

# REPORT OF SOCIETY MEETING

## THE 4LM UPGRADE PROJECT

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and Steve Ristow, 4LM Programme Delivery Manager

**A report of the LURS meeting at All Souls Club House on Tuesday 8 October 2019**

*Editor's Note – the delayed publication of this meeting report means that some of the information will have changed since the speakers addressed the Society, especially in the light of the Covid-19 pandemic.*

At short notice we were fortunate to hear an excellent presentation from both managers in the absence of the advertised speaker. Kasper Dixon began the first half of the meeting. The Four Lines Modernisation, 4LM project, is the world's biggest and most complex resignalling project, covering 40% of London Underground with 1.3 million passengers daily, and includes areas dating from 1863 onward. The project promises a 33% capacity uplift across all four lines, with a total final cost estimate of £5.4bn. A geographic map showed that the lines spread from Amersham to Uxbridge, and from Chesham to Wimbledon.

The project has already rolled out 192 new trains together with all new systems required to support them, including station OPO systems and significant ongoing depot works costing around £100m. There have also been around £150m of track works and power upgrades. The new rolling stock is reliable and passengers love it, particularly the air conditioning. Signalling has been a difficult journey, with the demise of the PPP approach, and the award and subsequent termination of the Bombardier contract. It has to work this time. There are 310 track kilometres, including 40km in tunnels, 113 stations and five complex junctions. The Thales signalling contract is worth around £800m, with a similar amount to be spent within LU on resignalling activities. Design and supply may be outsourced, but LU monitor and control all works, and will maintain the assets.

The new signalling system provides in-cab signalling with automatic train protection, operation and regulation. There is a new single integrated service control centre at Hammersmith which covers the whole 4LM network and eventually replaces eleven separate facilities. The system must provide for inter-running with Chiltern Railway trains to Amersham, with the Jubilee Line around Neasden Depot, the Piccadilly Line from Hammersmith to Uxbridge, London Overground to Richmond, and South Western Railway trains to Wimbledon.

The 4LM signalling migration areas will be commissioned sequentially. This started with SMA 0.5, a short section from Hammersmith to Latimer Road in March 2019. Areas 1 and 2 were delivered in August 2019, merged for efficient delivery. This was an incredibly complex area which has proved more reliable than expected. A few software related reliability issues have caused service delays, which Thales works hard to fix. Service-affecting failures settled quicker than in SMA 0.5 and are far better than those experienced on the Jubilee and Northern lines installations. The new system recovers well from failures. Driver familiarisation was a huge task and took longer than expected. Some radio coverage is within tolerance, but less than ideal and will be boosted.

Planning for area 3 around Aldgate in early 2020 allows for an uplift in the timetable, with quicker journeys and shorter dwell times, which will be the first benefit passengers' experience. Planning for areas 4 and 5 later in 2020 will complete the Circle Line, and then area 6 to Barking comes along later to allow timetable A in 2021, the first frequency uplift to 30tph in the central areas with 10% increase in S7 stock kilometres run. Areas 7 to 14 will follow to allow further uplifts out to 2022.

The provision of 46 signal equipment rooms has not been easy, with limited space available. At Barking, it required a 159 pile retaining structure, whilst at Turnham Green and Gunnersbury it involved major mining work under the railway arches. At Triangle Sidings, all deliveries were by engineering trains for piling beneath the Sainsbury's under-croft, whilst at Ealing Common, extensive excavations were required to protect the existing heritage station building.

The project scope required 150km of Cable Route Management System (CRMS) to be designed and installed, but the constraints of undertaking this on an operational railway with legacy assets has resulted in this increasing to 235km (up 57%). There are varied types of CRMS installation across the network, e.g. track crossings, under track crossings, under road crossings, hangers, trough and cable post routes. The CRMS installation programme is currently 95% complete.

All the above has been LU work, but then Thales installation of the signalling equipment requires 2,550 shifts each week. There remain 3,000km of cables to be installed, together with 70,500 more assets. These include tags, similar to Connect tags, around every 50m for positioning signals, cabling and Wireless Remote Units, the tall masts in outside areas. In tunnels, more frequent, smaller antenna are mounted on a fixing design which can hold a Mini Cooper car, although the antennas weigh around 500 grams. All Wi-Fi communications are through a secure radio link to prevent hacking from the standard Wi-Fi. Plate racks are installed in every area to change between legacy and new signalling at the flick of a switch, allowing very swift transition for testing from Friday night to Sunday night. The biggest spend is on digging holes, mainly a labour spend! On completion, there will be sufficient cables installed to reach to the moon and back!

Steve Ristow continued the talk about the Hammersmith Service Control Centre, the newest and largest on LU. The Metropolitan and District Line teams moved in from Baker Street on 5 May 2018 and run the existing railway on all four lines today. All communications and service control systems went into revenue service. This was the first and largest people move of the 4LM programme, and was completed prior to any signalling teams moving in.

Delivery of the S Stock fleet of walk-through air-conditioned trains was completed in November 2016, with 59 S8 trains on the Metropolitan Line and 133 S7 trains on the other three lines, the largest ever fleet order in the UK at just over 1,400 cars. All 192 trains were delivered from Derby to run on the legacy signalling system, and later moved back to Derby for fitting of the signalling equipment, just recently finished. It took around two weeks per train for fitting, testing and delivery in a collaboration between Bombardier, Thales and TfL over some 30 months. Logistically just to move the trains up, interfacing with Network Rail, was a nightmare that other railways would have avoided by using road haulage, but this saved some 2,800 truck movements.

The fitment of 33 engineering vehicles at Ruislip is ongoing. It is a massive challenge to find room for the equipment, which needs to be compatible with four different systems: 4LM, legacy signalling, Jubilee and Northern lines system, and Central Line system. There are two battery loco types. The 18 type A locos are completed and have undergone static and dynamic testing at Ruislip Depot. The first four of battery loco type B have been done, and the Rail Adhesion Trains are in progress before the outer-area signalling is commissioned, with ultimately an automated gritting system. The tamping machines are to be fitted by the end of signal installation.

With more trains for a more frequent service, there was need for more stabling and maintenance roads. This involved major reconstruction of all three main depots, at Neasden, Upminster and Ealing Common, with TfL as principal contractor. These works are now approaching completion.

There are rigorous operational trial weekends to give confidence in system readiness for commissioning each area into service. A timetabled service is run without passengers. Over 1,000 train operators have been trained on the new signalling in classroom, simulators, and hands-on practical training, on trial weekends or early days of commissioning. Also 150 signalling and control staff have been trained on the new system, and maintenance staff are trained at Acton Town with over 10,000 hours of multi-layered technical training. New works process and risk assessments were developed, involving two years of engagement with staff and Trade Unions. Process confirmation work-streams included cyber security and materials management. Specialist tooling and equipment was developed and in place, with £2m of spares delivered and onsite 'lean' equipment. Trained system engineers were in place for each area commissioning. Without these important deliverables in place, the business benefits of the installed new assets would be lost.

The next area to be commissioned will be around Aldgate in early 2020, with the Circle Line complete by the end of that year. 2021 will see the initial improvements to journey times in central London and out to Barking, with up to 30tph during peaks. 2022 will see the final section of new signalling completed, and trains increased to 32tph in central London and out to Barking during peaks. 2023 brings more trains on the Metropolitan Line in peaks and increased services on the busiest sections with better passenger information.

Following upon the formal presentation, a 20-minute question-and-answer session was held, including the following points:

Q: With short headway services, how do we persuade the public to await the next train and not hold doors ajar?

A: *This has been done on the Victoria and Jubilee lines with some success, although there are always some who cannot be reached.*

- Q: An audience member pointed out that the book "Handling London's Underground Traffic" by Mr. J.P. Thomas, the Underground Group Operating Manager in 1928, contains a District Line timetable extract showing 90 second intervals back then.
- A: *4LM promises an uplift to recent service levels, but there remains doubt as to whether the planned service of those days was ever achieved. Current conditions are much more complex, with overcrowding, growing safety consciousness, and regulations.*
- Q: Since 4LM signalling is a modern version of the system on both Jubilee and Northern lines, will those lines benefit from recent developments?
- A: *The Battersea extension will receive some benefit in its new installation, but there are currently no plans to modify the rest of those lines. The JNUP project looked forward to such an upgrade, and much work was done to prove a good business case, but funds are currently unavailable.*

The speakers were congratulated on their excellent presentation.

**John Hawkins**