

TRANSPORT FOR LONDON

BOARD

SUBJECT: RAIL AND UNDERGROUND RELIABILITY IMPROVEMENT PROGRAMME

DATE: 7 DECEMBER 2011

1 PURPOSE AND DECISION REQUIRED

- 1.1 This paper provides the Board with an update on the Rail and Underground Reliability Improvement Programme that is underway to improve service reliability for London Underground’s (LU) customers.
- 1.2 The Board is asked to note this paper.

2 BACKGROUND

2.1 The central objective in LU’s strategy is to run a safe and reliable service for our customers. Since 2003 LU’s reliability has improved significantly. For example, reliability as measured by the average distance between failures, has improved from 5,400km to 13,700km in 2010/11. The figure below translates this into the impact on customers through a measure of Lost Customer Hours (LCH) across the entire network, with a clearly improving trend. For completeness, 2011/12 performance data is pro rata based current performance data to date.

* Note: 2010/11 performance was affected by industrial action, asset failures, Jubilee line upgrade and 09 Stock (Victoria Line).



- 2.2 The Tube upgrade programme is the key driver of improved reliability. LU's assets date back over nine decades; the upgrade programme ensures that these end-of-life and sometimes unreliable legacy assets are replaced with modern, long-lasting and ultimately higher-performing equipment. As well as replacing trains and signalling this also involves replacing track, station equipment and civil infrastructure such as bridges and tunnels. This investment in core assets and improved maintenance delivery has been behind the reductions seen in the graph above. As per the latest TfL Business Plan asset LCH are forecast to reduce by 2.8m LCH by 2014/15.
- 2.3 However, against the back drop of record demand for services, reliability during the autumn and winter 2010/11 suffered, with several major asset failures, resulting in many customers experiencing unreliable service. The impact of these failures was exacerbated by several days of strike action.
- 2.4 During this period last year, the reliability of assets was particularly affected by fractures on ageing rolling stock, in particular the District and Metropolitan lines, prolonged winter weather and wheel defects. (Although LU responded well to winter weather and operated the service continually and safely across all lines). Since then significant effort has focused on understanding the root cause of the problems that impacted the service. This has helped LU design and implement the solutions that eliminate the cause of disruption or reduce significantly, in the case of winter weather, any potential for disruption. Examples include:
- (a) Leaf fall season maintenance has now been enhanced by daily forecasting of weather conditions to plan response accordingly, use of Network Rail high pressure water jetting train, automatic sandite dispensers installed to assist trains to grip track and use of route proving to secure routes and prove safe running in event of failure.
 - (b) To repair 'flatted' wheels accommodation bogies are now in place for quick exchange of damaged wheel sets and refurbishment of all anti wheel slip protection equipment on the Central Line stock will help to prevent wheel slide and hence reduce the number of flatted wheels.
 - (c) Dedicated depot based specialised crack detection and monitoring teams, as well as equipment, are in place with the sole responsibility for crack and fatigue management.
 - (d) Improvement in track profiles which has reduced crack initiation and propagation.
- 2.5 The commissioning of the new signalling system on the Jubilee line as part of the upgrade impacted reliability as the new system bedded in. Initially there were issues with the software, but these have been tackled through rapid root cause analysis leading to an intensive series of software changes that have significantly improved reliability across the line. Hardware issues were also evident, but a series of design tweaks have been undertaken to improve the reliance of the most vulnerable hardware. These improvements have a wide-scale permanent effect which the improved reliability trends demonstrate.

- 2.6 In the case of the Victoria Line Upgrade strenuous efforts to drive up reliability have been and continue to be made. Over the past 12 months:
- (a) rolling Stock reliability (excluding trainborne signalling) has increased from 6,500 km between failures to 10,500 km; and
 - (b) reliability of the trainborne signalling has increased from 100 hours between failures to 2,200 hours between failures.
- 2.7 Design modifications have been implemented with the aim of reducing LCHs incurred through customer activation of Passenger Emergency Alarms and the door Sensitive Edge system on the new trains, but further changes are being implemented to reduce further disruption from these causes and to improve system technical reliability.
- 2.8 In early 2011 LU established the Reliability Improvement Programme to re-double efforts and focus on improving reliability across the network.

3 RELIABILITY IMPROVEMENT PROGRAMME FOCUS AREAS

- 3.1 The Reliability Improvement Programme has three key themes to provide the focus to safely deliver a deeper, sustainable shift in reliability, the key themes are:
- (a) Response and Recovery;
 - (b) Predicting and Preventing Failures; and
 - (c) Improving how LU upgrades existing assets and purchases new assets.
- 3.2 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 deliver increasingly reliable performance, both in terms of day-to-day operations and investing for the long term.
- 3.3 The following sections provide more detail on the activities ongoing within the Reliability Improvement Programme.

4 RESPONSE AND RECOVERY

- 4.1 On any complex and aged railway network, such as the Underground, there will be incidents that disrupt services. The aim 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.
- 4.2 **Blue Light initiative:** LU 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 will be helping to get LU's Emergency Response Unit (ERU) swiftly to where incidents are taking place under blue light conditions.
- 4.3 The Blue Light initiative will be implemented around 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 circa 40 per

cent. The key objectives of this work are to reduce time to site and return the infrastructure to service with minimal passenger disruption.

- 4.4 **Enhanced Incident Response Initiative:** LU has been consistently seeking to improve its response and recovery times to day to day incidents. Since 2007/08 response times for Technical Officers to fix signal incidents have reduced from an average of 20 minutes to 10 minutes and over the same period the time taken to get to the site of a fault has reduced from 16 minutes to eight minutes around the inner circle line (Zone 1) by opening additional depots, increasing the number of staff and reviewing the various modes of transport.
- 4.5 As an example of these efforts a motorcycle unit response initiative will commence in February to improve the speed of first response to incidents.
- 4.6 **LU Command and Control:** LU is developing plans to invest £25m to co-locate engineering and operations staff, the Network Operations Centre, Tube Lines support personnel and colleagues from the BTP into a consolidated new LU Command and Control Centre. This will help respond in the quickest and most effective way to disruptions across the network. In the case of major emergencies, the new centre would improve response time and improve co-ordination of emergency service response to site and ensure the 'right' people are involved at the earliest opportunity.
- 4.7 To support this new way of working, LU is currently recruiting specialist Network Incident Response Managers, whose responsibility is to take overall charge of how the network as a whole recovers and not just focus on the disrupted line. These will be highly trained responders to serious incident in and around zone one (i.e. where service disruption is most disruptive).
- 4.8 Furthermore LU is also now recruiting a Senior Operating Officer, this new, senior, 24/7, on shift role will ensure that incident response is co-ordinated (across engineers, power controllers, operators, emergency services). This will lead to improved communication, consistency in approach and result in faster, better quality decisions and improved service recovery following incidents.
- 4.9 During 2012 LU will start introducing these new specialists into the network management structure and into the LU Command and Control centre.
- 4.10 **Changing how LU operates:** LU is conducting a review of how to improve the way trains are operated when there is a problem with the service. For example, operating procedures have recently been changed to reduce the time it takes a driver to correct a train path where an incorrect route has been taken. Using these rules drivers can save between 15 and 20 minutes when these situations occur.
- 4.11 Also there are locations around the railway where sidings can be used as an alternative route to and from the main line. This saves time when there are signal failures. It is also useful when reversing the train service when it is neither desirable nor possible to detrain customers. This opens up the possibility of using a number of cross-overs to more quickly normalise the service after an incident. These new operating procedures have been in place for eight weeks and have already saved over 200 minutes of train delays, over a year it is expected to save more than 100k LCH.

- 4.12 LU is also broadening the skills of Signalling Technical Officers (TO's) to carry out additional Call Point duties for Lifts and Rolling Stock assets. The support of the TO's to existing Call Point Operators will speed up the response to failures in these asset areas and speed the return of the assets to normal working levels. For Rolling Stock, the ultimate aim is to train all 110 TO's over a period of two years (four per week). For lifts, the initial training for 18 TO's for Central and Bakerloo lines will be completed by March 2012.
- 4.13 Overall, reliability is not just about fixing assets that break, but also having an in-depth look at procedures to see how these can be improved and become more efficient as the railway and its supporting functions becomes more technologically advanced.

5 PREDICTING AND PREVENTING FAILURES

- 5.1 This key theme seeks to embed technology processes and the key behaviours across the organisation that constantly seek to challenge ourselves in finding better ways of predicting failures and ultimately designing ways of preventing the failure from happening.
- 5.2 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.
- 5.3 **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 autumn of 2012; providing information to engineers on the current asset condition while the service is in full operation.
- 5.4 Costs for the ATMS development and roll-out / production are £15m and annual on-going costs of circa £1.3m. The benefits likely to be achieved are around £4.0m per annum and driven from: increased quantified inspection, reduction of the associated labour intensive manual qualitative inspections, reduction in corrective maintenance, reduction in repeat track failures, improved effectiveness of remedial work and improved ride for customers; return on investment of the project is a key part of the investment justification process.
- 5.5 **Signalling Intelligent Event Monitoring:** This is the real time analysis of events from the signalling system and identification of unusual patterns which are indicative of potential failure. An alarm will be generated when this is detected (e.g. points starting to move slowly) enabling a proactive response in advance of a failure affecting the operational railway. The benefits of this include: improved asset availability and effectiveness of remedial work. It is planned to invest around £800k by December 2012. This will result in around a 10 per cent reduction in Central line delays due to failures equating to 45k LCH.

6 IMPROVING HOW LU UPGRADES EXISTING ASSETS AND PURCHASES NEW ASSETS

- 6.1 **Learning Lessons from the Upgrades:** Experience from around the world indicates that new systems are likely to suffer some early problems that impact on service and reliability. In the case of the Jubilee line, the flawed PPP contracts exacerbated these issues considerably. However, LU is making sure that lessons have been learnt from those failures and designed the Northern line upgrade in a different manner:
- (a) **Weekend closures:** Under the PPP there would have been at least 65 weekend closures, but having learned from the mistakes on the Jubilee line upgrade, there will now only be eight weekends of full line closures, eight weekend closures on shorter sections of the line and six closures of parts of the line during the quieter Easter and Christmas holiday periods. This will mean a reduction of over 60 per cent in the number of disrupted passenger journeys during the upgrade.
 - (b) **Off-site testing:** LU will make considerable use of off-site testing using improved simulators on an extended and enhanced test track at Highgate.
 - (c) **System familiarity and staff training:** LU will be automatically carrying across the improvements made for the Jubilee line hardware and software to the Northern line. Train operators will have a greater involvement in new system testing on simulators to iron out issues off site. Those operators will have 50 per cent more training than they were afforded on the Jubilee line.
 - (d) **Investment Logic:** Future upgrades will adopt a “whole-life approach” to ensure that cost and performance associated with assets are optimised, from design through to purchase and finally decommissioning.
 - (e) **Embedding LU within the Supply Chain:** On the upgrade projects (Victoria & Sub Surface lines) staff have been embedded in the supply chain to gain intimate product knowledge on the new assets being introduced, this is ensuring that staff fully understand the asset at the point of handover reducing the bath tub reliability curve traditionally experienced.
- 6.2 **Sub Surface Line Upgrade Project (SUP):** LU undertook a thorough review of major and minor legacy contracts outside of Automatic Train Control (ATC) Signalling for Sub-Surface Lines, which showed that as a result of the PPP legacy, hard reliability targets were either not included as performance drivers or were not linked to programme delivery milestones.
- 6.3 The most recent major upgrade contract let (ATC Signalling for Sub-Surface Lines) contains world-class benchmarked targets, specified throughout the design, testing and implementation of the upgrade.
- 6.4 This will ensure that reliability will be proven (and early-life failures removed) before the assets have an opportunity to enter passenger service.

- 6.5 The legacy signalling systems on the Sub-surface lines, some of which date from the 1920s, cause approximately 820 service-affecting faults per year. The final steady state target for the number of service-affecting faults per year due to the new Signalling system represents a 90 per cent reduction of this figure.
- 6.6 **Deep Tube Upgrade and Other Contracts Methodology:** The changes described above, in the way in which LU procures assets, are being embedded into the procurement process via the Reliability Improvement Programme; ensuring consistency and continuous improvement.
- 6.7 A guidance note is now embedded into the Procurement Handbook to ensure that there are no gaps between the technical requirements specified for reliability performance and the contractual mechanisms required to manage and rectify under-performance.
- 6.8 The Deep Tube Upgrade will follow this methodology across a variety of new assets. The experience gained in software-reliability, through the SUP ATC Signalling Contract, will prove vital for this future upgrade.
- 6.9 The pan-TFL procurement framework for Lifts and Escalators is currently in the tendering phase and is expected to follow this approach.
- 6.10 **Victoria Line Upgrade:** In order to accelerate the contracted reliability improvement of the Victoria Line (which has a contractual end date after the 2012 Games), the programme has commissioned 'Project Atlas'. This will focus on both technical and non-technical opportunities for improvement.
- 6.11 The project is expected to reduce the number of Service Affecting Failures by at least 50 per cent from the current levels, prior to the 2012 Games.
- 6.12 **Smarter Assets:** The new fleet and signalling being implemented on the SSR & VLU will significantly improve the asset reliability, through self diagnostic backup systems that automatically switch over at the point of failure.
- 6.13 **Less disruption and lower costs:** Many opportunities exist for LU to reduce the frequency of maintenance interventions, deliver a better service and reduce costs. As an example, at Holborn low-loss lighting has been installed which will reduce the maintenance required from every 18 months to 5 years. As well as lowering costs (in this example £80k of energy costs and reducing carbon emissions by almost 600 tonnes) this reduces the interventions required and thus the chance of an impact on customer service.

7 FUTURE INITIATIVES UNDER CONSIDERATION

- 7.1 LU is committed to improving reliability and will continue the progress that has led to a forecast halving of disruption for customers since 2005/06. In addition to the existing programme of reliability work other projects are under consideration.
- 7.2 Such proposals continue to be developed and, if they demonstrate a strong business case, will form part of future LU business plans.

7.3 Examples of proposals under consideration include:

Response and Recovery

- (a) Increasing the number of trained incident response personal from 101 to around 130 and move from three depots to four (Acton, Camden, Stratford and Battersea) to increase the speed in which staff can attend incidents. This could deliver around 25 per cent reduction in response times during simultaneous incidents, has the potential to save lives, reduces service disruption and increases the skill base within LU.

Predicting and Preventing Failures

- (b) A plan is being delivered to develop detailed work instructions for key maintenance tasks across LU to ensure that maintenance activities are consistently carried out to a high standard without service impact. It is estimated that this programme will reduce asset LCH by one per cent.
- (c) 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.

Upgrading existing assets and purchasing new assets

- (d) With the experience gained from the Victoria, Jubilee, Northern and Sub-surface line upgrades LU is exploring ways to maximise the reliability of the next generation of Deep Tube upgrades. Extensive testing outside of passenger service is planned and the trains are being designed such that reliability is at the core of the requirements.

Investing in our people

- (e) To further focus the whole organisation on reliability and the key three themes, consideration is being given to whether a programme of Lean training and coaching should be rolled out across the organisation. This programme would be underpinned by an internal communication campaign to articulate the impact of service failure to all.
- (f) The programme would train and coach staff in Lean industry practices, giving the workforce the tools to solve problems at all levels. Built on the foundation of the training and coaching the staff would develop many simple improvement initiatives to contain the issues on the railway.
- (g) It is proposed that the coaching and training would be delivered across the organisation by industry experts over a period of 1-2 years. Based on similar programmes in other industries current high level estimates of around a 12 percent reduction in LCH and an eight percent reduction may be achieved.

8 DELIVERING THE IMPROVEMENTS IN RELIABILITY

- 8.1 **Command Centres:** In order to deliver the required improvement in performance, a series of “Command Centres” are being set up for every line on the network. These centres will bring together, every week, all of the key individuals responsible for delivering improvements in service reliability and to keep a constant focus on day-to-day and longer term plans to ensure they are being delivered effectively across each line.
- 8.2 **Investing in Reliability:** As outlined in section seven a review is being conducted of where priority area investment in reliability should be focussed over the next 12 months to build upon the improvements we have seen in the last year.
- 8.3 Furthermore, taking a longer term view, the programme will be running a series of “Reliability Forums” with participants from across Rail and Underground to develop the plans for reliability into the next few years. This will include some of the insight generated from talking to other metros and blue-chip companies. For example, National Grid believes that ‘reliability is in its DNA’, which has taken years to develop through the alignment of the company’s vision with staff performance objectives, structuring contracts with explicit reliability focus when purchasing new assets with long operational lives. Long term planning of reliability improvements is of crucial importance as the financial investment decisions (in assets, but also staff, processes, behaviours and attitudes toward reliability) taken today will be felt for years to come.
- 8.4 **Communicating our Plans:** As well as re-doubling efforts on improving reliability, a communication campaign is being developed to help inform customers of the range of activities that are underway to improve the reliability of the services they use.
- 8.5 All appropriate consultation with the Trade Unions and communication with our employees will be undertaken.

9 RECOMMENDATION

- 9.1 The Board is asked to NOTE the paper.

10 CONTACT

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