further integration or cross-referencing of the documents and manuals could enhance staff's understanding and assist in the

consistent and comprehensive implementation of the relevant management systems.

(b) Asset Registration and Digitalisation

- 2.7 A comprehensive and up-to-date asset registration is the foundation of proper asset management. As a follow-up to the Tsuen Wan Line train incident on 13 November 2022, which revealed shortfalls in the registration of railway assets, MTRCL conducted a comprehensive trackside infrastructure and equipment survey which provided a full inventory of trackside assets for management and maintenance.
- 2.8 As the network continuously expands, asset management should transform towards digitalisation. It is indeed a world trend to adopt asset digitalisation for improved performance monitoring. Digitalising asset management is also a key step in transforming time-based preventive maintenance to condition-based predictive maintenance, and data-based prescriptive maintenance.
- 2.9 The IMP noted that MTRCL would embark on a new computerised system, known as the Enterprise Asset Management System (EAMS), to drive digitalisation and data integration in asset management. As enablers for asset digitalisation, MTRCL has been putting in resources for the utilisation of innovation and technologies such as Internet of Things (IoT), video analytics, big data, etc. These are essential foundations for an optimised maintenance regime, enabling the transformation from labour-led to technology-led maintenance. The IMP also recognised MTRCL's establishment of a Data Studio to pursue the development of technology-led maintenance.

(c) Operational Risk Management Structure and Hazard Identification

2.10 There are a number of committees and working groups within MTRCL to handle railway operational risks. While MTRCL has set out the respective responsibilities of each committee and working group, the focus and purpose of each committee and working group could be better aligned and rationalised. A clear line of information flow would be conducive to the entire risk management process of hazard identification, risk assessment and risk control, and would also help to save management resources for running the risk management organisation.

2.11 The hazard identification process should also be carried out in a more comprehensive manner so that risk items at system level can be better addressed and integrated. There could be hazards, risks and risk controls overlooked if the operational risk management process is carried out largely based on the respective systems (e.g. permanent way, power distribution, etc.). An additional risk control process across systems through inspecting the respective physical zone of the railway network could assist in mitigating high-consequence low-frequency risk items to further enhance service reliability. This is of particular importance for trackside assets as revealed by the Tsuen Wan Line train incident on 13 November 2022.

(d) Staff Awareness and Just Culture

2.12 To instil a sense of ownership and responsibility in staff at all levels and escalate operational risks identified in the frontline effectively, staff needs to be fully aware of the management objectives of the AMS, the relevant manuals and procedures, and key performance indicators. These key messages should be cascaded from top management to each function area and the

respective responsible person.

2.13 The IMP noted MTRCL has been encouraging hazard reporting (e.g. the rolling out of the AAA iSPOTit mobile app⁵) and promoting the 5C⁶ Safety Culture as well as the essential attitudes of “Don’t Walk By and Speak Up”. Information from frontline staff is an important source of asset condition and performance and is crucial for the effective execution of the AMS.

2.14 Just Culture is one in which frontline operators or others are not punished for actions, omissions, suggestions, or decisions taken by them that are commensurate with their experience and training, but where gross negligence, wilful violations and destructive acts will not be tolerated⁷. A properly implemented Just Culture, supported by learning culture, reporting culture and well-documented Just Policy, could facilitate the collection of useful information from frontline staff.

IMP’s Recommendations

(a) Revamping the Asset Management System

2.15 MTRCL should conduct a thorough review to revamp the AMS documentation according to the ISO 55001 requirements for better organisation, alignment and integration of the management systems and associated documentations under HKTS. This

⁵ Anomaly Alert Action (AAA) iSPOTit is a mobile app to enable staff to report anomalies, hazards, and near misses so that appropriate and timely actions can be taken.

⁶ 5Cs represent Consequence, Compliance, Communication, Competence and Culture.

⁷ This definition is widely adopted by the aviation industry in Europe.

would also enhance the staff's awareness of the AMS, which is an essential part of its successful implementation.

(b) Implementing Asset Digitalisation

2.16 MTRCL should establish the necessary infrastructure to support asset digitalisation (e.g. a full-scale IoT-enabled point machine monitoring system for the signalling system) to enable the transformation from labour-led maintenance to technology-led maintenance.

(c) Strengthening Operational Risk Management Structure and Hazard Identification

2.17 MTRCL should streamline and rationalise its various risk-related committees and working groups to facilitate information flow and enhance accountability and responsibility. The linkage and reporting line of each committee and working group should be clearly presented, allowing staff at all levels to have a better sense of their respective accountability and ownership of the relevant risk items.

2.18 While MTRCL has an established risk management system in place, it should put further emphasis on identifying and mitigating high-consequence low-frequency risk items to further enhance service reliability. Risk items should be properly grouped and consolidated for better visualisation and management. An in-depth analysis of the identified risk should be conducted to establish the cause-and-effect linkages and formulate appropriate mitigation measures.

2.19 MTRCL should make good use of frontline wisdom and identify potential hazards through brainstorming workshops and site walks

with frontline maintenance staff. This is a proven supplementary means of risk identification and the IMP recognised MTRCL's effort of initiating such brainstorming workshops during the course of the review.

(d) Promoting Staff Awareness and Just Culture

2.20 MTRCL should formulate a Just Policy to further cultivate the Just Culture to be supported by learning and reporting culture that would facilitate the monitoring and analysis of asset conditions and performances. MTRCL should also conduct regular staff training to increase their awareness of the AMS, in particular after revisions or updates of the documentations.

MTRCL's Responses

(a) Updating the Asset Management System

2.21 MTRCL would revamp the AMS documentation for better alignment with the ISO 55001 requirements, and review the associated documentations of relevant management systems to incorporate the findings arising from the review for completion by end-2023.

(b) Implementing Asset Digitalisation

2.22 MTRCL would launch a new EAMS to facilitate asset registration completeness, data-driven asset management and enhanced asset management control mechanism. A pilot project would be launched for South Island Line in November 2023, and it would be rolled out to other railway lines in Q3 2024. MTRCL noted that this is a major system migration and a change management process has been put in place to manage potential implementation

risks.

2.23 MTRCL would further accelerate innovation and technology development to achieve data-driven asset management and control mechanism, and maintenance optimisation. MTRCL would put in more than HKD 1 billion in the coming five years in innovation and technology, and set up an MTR-ASTRI lab in Q3 2023 to drive the exploration of various innovation and technology development in the railway context.

(c) Rationalising Operational Risk Management Structure and Strengthening Hazard Identification

2.24 MTRCL would rationalise its various risk management committees and working groups to reinforce focused management and foster information flow as well as escalation of key operational risks for completion by end-2023.

2.25 MTRCL would conduct a review on high-consequence low-frequency risks in the existing system by Q3 2023 and assure the effectiveness of relevant mitigation measures.

2.26 MTRCL would formulate a 3-year plan by Q4 2023 using a structured scenario-based risk modelling tool, “Bowtie”, to aggregate risks into key failure scenarios for risk management, aiding visualisation and management of risk and consequence, as well as evaluating the effectiveness of the mitigations.

(d) Promoting Staff Awareness and Just Culture

2.27 MTRCL would further promote two-way open communication and Just Culture to facilitate the sharing of anomalies as observed at different levels for timely reporting and rectification.

Promotion campaigns would be launched by end-2023. Dedicated town hall briefings for all maintenance staff on the findings and follow-up actions of the comprehensive review would be conducted in Q3 2023.

3 Maintenance Regime

Overview

- 3.1 Maintenance is one of the key asset management activities. An effective maintenance regime would allow assets to remain in good operational condition at all times, and prevent unexpected repairs and operational downtime.
- 3.2 MTRCL adopts a systematic approach to maintaining assets by following the Original Equipment Manufacturer's recommendations in the operations and maintenance manual, i.e. time-based or usage-based maintenance. Maintenance would also be based on ongoing operational and maintenance experience.
- 3.3 The MTR railway network has expanded significantly since its commissioning in 1979, and some of the assets had been in service for decades. An effective and comprehensive maintenance regime is crucial for maintaining a safe, reliable and efficient railway service. Over the years, the required maintenance efforts have increased substantially over the life of railway assets, increasing patronage and passenger expectation, and expanding railway network. However, resource constraints, manpower and non-traffic hour (NTH) maintenance window in particular, had made the maintenance work more challenging and more innovative solutions are needed.

IMP's Findings

(a) Manpower Constraints

- 3.4 According to figures submitted by MTRCL, the overall

maintenance manpower shortage against its establishment increased from 6% in 2017 to 11.9% in 2022. The shortage was particularly challenging in the maintenance departments of power distribution system and track works and particular ranks. MTRCL has been making efforts in bridging the manpower gap mainly by re-prioritisation and optimisation of work, together with the topping up by term labour and staff overtime. While the IMP noted MTRCL's effort in bridging the manpower gap as far as possible, the prolonged strain on the maintenance workforce could pose impacts on output and staff morale.

(b) NTH Maintenance Window

3.5 NTH, which refers to the period during which no passenger trains are running, is the major maintenance window for the railway system. The operating hours of MTR have been extending over the years, with the latest opening and closing times of a typical railway line before 06:00 am and beyond 01:00 am respectively. After discounting the time required for proper work safety protection before the commencement of work and post-work site clearance for resumption of train service, the effective maintenance window is just about two hours per night.

3.6 Both operating lines and new projects have huge demand for NTH for preventive and corrective maintenance, asset replacement and new project works, in particular the interfacing works with operating lines. The situation would be worsened in case of unscheduled maintenance and survey arising from incidents and ad-hoc events.

(c) Release of Concession (ROC)

3.7 As an established practice, when certain maintenance work could

not be executed timely, issuance of ROC is required such that the asset could be put in service prior to completion of the overdue maintenance, subject to the condition of the asset concerned. The IMP noted that the main contributory factors for ROCs were manpower issues and NTH possession arrangements. While ROC could only be issued when the safe operation of the railway is ascertained, and risk mitigation measures are required should the situation warrant, accumulation of prolonged overdue maintenance work could give rise to operational risk in the long run.

(d) Maintenance Quality Assurance

3.8 Currently, the role of the first line of maintenance quality control is assumed by maintenance departments of the HKTS themselves, with regular independent audits conducted. Since the maintenance departments are the most familiar with the relevant maintenance work, they have the advantage of being the first line of defence to ensure that the maintenance work complies with the relevant requirements. That said, an enhanced quality assurance mechanism with strengthened compliance and surveillance audits by an independent team could bring in new angles from a system and process perspective and provide further assurance of the maintenance regime.

(e) Reliability Centred Maintenance (RCM) studies

3.9 RCM is a process to determine the most effective maintenance approach to an asset system to preserve its functions while minimising or avoiding failure. It was first applied on a large scale to develop aircraft maintenance programmes in the aviation industry. Standing at the forefront of the railway industry, MTRCL conducted RCM studies on selected assets as a good

practice to optimise its maintenance programme. It was used as an analytic tool with reference to the relevant operating records and AMS procedures, while the outcome is used to support the development of the relevant maintenance regime. With the stretched manpower and NTH constraints, RCM studies can assist in optimising the maintenance programme of various major assets so that resource deployment could be properly prioritised.

(f) Contractor / Supplier Management

3.10 MTRCL's maintenance strategy comprises in-house maintenance by its own staff, and outsourced maintenance by contractors. While safety or service critical and railway-specific assets are maintained in-house, non-railway specific items (e.g. escalators) are often outsourced due to unique skill-set and to drive cost advantage by market competition. In any event, the relevant maintenance work would often be required to be conducted by qualified personnel with specific licences, and hence the quality of the maintenance work is assured.

3.11 As for suppliers' products, MTRCL has developed inspection mechanisms for quality assurance. With reference to the Tseung Kwan O Line train incident on 5 December 2022, while the IMP acknowledged that it could be difficult for MTRCL to identify defects of proprietary products, MTRCL could consider strengthening the risk control measures with a view to minimising impact on passengers in the unexpected case of defects or failure.

IMP's Recommendations

(a) Strengthening Manpower

3.12 MTRCL should enhance resilience in its manpower plan to cater

for unscheduled work. It should roll out various human resources initiatives to ensure that it has sufficient manpower for the required asset management and maintenance work. The manpower situation of MTRCL's railway operation and maintenance should be reported to the Government regularly.

(b) Widening NTH Maintenance Window

3.13 MTRCL should explore the application of technology to widen the NTH maintenance window and improve work efficiency. The focus should be on optimising NTH management for maximum productivity. While the IMP noted that it is not uncommon in overseas railway systems that early closure, late opening or weekend closure would be arranged for maintenance work or brownfield asset replacement works that require lengthened NTH window, MTRCL should only consider such opportunity in consultation with the Government after exhausting all practicable options and having due consideration of the impact on passengers.

(c) Strengthening Control of ROC

3.14 While tackling the manpower and NTH resource constraints, MTRCL should also strengthen the control of ROC with enhanced checks and balances, and ensure proper mitigation measures are in place in case ROC is unavoidable.

(d) Strengthening Quality Assurance

3.15 MTRCL should set up a dedicated quality assurance team within HKTS to further enhance the system and process approach in the quality assurance process. This would provide further assurance of the quality delivery of the maintenance regime. The quality

control by the maintenance departments and the quality assurance by the independent team should have clear demarcation of responsibilities to complement each other. Apart from working with the maintenance departments in HKTS, the quality assurance team should also liaise with the Government to give early alarm on matters pertaining to maintenance regime, while the Government should appropriately monitor the work of the quality assurance team to ensure that they were up to standards and serving the intended purpose.

(e) Optimisation of Maintenance Regime through RCM Studies

3.16 MTRCL should explore the feasibility of conducting RCM studies for major critical systems to optimise resource deployment in maintenance work. Regular review should also be conducted to streamline maintenance schedules. To make full use of RCM studies, real-time monitoring devices, such as sensing systems and IoT networks, should be widely introduced. This would enable the utilisation of real-time operating conditions to determine the optimal maintenance regime, and lead to the transition from a time-based preventive maintenance process to a condition-based predictive maintenance process.

(f) Enhancing Contractor / Supplier Management

3.17 MTRCL should enhance its contractor and supplier management, including the use of innovation and technology and digitalisation for more effective work supervision.

(g) Increasing Resources for Asset Upkeeping and Replacement

3.18 MTRCL should increase the resources put into asset upkeeping and replacement, which is conducive to minimising the manpower

and NTH required for maintenance.

MTRCL's Responses

(a) Strengthening Manpower

3.19 MTRCL would drive various recruitment and retention initiatives, including job referral by staff, diversified recruitment channels and promotion, employee wellness/friendly initiatives and policies, staff development programmes, expanding trainee intakes at different levels and deferred retirement to enhance manpower resource resilience and meet future needs. Targeted initiatives would be mapped out for specific disciplines with particular manpower challenges. The manpower situation of MTRCL's railway operation and maintenance would be reported to the Government regularly.

(b) Widening NTH Maintenance Window

3.20 MTRCL would put in around HKD 500 million in ten years for various NTH initiatives and continue to explore initiatives to gain extra production time, to be championed by the dedicated NTH Office. In the meantime, MTRCL would continue to implement initiatives in the pipeline, such as remote red flashing lights, remote earthing, and new engineering trains, to enhance work efficiency during NTH.

3.21 MTRCL would set up a dedicated task force under the NTH Office by Q3 2023 to explore the early closure and/or late opening arrangement for unmet NTH demand after exhausting all practicable options. Due consideration of the impact on passengers would be taken into account. MTRCL would consult the relevant Government departments on the necessities of the

arrangement and measures to minimise the impact on passengers.

(c) Strengthening Control of ROC

3.22 MTRCL would strengthen the control of ROC by enhancing checks and balances in the ROC process. It would be completed by end-2023 and MTRCL would also map out the additional manpower requirement for implementing the revamped ROC.

(d) Strengthening Quality Assurance

3.23 MTRCL would set up a centralised and independent quality assurance team by end-2023. The new team would further enhance quality delivery of the maintenance regime, in particular the maintenance work performed by maintenance departments and contractors through strengthening compliance and surveillance audits of maintenance process and output, and spearheading the promotion of quality delivery and Just Culture. The team would also work closely with the Government to facilitate its monitoring and regulatory work.

(e) Optimisation of Maintenance Regime through RCM Studies

3.24 MTRCL would extend the application of RCM methodology in a structured and data-driven manner to critical major assets, with data structure setup aided by the use of technologies, such as IoT. Following a pilot study by Q3 2023, a 5-year plan of RCM studies on major assets would be formulated by Q4 2023.

(f) Enhancing Contractor / Supplier Management

3.25 MTRCL would devise focused assurance efforts on contractors' work and suppliers' products with the assistance of the

abovementioned rollout of RCM studies.

(g) Increasing Resources for Asset Upkeeping and Replacement

3.26 MTRCL would further increase the resources put into upkeeping asset performance, system upgrades and asset replacement, with a particular focus on adopting new innovation and technology. MTRCL would put in about HKD 65 billion during 2023 - 2027 on asset upkeeping and replacement, an increase of about 20% from the last five-year period, to enhance asset performance and maintainability. The resources required would be reviewed on an annual basis.

4 Conclusion

- 4.1 The trigger of MTRCL's comprehensive review and the IMP was the two major incidents that occurred in end-2022. To prevent the recurrence of such major incidents, hazard identification and mitigation are the key steps. Enhancing the sense of ownership and accountability of MTRCL's staff at all levels, and establishing a stronger linkage between safety and reliability performance of railway service and staff performance evaluation could help foster a more mature safety and reliability first culture at the corporate level.
- 4.2 The findings and recommendations of the IMP have been incorporated into MTRCL's review to the IMP's satisfaction. The IMP looks forward to MTRCL's timely implementation of the follow-up measures. There should be performance measurements and evaluations to track the effectiveness of the various improvement measures put forward so that timely adjustments could be made as necessary. Meanwhile, asset management and maintenance strategy is not a static regime, but should be updated dynamically to incorporate the experience gained during the ongoing maintenance work, lessons learnt from incidents, and to address the increasing usage over the life of the assets.
- 4.3 To achieve such continuous improvement, both MTRCL and the Government should put more resources, especially manpower, to take forward the enhancement measures formulated in this review exercise, and to support the ever-expanding railway network. With the concerted effort of the railway operator and regulator, Hong Kong's railway service shall continue to shine in the international arena and be recognised for its safety, reliability and efficiency.

(1) Membership of the IMP

Chairman: Ir WAI Chi-sing
Members: Ir Warren CHIM
Dr LEE Kang-kuen
Director of Electrical and Mechanical Services

(2) Terms of Reference of the IMP

In light of the railway incidents of the MTR Corporation Limited (MTRCL) that occurred in end-2022, from the point of view of railway safety regulation:

- i. to monitor MTRCL's comprehensive review on the asset management and maintenance regime, so as to ensure that its scope, review methodology and procedures, follow-up recommendations and implementation plans are appropriate, and the relevant review work is comprehensive, in-depth, sound and complete;
- ii. to monitor MTRCL's comprehensive assessment of potential risks in different areas of the railway system, so as to ensure MTRCL's maintenance and operation management work keeps pace with the times, including developing appropriate inspection and maintenance measures, and in particular, strengthening preventive maintenance and application of technology; and
- iii. to make recommendations on matters relating to railway safety regulation, so as to maintain the safety and reliability of railway services in Hong Kong.