

Transport For London

Rail and Underground Panel

**Subject: Reliability, Availability, Maintainability And Safety Programme**

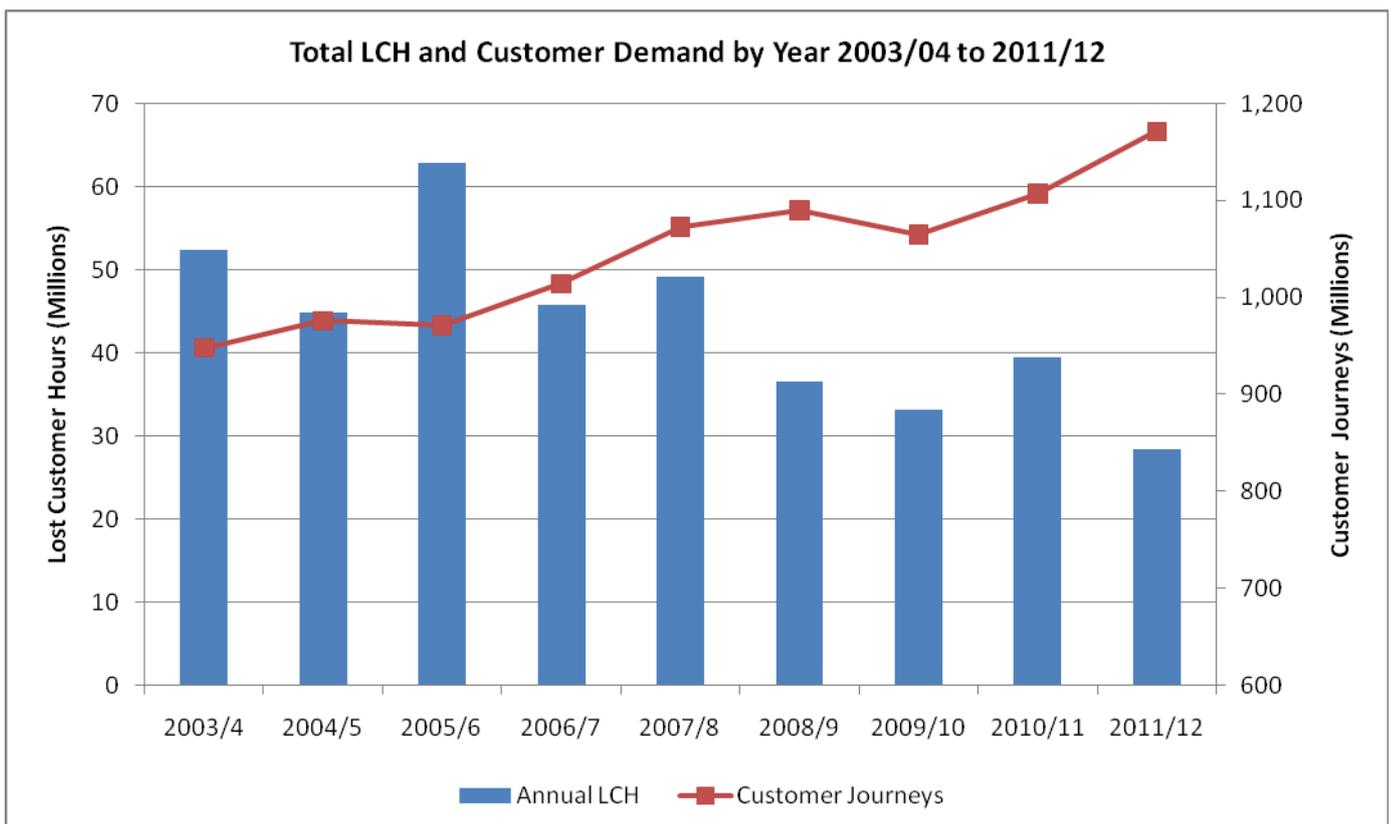
**Date: 22 May 2012**

**1 Purpose and Decision Required**

- 1.1 This paper provides the Panel with an update on the Reliability, Availability, Maintainability and Safety (RAMS) Programme that is underway across Rail and Underground (R&U) to improve the railway’s performance for customers. This paper focuses on the first three elements of the RAMS Programme as these are recently established aspects of London Underground’s (LU) Plan.
- 1.2 The Panel is asked to note this paper.

**2 Context**

2.1 The central objective in R&U strategy is to run a safe and reliable service for customers. Since 2003, LU reliability has improved significantly while carrying ever increasing numbers of customers. Delays on the network, as measured by Lost Customer Hours (LCH), have reduced by 46 per cent since 2003/04 and the number of customer journeys has increased by 24 per cent over the same period.



- 2.2 In 2011/12, reliability was at a record high, with the annual network LCH at its lowest ever level of 28.4 million (taking account of LU industrial action). This comes at a time of increasing passenger numbers, which rose by 5.7 per cent from the previous year to a new record of 1,171 million.
- 2.3 In addition, the running of new enhanced timetables and a lower level of disruption due to planned engineering works, contributed to LU delivering a record train service volume of 72.4m kilometres for the year. This is an increase of over five per cent from the previous year and at 97 per cent of the timetabled kilometres, the best performance for 19 years.
- 2.4 In 2011, the R&U Board established the RAMS Programme to focus on a systematic way of improving the reliability, availability, maintainability and safety performance of the network. Developing a systematic approach to performance improvement is particularly important ahead of the Games but also beyond that, in ensuring that performance continues to improve as the Tube Upgrade Programme continues to deliver its improvements.
- 2.5 Reliability improvement has to be addressed by looking at the railway as a whole – a complete system – rather than a set of sub-systems. This is the fundamental approach that the RAMS Programme is taking to improving performance.

### **3 Delivering the Improvements in Reliability**

- 3.1 The RAMS Programme is intentionally structured to provide both a project-based “Theme” approach, as described in the subsequent sections and a strong focus at a line level on a weekly basis to review performance and target the key performance affecting issues impacting every line.
- 3.2 **Command Centres:** In order to deliver the sustained improvement in performance, the RAMS programme set up a series of “Command Centres” for every line on the network. These centres bring together, every week, all of the key disciplines responsible for delivering improvements in service reliability and to keep a constant focus on day-to-day performance and longer term plans to ensure they are being delivered effectively across each line.

### **4 Reliability Improvement Programme Focus Areas**

- 4.1 The RAMS Programme is working under a number of key themes to provide the focus to safely deliver a deeper, sustainable shift in reliability across the organisation, which are:
- (a) Safety;
  - (b) Response and Recovery;
  - (c) Predicting and Preventing Failures;
  - (d) Improving how LU procures and introduces new assets into service, and;
  - (e) People.

- 4.2 The programme is also working with and learning from the operators of other metro systems, as well as a range of blue-chip companies outside of the rail industry, to understand how they safely deliver increasingly reliable performance, both in terms of day-to-day operations and longer term sustainable shift in performance levels.
- 4.3 In order to provide good governance and scrutiny across the full range of projects that are working to improve performance on the network, a dedicated cross network Reliability Tracking Room has been set up. To date, over 50 projects have been approved based on a “reliability” return on investment perspective and are in progress across the organisation. The majority of these projects are on track to deliver ahead of the Games.
- 4.4 The following sections provide more detail on the activities ongoing within the Programme’s workstreams.

## 5 Safety

- 5.1 Safety is the number one consideration throughout the organisation and the safety improvement programme is well established throughout the business. This is reflected in the 15-fold safety improvement since 2000. This workstream is focused on further improving the safety performance and reputation of the R&U Network for customers, employees and suppliers through these five activities which are not covered further in this paper:
- (a) safety leadership and the understanding of roles and responsibilities;
  - (b) understanding of major accident risks;
  - (c) understanding of LU’s Safety Culture
  - (d) frameworks for safety performance measures: and
  - (e) implementation of recommendations arising from Formal Incident Investigations reports.

## 6 Response and Recovery

- 6.1 On any complex and aged railway network, such as the Underground, there will be incidents that disrupt services. The aim of this workstream is to ensure that when problems do occur, the response minimises the impact of the incident and returns the service to normal as quickly as possible.
- 6.2 **Blue Light initiative:** R&U is working closely with the British Transport Police (BTP) in order to respond quickly to incidents. In recognition of the unique importance of the Tube to the functioning of the city, the BTP has provided seven officers on a 24/7 basis to help react quicker to incidents involving passenger safety by getting the Emergency Response Unit (ERU) swiftly to where incidents are taking place under blue light conditions used by the emergency services. The ERU is operated by Tube Lines on behalf of TfL and covers all parts of the R&U network.
- 6.3 The Blue Light initiative started in February 2012. The ERU response time to faults in central London locations is currently on average around 20 minutes; with blue light status this can be reduced by approximately 40 per cent.

Since commencement of the trial, the initiative has reduced delays by an estimated 14,000 LCH.

- 6.4 Furthermore, from 1 July, LU will be increasing the staffing at ERU depots from 101 to around 130 to enhance incident response capabilities from the four ERU depots. 30 recruits are undergoing intensive training, one of five shifts is already fully operational with all on target for 1 July.
- 6.5 **Motorcycle Response Initiative:** The Motorcycle Response initiative started in February 2012. This provides ERU with a motorcycle delivery option when responding to signal failures and the ability to provide first response and deliver signal parts required urgently to site. This reduces delays associated with failures and improved the overall time to fix. An example of the benefits of this capability occurred in March, when the motorcycle response reduced the duration of an incident at Amersham on the Metropolitan Line. The motorcycle response time was 1.7 minutes per mile against an accepted norm of 6.5.
- 6.6 **Enhanced Incident Response:** LU is always seeking to improve its response and recovery times to day to day incidents. For example, key signalling spares are located at strategic points around the network to reduce the delays arising from signal failures. This saves considerable time as engineers have the right spares in the right locations at the right times. The same logic is being applied to track points and electrical tools.
- 6.7 For Track tunnel sections with little space for equipment storage, a solution has been developed that fits between the sleepers on the track. This enables the patrolman to correct minor tasks quickly rather than calling on more specialist teams. The products are currently being rolled out on the Bakerloo and Victoria lines and will continue post Games.
- 6.8 In preparation for the Games this year, signalling engineers have been modelling numerous response time scenarios to signal failures across the network. This has informed how LU optimises the location and manning levels of the signalling resource in an attempt to mitigate and reduce the time to fix any signalling-related faults. Over £100k has been invested in the creation of two new signalling depots at Oxford Circus and Stratford.
- 6.9 LU is working with BTP to provide a dedicated helicopter with night flying capability, Infra Red cameras, and the capability to identify offenders trackside. This would also potentially provide an asset that could be used in major incident deployment and line inspections. This initiative is expected to avoid delays totalling around 93,000 LCH in a year.
- 6.10 **LU Command and Control:** LU has secured authority to take forward its plans to build the LU Command and Control Centre at Palestra. The delivery phase is currently on budget and on programme for completion in May 2013.
- 6.11 LU has recruited eight Senior Operating Officers (SOOs) that have now completed their training and development period and are now deployed in the existing Network Operations Centre. Their full deployment from 1 April 2012 coincided with the introduction of a revised incident management rule book.
- 6.12 LU has also now recruited seven specialist Network Incident Response Managers and they are also in training, due to become fully active on 20 May 2012.

- 6.13 **Changing how LU operates:** LU is continually reviewing how to improve the way trains are operated when there is a problem with the service. LU is developing flexible rules and decision support tools that speed up the response when incidents occur. This will allow the SOO to make the most appropriate and safe decision in order to return the network to good service as quickly as possible.
- 6.14 LU is also working to multi skill and increase the flexibility of its technical staff, for example, training signalling technicians on how to deal with rolling stock and lift failures. This increased flexibility is improving response times and reducing the impact of delays.
- 6.15 **BTP Medic Response Initiative:** Over the last three years there have been over 3,200 incidents amounting to over 5.2 million LCH due to people taken ill on trains. To help reduce the impact of these incidents on the network and keep London moving, LU is working with the BTP to provide an enhanced medically trained response capability. BTP medically trained officers will be able to facilitate the appropriate treatment for the ill person while taking into account other issues that may have stemmed from the original incident, such as large numbers of people detained (or delayed) on trains stalled in tunnels.
- 6.16 LU and BTP are investing over £1m on training up 20 officers, providing the necessary vehicles and equipment to support. The officers are on track to be deployed across the network, with a particular focus on the zone 1 area, in June 2012.
- 6.17 Furthermore, LU has developed a communications campaign for medical professionals to reduce the number of times doctors and nurses attending a passenger ill on an underground train advise staff that they or the train must not be moved. This campaign seeks to explain the balance of risks of the ill customer with those travelling on the rest of the network (e.g. on crowded trains stopped in tunnels).
- 6.18 **Cable Theft Mitigation Initiative:** Cable theft has been an increasing issue for LU recently. There has been a significant increase in theft events, with over 19 thefts of live cable, with an associated direct cost of approximately £200k alone in a four-week period during February. This is in addition to the serious service affecting impact that cable theft can have on customers.
- 6.19 In order to tackle the increasing frequency of thefts, R&U is working very closely with the BTP and staff to equip them with the necessary intelligence and equipment to detect crimes ideally before they are committed but due to the size of the network this is often not possible. Therefore a secondary approach to detect cable theft as it is occurring is also in operation (see section 7.10).
- 6.20 **Customer Communication:** Customers have a very important role in helping to increase reliability. In 2011/12, customers and members of the public accounted for about 18 per cent of all of the LCH delays across the network. From research LU has carried out, customers have indicated that they are more willing to reconsider their behaviour when an explanation for why an incident has occurred is provided. In response to this, LU is developing a consistent and integrated strategy across multiple communication channels. This strategy will seek to educate customers of the impact of their behaviours (e.g. discarding litter on stations or trains or

holding open the doors) but also explain to them how the upgrades are changing the system that they travel on (e.g. air conditioning to help reduce passengers taken ill on trains).

- 6.21 **Raising Reliability Awareness for LU Non Operational Staff:** Reliability awareness campaign is underway. It aims to educate the non operational workforce in TfL in learning to take simple actions as they travel on the network which will contribute to service reliability. Focusing and identifying things in the customer domain which non operational employees can do, report or assist with, helps prevent or reduce service affecting incidents. An example is to keep stations and trains litter free, preventing newspapers and other discarded litter from blowing on to the track, which in turn could add to the risk of fires and service disruption.
- 6.22 **Electronic Service Update Boards (ESUBs):** Another example is the ESUBs which can be found in the ticket halls of most LU stations. ESUBs are a vital tool in relaying real time information to customers about the level of service operating across the network. LU is investing over £1.7m until October 2013 to replace over 100 ESUBs that are life expired, 50 of which will be completed before the Games and the delivery of ESUBs at 13 stations that do not already have the service.
- 6.23 R&U is also working with suppliers of cleaning services to help make those individuals more easily identifiable and approachable to customers as part of the wider R&U family.
- 6.24 Overall, reliability is not just about fixing assets that fail, but also having an in-depth look at how LU operates to see how improvements can be made to become more efficient as the railway and its supporting functions become more technologically advanced.

## **7 Predicting and Preventing Failures**

- 7.1 The overall emphasis of the programme is to help the organisation shift its emphasis away from “Response and Recovery” and towards “Predict and Prevent”. Therefore, this theme seeks to embed processes, technology and behaviours across the organisation that constantly seek to find better ways of predicting failures and ultimately designing ways of preventing the failure from happening. While the main focus is currently on assets, the principles and concepts of “predict and prevent” will be applied in other critical parts of the organisation that support the service (e.g. staff and customers).
- 7.2 For assets, LU is rolling out a range of predict and prevent techniques to determine the condition of assets in order to predict when maintenance should be performed to prevent unexpected equipment failure. This moves maintenance from a time-based approach to that based on condition of the assets and asset utilisation.
- 7.3 **Automated Track Monitoring System (ATMS):** ATMS is the continuous monitoring of track condition using in-service trains enabling degradation of the track to be measured, automatically identifying any track related defects and allow maintenance activities to be planned to minimise disruption to passengers. A prototype unit has been installed on a District line passenger train since 2009; 12 service trains will be fitted with the production system, providing up to two service trains on the Bakerloo, Central, Victoria and Sub-

Surface lines by late 2012 and the programme team remain confident in the ability to achieve early benefit realisation by fitting some in-service track measuring equipment on some lines prior to the Games.

- 7.4 The programme is progressing well, however it should be noted that the technology that is being fitted is groundbreaking in its field and therefore by its very nature has unique and complex issues to overcome. The cost of development and roll-out / production is £15m and annual ongoing costs of approximately £1.3m. The benefits likely to be achieved are around £4.0m per annum.
- 7.5 **Signals Condition Monitoring Strategy and Plan:** Signals maintenance is currently based on a combination of time, emergency (failure) and run-to-fail strategies. It is the intention to move to a maintenance regime that exploits the advantage of condition monitoring technologies. Some of the initiatives currently being implemented are:
- (a) **Central Line Intelligent Event Monitoring:** This is a current system that performs real time analysis of signalling event data to identify unusual patterns that are indicative of potential failure. This enables a response to the problem to be made before the asset fails. The scope of the project is to renew the existing technology, which is obsolete and provide additional functionality under planned investment of around £800k by June 2013, providing approximately 10 per cent reduction in Central line signalling LCH by March 2014.
  - (b) **M63 Points Monitoring:** This tool monitors power consumption and the time taken for the point machine to move, hence detecting degradation so as to prevent disruption to the service. This has been successfully installed and trialled at three prototype sites and is now being rolled out to 30 other critical locations at a total cost of £85k, with planned completion at the end of March 2013. Over a year, it is expected to save around 150,000 LCH.
  - (c) **Point Heater Monitoring:** Installation of remote monitoring to ten critical sites across the Sub Surface Railway network covering the north end of the Metropolitan line and east end of the District line. This monitoring is designed to alert staff if there is any degradation in performance of the machines designed to heat sets of points during cold weather. The installation is scheduled to complete in August 2012. Costing a total of £20k with an estimated six per cent reduction in LCHs for those assets fitted with the monitoring.
- 7.6 **PEA Covers for Jubilee, Northern, Piccadilly, Bakerloo, Central and District Line:** Passenger Emergency Alarms (PEAs) are used to alert the driver to an incident. On occasions, these are triggered accidentally or maliciously. The activation of the PEA in a non-emergency is unnecessarily disruptive to train services as the operator must confirm it is a non-emergency, and then reset the PEA in the affected car before the train can continue.
- 7.7 The installation of PEA covers on the Victoria line has reduced the number of accidental activations without affecting the use of the PEA in an emergency, thereby improving reliability. There is a project currently ongoing to design and fit PEA covers to the Jubilee, Northern and Piccadilly fleets prior to the

Games. Furthermore, a project has also been established to roll out a similar solution on the Bakerloo, Central and District lines by September 2013. The total estimated project cost is £4m with expected benefits of over 350,000 LCH per year.

- 7.8 **Other initiatives:** A programme commenced in January 2012 to develop detailed work instructions for key maintenance tasks across LU. This “artificial intelligence” aims to ensure that maintenance activities are consistently carried out to a high standard without service impact. The project is on track and is scheduled to be completed by June 2013 and aims to reduce asset LCH by 70,000 by 2015. This programme links with the development of a Business Organiser tool being rolled out in 2012. The tool automatically downloads relevant documentation to hand held devices as asset management staff complete their tasks, which enables all tasks to be completed consistently and in an auditable manner.
- 7.9 The current design of lift doors across the network dates back to the 1960s, and earlier in some cases. Typically, doors include over 200 components. LU’s engineers are currently developing a new design that reduces the number of components to around 30. As a consequence, the project’s aim is to eliminate around a third of all lift failures and reduce the risk of lift entrapment for customers. The project has the opportunity to reduce the current 400 lift failures per year attributed to door defects. To deliver these targets engineers are currently working with external manufacturers to produce two working door models with the intention of demonstrating performance improvement by May 2012 as part of the trial.
- 7.10 A six month project is underway on the east end of the Central line to evaluate if fibre acoustic monitoring can be used to detect and prevent imminent cable theft, vandalism and criminal activity (at an estimated cost of £395k and LCH benefit of around 20,000 per annum).
- 7.11 LU is also investing in a clean room facility at the Railway Engineering Works in Acton. The clean room and climatic chambers will help prevent failures and improve the reliability of the asset, principally electrical switches (called relays) used in signalling systems, through more rigorous testing prior to installation. The facility is expected to be operational by November 2012.

## **8 Improving How LU Upgrades and Purchases New Assets and Introduces Them Into Service**

- 8.1 This workstream aims to drive improvements in the way in which LU is embedded with suppliers to design, contract and deploy new and upgraded assets into service – with reliability at the heart of decision-making throughout the whole life-cycle process.
- 8.2 **Jubilee Line Upgrade:** Underlying signalling system reliability has continued to improve as software and hardware modifications are made in line with the improvement programme and further work is underway to introduce the final pre-Olympic software modifications and hardware improvements to the system.
- 8.3 The Jubilee Line rolling stock reliability improvement programme is on target to deliver the necessary reliability improvements and the programme of track

works including replacement of crossings and track improvement activity, is on schedule.

- 8.4 **Northern Line Upgrade:** One of the lessons learned from the Jubilee Line Upgrade has been to develop a series of tests, called Reliability Objective Group (ROG) tests that have been rolled out on the Northern line since February. The aim of the tests are to check that various parts of Transmission-Based Train Control system are working as required before progressing to more critical activities, for example testing for timetable operation. ROG tests have already identified potential issues, which have been rectified. Further testing will commence in May.
- 8.5 **Victoria Line Upgrade:** There has been an intensive focus on improving the examination of incident download data for every failure, as well as nightly checks for hidden and potential failures. This information can help to identify both asset and non-asset causes of incidents in order to improve root cause investigation and initiate corrective action. This work has resulted in further reliability improvement:
- (a) rolling stock reliability (excluding trainborne signalling) has increased from 10,500 km between failures to 30,000 km; and
  - (b) reliability of the trainborne signalling has increased from 2,200 hours between failures to 3,000 hours between failures.
- 8.6 To further enhance this capability ahead of the Games, additional functionality will allow data to be downloaded over Wi-Fi to allow engineers to gather early indications of why failures are happening. This is particularly valuable for rolling stock, as engineers are able to prepare specifically to tackle clearly identified problems before the train returns to the depot.
- 8.7 **Deep Tube Upgrade:** Work is ongoing regarding the setting of highest order Reliability, Availability and Maintainability (RAM) requirements for the Deep Tube Railway. The principles of target setting are based on business needs alongside understanding what is achieved by other operators of metros around the world.
- 8.8 **Embedding LU within the Supply Chain:** On the upgrade projects (Victoria and Sub Surface lines), staff have been embedded in the supply chain to gain intimate product knowledge of the new assets before they are introduced into service. This way, staff fully understand the asset during manufacture, which will assist in the performance of maintenance tasks.
- 8.9 **Contracting Reliability:** The workstream is working closely with the R&U Commercial Directorate to ensure that there is common understanding of setting engineering and contractual RAM requirements when letting contracts through the creation of a RAM Guidance Note. Historically, contracts have not directed the supply chain on the specifics of delivering reliability. LU is now able to specify the desired reliability, and how it should be delivered into customer service.
- 8.10 The pan-TfL procurement framework for Lifts and Escalators has been reviewed against the proposed RAM Guidance Note. For this contract, the supplier must be able to demonstrate a minimum acceptable level of asset reliability, prior to the first asset being installed into service.

## 9 People

- 9.1 The people workstream underpins the four core themes summarised previously. People are clearly critical to the safe and reliable performance of the railway, and this workstream focuses on ensuring R&U has the right people in the right place at the right time, and that they are fully capable of performing in their roles now and in the future.
- 9.2 In order to continue to drive down delays, R&U recognises the need to work smarter, be more consistent in working collaboratively across the whole organisation – as well as still reacting quickly when required.
- 9.3 **Training of Station Supervisors:** A project to increase the numbers of Station Supervisors ahead of the unprecedented demand of the Games is well underway.
- 9.4 **Training of additional Train Operators for enhanced Games service levels:** A training programme to ensure that LU has sufficient drivers to meet scheduling needs as defined in the Olympic plan is underway and is on track to deliver ahead of the Games. The Jubilee, Central and District lines will see their schedules enhanced during the Games period necessitating an increase in the number of drivers needed to operate the additional services.
- 9.5 **Competency based training:** LU is developing a programme of competency based assessments for all maintenance staff to ensure effective delivery of their business and safety critical duties. This approach is modelled on successful practice for LU operational staff and ensures that the individuals perform competently and consistently over time and ensure that good practices are embedded at the outset. This typifies one of the aims of the RAMS Programme, which is to identify and apply good or best practice systematically, consistently and collaboratively across all relevant parts of the business.

## 10 Summary

- 10.1 Reliability has to be addressed by looking at the railway as a whole – a complete system – rather than a set of sub-systems. This is the fundamental approach that the RAMS Programme is taking to improving performance.

## 11 Recommendation

- 11.1 The Panel is asked to NOTE the paper.

## 12 Contact

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