

Date: 19 July 2023

Item: London Underground Four Lines Modernisation Programme

This paper will be considered in public

1 Summary

- 1.1 The purpose of this paper is to update the Committee with progress on the delivery of the London Underground (LU) Four Lines Modernisation (4LM) Programme.
- 1.2 The Committee is asked to approve additional unbudgeted Financial Authority to align to the Programme and Project Authority approved by the Committee in July 2022. Existing Financial Authority comprises Budget for 2023/24 and 2023 Business Plan beyond this. Financial Authority is less than Programme and Project Authority due to rephasing of £10m from 2023/24 to later years during budget setting this will need to be managed in the 2024 Business Plan as part of TfL's overall funding position.
- 1.3 Additional Procurement Authority for the Automatic Train Control (ATC) signalling contract is also requested.
- 1.4 A paper is included on Part 2 of the agenda, which contains exempt supplementary information. The information is exempt by virtue of paragraph 3 of Schedule 12A of the Local Government Act 1972 in that it contains information relating to the business affairs of TfL. Any discussion of that exempt information must take place after the press and public have been excluded from the meeting.

2 Recommendations

- 2.1 **The Committee is asked to note the paper and the exempt supplementary information on Part 2 of the agenda and:**
 - (b) **approve additional unbudgeted Financial Authority of £10m to fully align this with existing Programme and Project Authority of £5,520m granted in July 2022; and**
 - (c) **approve additional Procurement Authority for the Automatic Train Control signalling contract in the sum requested in the paper on Part 2 of the agenda.**

3 Background

- 3.1 The LU Sub-surface Railway (SSR) consists of four lines – the Metropolitan, District, Hammersmith and City and Circle lines. Pre-pandemic, the four lines carried 1.3 million passengers per day, which represented a quarter of overall LU ridership, and between them they cover over a third of the LU network in terms of

track kilometrage.

- 3.2 The 4LM Programme is in the process of replacing, modernising and integrating life-expired assets (Signalling, Rolling Stock, Track, Power and Depots) on the SSR. This will add capacity (through improved train frequency when demand sufficiently recovers) and improve journey time. The 4LM Programme is the largest single upgrade in the history of the network and one of the most ambitious signalling upgrade programmes in the world. Due to its scale and interoperation with other LU lines, Train Operating Companies and Network Rail, it has a high level of complexity. Although we already have Automatic Train Control on the Victoria, Jubilee, Northern and Central lines on the LU network, the scale and complexity of upgrading the four lines of the SSR in one programme is a global first and is transforming the overall experience for our customers.
- 3.3 The renewal of life-expired assets is essential to ensure we have a reliable asset base which can be maintained at an affordable cost. Future demand and operational costs will determine the higher frequency timetable introduction dates once the capability provided by the new signalling is delivered.
- 3.4 In July 2015, the Board approved Programme and Project Authority of £5,412m to undertake the Programme. Subsequent requests to increase Programme and Project Authority were approved by the Committee in July 2021 and July 2022, bringing the current Programme and Project Authority for the Programme to £5,520m.
- 3.5 The Programme consists of 192 new trains, infrastructure changes, upgrades to three depots, which will maintain the trains, and new signalling (and associated signalling works). With the full introduction of the new fully walk-through, air-conditioned trains in 2016, most of the work is now complete, except for the remaining signalling works on parts of the District and Metropolitan lines.
- 3.6 A contract was awarded in July 2015 to Thales Ground Transportation Systems UK Limited to signal the SSR with an automatic, modern signalling system. Given the scale of the programme, the SSR has been split into sections (known as Signal Migration Areas or SMAs) for the purpose of introducing the new signalling system.
- 3.7 Since the awarding of the signalling contract in July 2015, our forecast completion date for commissioning the new signalling system has been delayed. This is principally owing to challenges with complex software development, testing and commissioning, closure availability and the impact of the coronavirus pandemic.
- 3.8 As previously reported to the Committee in July 2022, delivery of the 4LM Programme continues to be challenging due to its scale and complexity and the Programme continues to face both schedule and cost pressures.

4 Project Update and Challenges

Signalling Go-Live

- 4.1 Since the last update to the Committee in July 2022 the signalling section between Stepney Green and Becontree (SMA6) went live on 15 January 2023. This was quickly followed by commissioning of the signalling section between Dagenham East and Upminster (SMA7) on 19 March 2023.

- 4.2 Following the successful commissioning of SMAs 6 and 7, the remaining areas still to go live with the new signalling system include the Metropolitan Line north of Finchley Road (SMAs 8, 9, 13 and 14) and sections of the District line from Barons Court to Stamford Brook (SMA10) and Fulham Broadway to East Putney (SMA12).
- 4.3 Software development continues for the next SMA to be commissioned, covering the Metropolitan line between Finchley Road and Preston Road (SMA8) (including the interface with Neasden Depot and the Jubilee line).

Software Schedule

- 4.4 Commissioning of SMAs 6 and 7 represented a major achievement for the programme, as it completes the roll out of the new signalling on the Hammersmith and City line, extends the roll out of the new signalling system on the District line to include the entire section between Earl's Court and Upminster and connects the first depot (at Upminster) to the network.
- 4.5 The area now operating under the new signalling contains 62 stations and four complex junctions, including the full Circle and Hammersmith and City lines and the majority of the District line. For comparison purposes, the Jubilee line has 27 stations. This means that two of the four sub-surfaces lines (and around 57 per cent of the Tube network in total) is now operated by an automatic train control signalling system. The signalling migration area map is attached as Appendix 1 and shows the sections of the SSR now operating under the new automatic train control signalling system.
- 4.6 However, despite this progress, there have been ongoing challenges and pressures to the software schedule due to the complexity of the software development required.
- 4.7 Since commissioning SMA5 (in March 2022), the underlying system performance has been good. However, a revenue software uplift was rolled out in November 2022 to address a safety issue identified. This enabled temporary mitigation measures to be removed. This additional software release impacted on the Go Live dates for SMA6 and 7 (which were rescheduled from June 2022 to January 2023 and from November 2022 to March 2023 respectively).
- 4.8 Unrelated to the commissioning of SMA7 (in March 2023), we have identified two significant software issues that are currently being mitigated through additional operational restrictions. The impact of resolving these issues has been assessed and a plan is now in place to address these prior to implementation of the Finchley Road to Preston Road signalling section (SMA08). We are continuing to keep the Office of Rail and Road (ORR) informed and updated of our progress.
- 4.9 SMAs 8 and 9 (Neasden and Harrow) known as the Interoperable Area present the Programme with significant new challenges associated with the integration of the new SSR signalling system with the Jubilee line and Neasden depot train control software and the management of manually driven Chiltern trains. SMA14 (Uxbridge) includes interoperation with the Piccadilly line.
- 4.10 The first system testing of SMA 9 was conducted in February 2023 followed by the latest SMA 8 system test in April 2023. This is a significant step forward for the programme and enables a better understanding of the challenges of these

technically complex areas and therefore the schedule to completion.

- 4.11 An extensive review of the schedule has recently been undertaken and the Programme is currently targeting SMA8 (Finchley Road to Preston Road) to go live in spring 2024 and the final section of signalling, SMA14 (Rayners Lane to Uxbridge) to go live in spring 2025. However, these represent stretching target dates and there remain significant challenges to achieving these.

Challenges

- 4.12 Since July 2022, the Committee has been regularly updated on the continuing challenges facing the programme. While significant effort is focused on mitigating cost increases, there are several factors that could result in an extension of the programme, coupled with an increase to the Estimated Final Cost (EFC).
- 4.13 The key challenges are:
- (a) technical complexity of the software development, particularly in the SMA8, SMA9 and SMA14 interoperable areas;
 - (b) the training requirements to support operation of the interoperable areas, which are expected to be significantly greater than for previous migration areas;
 - (c) reliance on retention of specialist resources; and
 - (d) restricted access opportunities due to sporting and entertainment events at Wembley and the need for closures significantly impacting on a combination of the Metropolitan, the Jubilee line, the Piccadilly line and Chiltern Railway operations.
- 4.14 Closures are required to enable the delivery of the new signalling system. Crucially, they are also used to familiarise Train Operators with the new system. We carefully monitor the use of closures to ensure that each closure is used as efficiently as possible for installation and testing of the new signalling system and infrastructure. Closures are also subject to change to avoid unnecessary closures when plans change.
- 4.15 It is recognised that delivery to the earliest possible schedule, and therefore lowest possible final cost, is imperative but this remains very challenging. The 4LM Programme team is committed to working collaboratively with our signalling supplier Thales to meet the programme challenges, with the aim of delivering the existing full 4LM Programme scope within the existing £5,520m Programme and Project Authority granted by the Committee in July 2022.
- 4.16 The Committee will continue to be kept updated on progress at each meeting going forward. Greater certainty on cost and schedule is expected when the higher-risk development of software on the interoperable sections of the Metropolitan line has been further progressed.

Timetable changes

- 4.17 Since our last update to the Committee in July 2022, a new timetable was successfully introduced in September 2022 as planned. This has enabled a journey time improvement of around five per cent on average on the Circle and

District lines between Monument, Fulham Broadway, Barons Court and Paddington. This adds to the journey time improvements of up to 10 per cent already introduced on the north side of the Circle line through a timetable change in September 2021.

- 4.18 The successful commissioning of SMAs 6 and 7 in January and March 2023 allows further runtime improvements to be included in a planned timetable change in early 2025. This will enable a 5-10 per cent improvement in average journey times between Stepney Green and Upminster.
- 4.19 As a result of the delays to the signalling software roll out, as previously reported to the Committee in July 2022, the timetable frequency improvements cannot be introduced by the dates originally planned in 2015.
- 4.20 We will continue to review the implementation dates for service frequency improvements based upon balancing demand with operational costs, Network Rail timetable introduction dates, operational readiness and the dates at which capability becomes available (noting that further optimisation of the commissioned signalling software is required in certain areas).

Table 1: Movement of planned dates set at Programme and Project Authority in 2015

Timetable Milestones	2015 Planned Date	Current Forecast Date
Runtime Improvements (SMA3)	May 2021	Achieved Sept 2021
Runtime Improvements (SMA5)	N/A	Achieved Sept 2022
Runtime Improvements (SMA7)	N/A	Planned early 2025
30 trains per hour in Central Area	Dec 2021	The implementation dates for service frequency improvements are under review as described above.
32 trains per hour in Central Area*	May 2022	
24 trains per hour Metropolitan Line	Dec 2021	
26 trains per hour Metropolitan Line	Dec 2022	
28 trains per hour Metropolitan Line	May 2023	

*Achievement of a reliable 32tph service level is also dependent on the renewal and remodelling of Aldgate Junction

Signalling Infrastructure Works

- 4.21 Design and installation of the trackside signalling assets continues to support future SMA commissioning.
- 4.22 On the Metropolitan line north of Finchley Road in SMA8 100 per cent, SMA9 94 per cent, SMA13 80 per cent and SMA14 59 per cent of installation is completed. On the sections of the District line from Barons Court to Stamford Brook (SMA10) and Fulham Broadway to East Putney (SMA12) 63 per cent of installation is

completed. We are aiming to complete all installation by March 2024.

- 4.23 Cable pull has been delayed by the impact of the fires at Barking and Upney last year, which destroyed commissioned cables along with additional work required to deliver a compliant radio network in SMAs 6 and 7 for the recent commissioning dates.

Depots

- 4.24 Upgrade works at Ealing Common Depot, bringing new facilities to allow maintenance of the new train stock, were completed in 2022. Along with the already completed upgrade of Upminster Depot, we have now delivered casualty and planned maintenance facilities for the District, Hammersmith and City and Circle line trains.
- 4.25 The Heavy Maintenance Facility upgrade works at Neasden Depot achieved a significant milestone with the Bringing into Use of the Long Shed in July 2022. This has enabled critical door maintenance capabilities for the Depot. The team have also made progress with the procurement process for the remaining packages for the Heavy Lifting Shed and the new Staff Accommodation building. Once complete these facilities will enable the planned overhaul of the new trains and provide much needed welfare facilities for the maintenance staff carrying out these activities.



Figure 2 – S Stock train integration at the new Long Shed at Neasden Depot



Figure 3 – Cable Route installation

Train Fitment

- 4.26 We continue to progress with the fitment of signalling equipment to our fleet of Engineering Vehicles with all 29 Battery Locomotives completed. Both D-Stock Rail Adhesion Trains have been fitted and have undergone dynamic testing. We have commenced the mechanical fitment of the Tamper train with the electrical fitment on target to commence by the end of 2023.

5 Benefits and Value

- 5.1 The introduction of the 192 new trains has delivered 25 per cent of the programme benefits which include:
- (a) the first step up in capacity while maintaining the current train service

frequency as the new trains are longer and carry more passengers;

- (b) an improved customer experience with walk-through gangways, in-car CCTV, air conditioning, a Rail Vehicle Accessibility Regulations compliant saloon and improved Customer Information Systems; and
- (c) the opportunity to recover energy through regenerative braking.

5.2 The introduction of the new signalling will deliver 75 per cent of the programme benefits, which include:

- (a) speed increases which reduce journey times between stations; and
- (b) the ability to run trains closer together increasing service frequency up to 32tph in the central area.

District line Branches

5.3 As reported to the Committee in July 2021, following a review assessing and challenging costs and schedules for the Programme, the western branches of the District line will not be re-signalled. This means sections of the District line south of East Putney and west of Stamford Brook will remain under the existing signalling. Journey times in these sections will remain unchanged, however, we can still increase frequencies to up to 16 trains per hour, as originally planned. We will also continue with works to improve the live customer information available on platforms in this area.

Metropolitan line Branches

5.4 There remains a strong case to continue with the re-signalling of the Metropolitan line north of Finchley Road. The re-signalling of the Metropolitan line differs from the District line because:

- (a) the existing signalling on the Metropolitan line is older than the District line. If it is not replaced the ongoing renewal and maintenance costs are significant and greater than the District line;
- (b) our planned step-change in passenger experience relies on the line being re-signalled. If we retain the legacy signalling, then we will be unable to either reduce passenger journey times or increase train frequencies; and
- (c) as we are close to completing the installation works our opportunity to save costs by reducing scope are limited and outweighed by the ongoing renewal and maintenance costs of retaining the existing signalling.

5.5 Replacing life-expired signalling is key to achieving cost effective management of our asset base. Though we may be able to achieve some immediate savings by not signalling the Metropolitan line branches, in the longer term we will spend more than we save and do not achieve any customer benefits.

5.6 Despite cost pressure on the programme, there is a strong case to complete the remaining signalling migration areas, however the immediate affordability will be kept under review as the programme progresses.

6 Assurance

- 6.1 TfL Project Assurance and Independent Investment Programme Advisory Group (IIPAG) have undertaken their review of the 4LM Programme via continuous assurance. They have received detailed briefings from the project team and are fully aware of the issues and challenges on the 4LM Programme. In addition, TfL Project Assurance have undertaken a targeted review to support this submission to the Committee.

List of appendices to this report:

Appendix 1: Signal Migration Area map

Exempt supplementary information is included in a paper on Part 2 of the agenda.

List of background papers:

Independent Investment Programme Advisory Group Report

TfL Project Assurance Report

Management response to TfL Project Assurance Report

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