

# NEW TUBE FOR LONDON OPERATIONS AND MAINTENANCE CONCEPT

by John Hawkins

TfL have published answers to Freedom of Information requests received since the start of 2017 on their website. An average of 200 appear monthly. My eye was drawn to a request headed 'Driverless Trains', which asked for all reports held and internal correspondence with the Mayor since January 2016. This succeeded in revealing a 320-page report headed "NTfL Operations and Maintenance Concept" from which all mention of driverless trains has been redacted (88 pages are blanked out, over a quarter!). TfL state that the document examines how further automation *could* work to inform equipment design, and does not form the basis for any proposed changes (emphasis in document). It was prepared under the previous Mayor. Information which might impact discussions with Trade Unions has been removed. No correspondence was found. The report is an outline of possible future ways of working, and could be thought of as a dream. There is currently no money approved beyond the Piccadilly Line upgrade except for these preparatory studies.

The released issue 3 is dated 20 July 2016. It states that an issue 4 update was planned for February 2017. The request for information was made on 8 March 2017 and TfL replied on 13 July 2017, so perhaps issue 4 had not appeared at that time. Issue 3 was prepared before responses to invitations to negotiate from the rolling stock and signalling supply chains, which could firm up details in the next revision of the document. There is probably more detail included about the current state of these lines and depots than there is about their possible future.

The previous version of this document was titled 'Deep Tube Operations and Maintenance Concept 2020'. With the recent change of Mayor it seems that the project has dropped the NTfL name, and reverted to its previous name. However, the UCL study (see side bar) finds that the public feel the word 'deep' is scary. The report covers all four lines involved. It is a pity the 4 Lines Modernisation name has already been used for the sub-surface lines.

## PUBLIC VIEWS ON DRIVERLESS TRAINS

This enquiry also produced a July 2016 presentation on an academic project conducted by UCL about public confidence in automated cars and trains. Four extended discussion groups felt that automated vehicles are part of the short-term future for both road and rail. They had less confidence in automated cars than trains. The DLR has provided a strong reference point for LU users, who are more concerned with travelling safely, quickly and reliably, and pay little attention to how this is achieved. Even the most confident would feel more comfortable on automated sub-surface lines rather than deep level lines. Their biggest concern relates to a lack of human presence, but virtual voice/reassurance can overcome fears. Provision of relevant and evidence-based information will increase the acceptability of unattended automated tube trains.

## TRAINS

This project aims to upgrade the remaining LU lines with a common design of train with air cooling and walk-through car ends. The target is for 33 trains/hour on the Piccadilly and Central lines, and 27 trains/hour on the Bakerloo and Waterloo & City lines. The Bakerloo will receive 36 trains, as currently. The Waterloo & City line will have 5 to 7 trains – currently 5, with no spare train available. No figures are shown for the other lines. No line order or dates are shown for these upgrades. The new rolling stock should achieve 120,000 km mean distance between failures, although the 40-year old Piccadilly line fleet achieved 137,324 km between failures in March 2015, and the NTfL Feasibility Report originally aimed for 200,000 km.

Current legacy trains are manually driven by a Train Operator in the driving cab, protected by trackside colour light signalling and tripcock/trainstops. This is Grade of Automation 1 (GoA1). The new trains will be introduced progressively to operate in this way as they are delivered to the Piccadilly and Bakerloo lines, as has happened with the recent S Stock. This requires few on-site modifications: perhaps additional camera equipment for in-cab monitors.

When all old trains have been withdrawn, a start will be made on converting operation to GoA2, site by site. This means that the train operates automatically between stations once the Train Operator closes

the doors and gives a start signal. It has been used for almost 50 years on the Victoria Line. Current Central Line trains are already GoA2, and it is not detailed how the new trains will operate on delivery. On the Victoria Line there was a compromise system for the new trains until all old trains had been withdrawn, after which the new signalling system was fully commissioned.

The new trains will have provision for unstaffed operation (GoA4) which could be introduced later in their 40-year planned life. However, all references to this have been removed from the released document. It would appear that such operation is not contemplated for the Bakerloo Line. However, the Waterloo & City Line upgrade is planned differently to other lines. It is intended to close the line for a period of time, as has happened in the past, and to reopen with GoA4 automation.

The train will have a partitioned driver's cab with cab-side doors, unlike the artist's impressions used at the NTfL launch exhibition in 2014. At the launch the Mayor, Boris Johnson, gave an assurance that there would always be a train captain on board these new trains. This is classified GoA3, as operating on the DLR for 30 years, but is not mentioned in the paper. A member of staff could accompany each GoA4 train, but would they have a worthwhile job? A train captain could not wander the length of a train with peak loadings. Perhaps they could be based in a cab and use modern communications to help with public travel enquiries, saving some current office positions. The position would require less training than a driver, and probably receive a lower pay rate. If trains still require a staff member present they will require rostering, meal relief and crew hand-over management. This would provide practical experience of GoA4 with the protection of a staff member on board.

There will be no need to detrain if reversing in a siding. An audio/visual message is considered enough to advise passengers to alight. Presumably, with no inter-car gaps there can be no escaping for trapped passengers. Detraining will be required if stabling for an extended period of time. Moves to depot reception roads and sidings will be in automatic mode. Depots may be signalled for automatic moves to berthing locations, but there will be no auto operation in maintenance areas. Transfer of train from stabling site to station will be under Train Operator control, either manual driving or automatic if available. To walk to sidings in tunnelled sections, traction current must be discharged.

## OPERATING PROBLEMS

The trains will feature an automatic sanding facility, as introduced on S Stock.

Each train will have sleet brushes to clear conductor rails. A third or more of trains will be able to lay de-icing fluid which, with a nine-hour capacity, will need regular refilling during severe weather.

All key sets of points will have point heaters, whilst depot and stabling roads will have conductor rail heating strips. A screen washing system will be fitted, based on experience with S Stock, and will require refill facilities.

Movement without traction power, drawing on on-board batteries, is expected to be limited to 50 metres at slow speed with crush load, or 200 metres when empty on level track, but will reduce the power remaining for essential on-board services, the number of which continue to grow (see side bar).

## BATTERY MAINTAINED ESSENTIAL ON-BOARD SERVICES

Saloon emergency lighting.  
Train Radio.  
Remote public address system.  
Passenger emergency alarms (including control centre monitoring).  
Train secured indication.  
External lighting and display systems.  
Recording and on-demand transmission of CCTV images.  
Saloon ventilation.  
Control functionality to resume auto-operation on restoration of power.  
Control functionality to enable self-powered movement.  
Fire detection.  
Saloon interior digital customer information displays  
(Q Stock operated without emergency batteries until 1971 withdrawal).

Current crew step-back arrangements on these four lines are normally limited to Arnos Grove and Elephant & Castle. Despite only 11 trains/hour reversing at Arnos Grove, stepping back allows service recovery by reducing turn-back times to 2 minutes. Arriving Train Operators step back to a later train. Stepping back also takes place at White City and Liverpool Street during line closures.

A wide range of operational problems and work-around procedures are listed. Some sections are blanked out since they may provide information which could be used to disrupt normal rail operations. Passenger emergency alarms will provide intercom, are monitored by CCTV, and can be reset from the train cab. It will be easier to evacuate a walk-through train if necessary compared to current trains.

The Uxbridge branch will remain under control of the new 4LM Hammersmith control centre, and Piccadilly Line trains will operate under the Metropolitan Line Service Controllers. A paragraph on this branch is blacked out, but is believed to refer to the impossibility of fitting platform edge doors where mixed rolling stock operates, a feature also north of Queen's Park. PEDs are not mentioned in the released document, so must be confined to the GoA4 paragraphs that have been withheld.

Functionality of NTfL features under Network Rail signalling north of Queen's Park has still to be determined. The NTfL control centre will maintain visibility and awareness of the entire line's service, trains' health status and condition of LU assets. No mention is made of the proposed Lewisham extension, for which additional trains would need to be maintained at Stonebridge Park Depot. This extension is now to be tied in with the line upgrade.

West of Barons Court the Piccadilly and District lines will each operate under their own control centres. West of Turnham Green, District Line trains will operate out of service under the NTfL Control Centre. District Line trains returning to Ealing Common depot will detrain at Turnham Green but, to avoid delaying following trains, will be checked to ensure that all passengers have alighted at the old Chiswick Park westbound platform. Presumably stragglers will be directed to new platforms on the Richmond branch. District Line trains to and from Ealing Common Depot will operate as now, but without passengers west of Turnham Green. Transfers, primarily of engineer's trains, between lines will be retained on the Piccadilly line at King's Cross, Finsbury Park, and Hammersmith.

It is noted that working timetables for the Piccadilly and Bakerloo lines change on set Sundays in May and December only, in line with National Rail timetables. The Bakerloo has to inter-work with London Overground services. The Piccadilly line has to co-ordinate with sub-surface line services which in turn inter-work with National Rail trains.

## DEPOTS

The aim is 90% fleet availability, with each line having 2 to 5 hot spares available for immediate service. 3-day automatic train washing of all trains is planned. All regular train movements within depots will be over powered points. Depots are to be signalled at least to support service ramp-up and ramp-down moves. It is noted that depot upgrades should not infringe gauge requirements for heritage stock. Sandite trains will still be required, and a future RAT strategy will need to be agreed.

NTfL trains will likely be delivered to Ruislip depot for commissioning and testing. NTfL central stores will be located at Acton with delivery to depot stores as required. The Bakerloo and Waterloo & City lines will remain self-contained with their new fleets. London Road depot will require three pitted roads for light maintenance, whilst the stabling area will operate as manually driven signalled sidings.

Three redacted options for the Piccadilly and Central line depots are: twin balanced line specific depots as today; line separate major depot (Cockfosters and Ruislip) with satellite depot (Northfields and Hainault); or integrated Ruislip depot heavy maintenance hub for both lines. With different train lengths on these two lines, it will be unusual for a train to transfer between them despite being maintained together. Line maps and diagrams are to be in traditional paper format, allowing for maintainability. It is reported that, at a number of locations, the train length will be greater than the platform so the cab will be in the tunnel. These dimensions are not revealed.

The NTfL solebar height will be similar to existing tube stocks. The introduction of S Stock has revealed limitations with side-pitted roads, so there will be an aim for swimming pool type roads for maintenance and inspections, where the workshop floor is a comfortable distance below rail level. However, it is noted that there are lessons from the Neasden rework rather than using a fresh site. It will be intended to bi-annually skim all wheels on an underfloor-lathe. The Waterloo & City wheels will need to be sent to Acton for turning. Currently this is also the case on the Bakerloo Line.

Current depots lift only a single car on the Piccadilly and Bakerloo lines, and a pair of cars on the Central and Waterloo & City lines. The new trains will not be easily split, and will need to be lifted as whole trains in a synchronised lift. Component/bogie drops will be a new feature to LU.

The current train wash machines are life expired, and it is recommended that new wash machines be installed, with one at each end of double-ended depots. NTfL depot upgrades do not cover renewal of legacy assets unless to support introduction of the new fleets.

Modern trains have required three times as much time for door maintenance, with an annual inspection and 4-5 year overhaul cycle. Each train spends a week each year for door maintenance with complete removal and manipulation using dedicated equipment.

## SIGNALLING

The new signalling system will require less maintenance, and allow the train service to operate for longer hours. All four lines will be operated from a common control centre, with each line having its own room. Signal control and line control will not be in the same room, as they are for the Jubilee and Northern lines, but will probably be sited in the same building. This is a preference which has swung to and fro over the years.

Bi-directional signalling will aid incident handling and service recovery. Remote opening of traction current section switches will allow timely current recharging of smaller areas. There is talk of an end-state track layout, in the fashion of 4LM, but no locations are mentioned. With a 40-year life, a mid-life upgrade of both trains and signalling is envisaged.

### DEPOT MAINTENANCE ROADS

Heavy maintenance facility – Overhaul.  
 Heavy maintenance facility – Casualty.  
 Modified general exam & inspection (6).  
 New general exam & inspection (4).  
 Cleaning road – above solebar (3).  
 Underframe cleaning road.  
 Automatic train wash.  
 Door road – periodic inspection.  
 Door road – overhaul.  
 Fluid replenish – de-icing (5).  
 Fluid replenish – sanding (5).  
 Fluid replenish – screen wash.  
 Wheel turning facility.  
 Specialist road – vent system cleaning.  
 Specialist road – Sandite refill.  
 Auto inspection equipment.