Programmes and Investment Committee

Date: **26 June 2024**

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 (the Programme).

1.2 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:

(a) approve additional Programme and Project Authority for the sum set out in the paper on Part 2 of the agenda;

(b) approve additional Procurement Authority for the Automatic Train Control signalling contract for the sum set out in the paper on Part 2 of the agenda;

(c) approve the transfer of Programme and Project Authority (granted by the Committee in July 2022) and Financial Authority for the signalling element of the works at Aldgate Junction to the London Underground Renewals Programme for the sum set out in the paper on Part 2 of the agenda; and

(d) note that the matters for which Authority is sought above extend beyond the period of the 2024/25 Budget and 2024 Business Plan. Provision will, therefore, need to be made for them in future Business Plans and Budgets.

3 Background

3.1 The LU Sub-surface Railway (SSR) consists of four lines – the Metropolitan, District, Hammersmith & City and Circle lines. Between them these four lines carry one million passengers per day, representing a quarter of overall LU ridership, and cover over a third of the LU network in terms of track kilometrage.

3.2 The 4LM Programme comprises the replacement, modernisation and integration of life-expired assets (signalling, rolling stock, track, power and depots) on the SSR. This will add capacity (through longer trains and improved train frequency) and improve journey times. 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.

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 Metropolitan and District 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 (noting that on 31 May 2024 Hitachi Rail announced the acquisition of Thales' Ground Transportation Systems business).

3.7 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.

3.8 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.

3.9 As previously reported to the Committee in July 2023, 4LM is a complex and challenging programme and remains under both schedule and cost pressure as we progress with the development and commissioning of the most complex areas.

3.10 Since July 2023, the Committee has been regularly updated (through the Investment Programme Report updates) on Programme progress and challenges including the latest schedule and cost position.

3.11 A review of the schedule and cost has been undertaken which has informed the requested change to the Programme and Project Authority sought in this paper.

4 Project Update and Challenges

Signalling Infrastructure Works

4.1 Since the last update to the Committee in July 2023, we have made significant progress in the design and installation of the remaining trackside signalling assets with installation of these assets now substantially completed (a very small number of assets remain outstanding as they require a more complex installation method; these assets are due to be completed by the end of 2024).

4.2 With these trackside assets now in place, the 4LM Programme is now principally focused on the development, implementation and testing of the signalling software to enable the go live of the new signalling system in the remaining signalling migration areas.

Signalling Software Development and Testing

4.3 Following the successful commissioning of SMA6 (Stepney Green to Becontree) and SMA7 (Dagenham East to Upminster) in 2023, the new automated signalling system is in operation through 62 stations, including the whole of the Circle and Hammersmith & City lines, as well as the east end 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.

4.4 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 small sections of the west end of the District line from Barons Court to Stamford Brook and Fulham Broadway to East Putney.

4.5 The Metropolitan line areas are the most technically complex areas in the Programme and present significant unique challenges associated with the integration of the new signalling system with the Jubilee line and Neasden depot train control software, along with the management of manually driven Chiltern trains and integration with the Piccadilly line.

4.6 There are also additional challenges arising from the restricted access opportunities (due to sporting and entertainment events at Wembley and the need for closures significantly impacting on a combination of the Metropolitan line, the Jubilee line, the Piccadilly line and Chiltern Railway operations) and the training requirements to support operation of the interoperable areas (which are significantly greater than for previous migration areas).

4.7 In the past year significant progress has been made in developing and testing the signalling software in the next two areas to go live, SMA8 (Finchley Road to Preston Road) and SMA9 (the Harrow area) with positive progress in software development and successful site system testing being undertaken. This has increased our confidence in the maturity of the software for go live and enabled a better understanding of the challenges of these complex areas and therefore the schedule to complete.

4.8 The next SMA to be commissioned, covers the Metropolitan line between Finchley Road and Preston Road (SMA8). This area is one of the most complex on the London Underground network. Metropolitan line trains share tracks with Jubilee line trains and the signalling system needs to enable trains from both lines to enter and exit the depot at Neasden.

4.9 We have increased our confidence in the system integration for this complex area through significant off-site testing, ensuring that we optimise efficient use of on-site planned closures. This includes successful works undertaken during a closure on 10-11 November 2023 to test the connection between the control systems of the Jubilee and Metropolitan lines to ensure communication between them. On 13-14 April 2024 we completed further system testing during a weekend closure with more testing planned for July 2024. This is a step forward towards achieving our planned commissioning milestone for this area in early 2025.

4.10 Beyond SMA8, further progress was made in October 2023 when we completed the second system test for SMA9 in the Harrow area, successfully testing the integration of Chiltern trains with the new signalling system for the first time. We continue to make positive progress in maturing the software development for this area ahead of our third system test planned for later this year.

Signalling Go Live

4.11 While we have made positive progress in the signalling software development and testing over the last year, there have been ongoing challenges and pressures to the software schedule due to the technical complexity of the software development required.

4.12 Since the last update to the Committee, in July 2023, our forecast commissioning dates for the remaining SMAs have been revised. We are now targeting SMA8 to go live in early 2025 and the final section of signalling, SMA14 (Rayners Lane to Uxbridge) to go live in 2026.

4.13 The revised software schedule reflects an updated assessment of the timescales for development, testing and commissioning and completion of operational readiness activities.

4.14 This follows a detailed collaborative review with our signalling supplier specifically focusing on the next two SMAs to go live (SMAs 8 and 9) with consequential updates to the schedule for the remaining SMAs beyond this (and to the estimated cost of the programme). Additional time is needed for development and testing of these complex areas to ensure reliable operations once these areas are commissioned.

4.15 Closures are required to enable the installation, testing and commissioning of the new signalling and to familiarise Train Operators with the new system. We have had to carefully balance the use of weekend closures to support the programme whilst also keeping the railway open to customers and planning around major events in London.

4.16 The revised schedule also reflects the impact on our signalling software schedule arising from the need to accommodate additional fixes to resolve two software issues identified in the commissioned system. This was not unexpected, given the complexity of the signalling system, and these fixes were successfully implemented in August 2023.

4.17 The revised commissioning schedule for the remaining SMAs represent target dates and there remain challenges to achieving these. We continue to work collaboratively with our signalling supplier to review opportunities and mitigate future risks associated with the delivery of the remaining signalling migration areas including assessing the benefits of different delivery strategies.

Timetable changes

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 five to 10 per cent improvement in average journey times between Stepney Green and Upminster.

4.19 This adds to journey time improvements of around five per cent on average on the Circle and District lines between Monument, Fulham Broadway, Barons Court and Paddington that were introduced in September 2022 and the journey time improvements of up to 10 per cent introduced on the north side of the Circle line through a timetable change in September 2021.

4.20 As a result of the delays to the signalling software roll out, as previously reported to the Committee in July 2023, the timetable frequency improvements cannot be introduced by the dates originally planned in 2015.

4.21 We continue to review the implementation dates for service frequency improvements based upon balancing passenger 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 September 2021
Runtime Improvements (SMA5)	N/A	Achieved September 2022
Runtime Improvements (SMA7)	N/A	Planned early 2025
30 trains per hour (in the central area)	December 2021	The implementation dates for service frequency improvements remain under review as described above.
32 trains per hour (in the central area)*	May 2022	
24 trains per hour Metropolitan Line	December 2021	
26 trains per hour Metropolitan Line	December 2022	
28 trains per hour Metropolitan Line	May 2023	

*Achievement of a reliable 32 trains per hour service level is also dependent on the renewal and remodelling of Aldgate Junction currently targeted for summer 2027.

Depots

4.22 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 & City and Circle line trains.

4.23 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. In the past year the team have made progress with the awarding of contracts for the remaining packages for the Heavy Lifting Shed and the new Staff Accommodation building. The works has experienced some delays owing to challenging ground conditions with a high volume of buried cables and pipes within excavations that were not detailed in records. Once complete in 2025 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.

4.24 The detailed design for the new staff accommodation block is close to completion and will include a number of sustainable technologies to minimise operational carbon and environmental impact including a solar panel system (with any excess

electricity feeding back into the LU supply network), LED lighting and a new efficient intelligent heating and cooling system.

Train Fitment

4.25 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 and we continue with the fitment of the signalling equipment to our two Tamper trains. Commissioning of the signalling on all our Engineering Vehicles is planned to be completed alongside the go live of the final signal migration area (SMA14).

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, walk-through 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 32 trains per hour 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 branches because:

(a) the existing signalling on the Metropolitan line is older than that on 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, we will be unable to either reduce passenger journey times or increase train frequencies; and

(c) as we have substantially completed 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. Any immediate savings made by not signalling the Metropolitan line branches will result in higher spend in the longer term and will 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. All recommendations are being addressed, as detailed in the management response.

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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Appendix 1: 4LM Signal Migration Area map