DEEP TUBE UPGRADE PROGRAMME – 2017 BUSINESS CASE

by John Hawkins

Please note that the case was revisited in 2018 before rolling stock was ordered, and therefore the 2017 case does not reflect current plans but is an indication of their development path. Consequent upon the 2016 TfL business plan, the Bakerloo Line implementation is delayed by a year to 2029, whilst the Waterloo & City Line has been moved from 2026 to be the final line in 2034, when it will provide a demonstration of fully automated trains.

Since the previous analysis TfL have taken a decision to change the temperature standard from 30ºC to 32ºC, which reduces the calculated benefit of the new trains. The discovery of problems with tunnel air velocities, and also with station capacity problems, has further reduced the value of the proposed investment, but the case remains strong.

Since the 2016 study, the Chiswick Park proposal has been revised to avoid new platforms on the Richmond branch by providing new crossovers to allow Piccadilly Line trains to serve the current platforms. It is expected that these will be used by Ealing Broadway and Rayners Lane trains only, the more heavily loaded Heathrow and Uxbridge trains continuing to use the fast lines. This gives a signage problem which could be eased if only Ealing Broadway trains stopped there as currently happens. Presumably the crossovers will be positioned midway between stations, allowing stopping trains to slow or accelerate clear of the fast lines, but also to allow empty District Line trains to stand clear of the Piccadilly Line awaiting a path to or from Ealing Common Depot. The eastbound crossover will solve a problem when Rayners Lane trains operate a shuttle to Acton Town, since Heathrow trains cannot currently cross from the slow to the fast line until a reversing train is fully in the sidings. Further study of late evening capacity restraints at Hanger Lane Junction have led to a proposal to divert only some Ealing services to Rayners Lane, and to stable District Line trains at a slower rate, presumably starting earlier.

Assessments now show negative benefit (or dis-benefit) from attended GoA4 (full automation), but similar levels of benefit from either planned attended or unattended GoA4. The impact on station dwell times awaiting platform edge doors at each station adds 0.5 seconds, and gap fillers at curved platforms add a further 1 or 2 seconds. This will be left to a subsequent investment programme, allowing time for more study since a decision is not needed until the coming decade.

TUNNEL AIR VELOCITIES

It has been found that tunnel air velocities could exceed existing levels, which will be dealt with by ventilation works in the central area, and reduced speeds in outer areas. Studies were made for the Piccadilly Line, but similar problems are expected on other lines. Tunnel cooling by new infrastructure is planned at seven key Piccadilly Line stations to retain full speed performance through these central area locations: South Kensington, Knightsbridge, Green Park, Piccadilly Circus, Covent Garden, Holborn, Russell Square and Caledonian Road. To maintain 33tph peak / 30tph off-peak with slower running requires two extra trains.

Reducing the scope of the Piccadilly Line upgrade to eliminate these infrastructure works, which eliminates the need for tunnel-cooling infrastructure, leads to reduced speeds and is not worthwhile. However, this approach may be chosen for implementation due to current budget restrictions as the full scope can be implemented when funding permits at a later date, when the full benefits can be restored,

There is a financially positive case to move from a frequency of 33tph peak + 30tph off-peak, to 36tph peak + 33tph off-peak on the Piccadilly and Central lines with end-to-end services. All trains may reach Cockfosters, but there seems to remain Rayners Lane reversers in addition to Uxbridge trains. An alternative 36tph service pattern with short tripping to minimise the additional number of trains required on the Central Line was found unworthwhile. Short tripping in the Central Line off-peak service will not change the train order, but may be more efficient. The programme continues to implement infrastructure to enable the higher frequency service pattern to be delivered, should funding permit the procurement of the larger fleet required (+8 trains for the Piccadilly Line and +10 trains for the Central Line).

STATION CAPACITY CONSTRAINTS

As the business case has developed, it has been discovered that station capacity constraints will result in significant negative benefits for passengers. Where growing demand, catered for by the new trains, is beyond the capacity of some stations, station control measures will dis-benefit some passengers. Planned station upgrade schemes will relieve some of these locations after the new trains enter service. With the Piccadilly Line offering the largest service uplift, it features the largest number of stations with capacity problems, including many of the historic central zone stations in cramped locations. These include consecutive stations between Covent Garden and Green Park. Station control may require exit-only operation in the evening peak. Finsbury Park and Green Park will require intermittent station control with no solution available. At Covent Garden contra-peak direction non-stopping is proposed in the evening peak until a 2035 scheme. Leicester Square and Piccadilly Circus will become exit only in the evening peak, with a 2035 scheme at Leicester Square easing demand at Piccadilly Circus.

On the Central Line, only Oxford Circus will require intermittent station control until 2035, when a scheme will also assist the Bakerloo Line. Paddington Bakerloo will become exit-only until a 2033 scheme, whilst Baker Street will require intermittent station control with no solution available.

AN ALTERNATIVE TRAIN LAYOUT

An estimated fleet size for the current proposed services is provided, which again totals 250 trains, starting with 101 for the Piccadilly Line, 41 for the Bakerloo, 102 for the Central Line and six for the Waterloo & City Line. Delivery of 70 trains per year (every five days approx.) was expected from two production lines, but the tender was modified to request 40 trains each year (every 9 days approx.) from one production line to smooth arrivals and cut costs. This could defer Piccadilly Line timetable enhancements by 18 months, but it is hoped to reduce this delay by negotiation with the successful tenderer.

We have known little detail of the train proposal, although the June 2018 TfL press release stated, “each new train will be six metres longer than the existing Piccadilly Line trains”. This confirms that the new trains will fill tunnel platforms in the way that current Bakerloo Line trains do. The Business Case states that calculations have been based on a 10-car New Generation Train (NGT), but comparative figures are now provided for an alternative (ALT) 9-car variant, which was included in the tender documents. By omitting a car, this train has two less double doorways on each side. Although the remaining doors would be spread further apart on nine longer cars, they would be slightly wider. The longer cars would permit more seats in each but feature slightly narrower vestibules at each doorway in consequence. The total capacity of the NGT is stated as 232 seated and 729 standing, total 961; in comparison the ALT figures are 256 + 635 = 891. or 7% lower. This choice would have impact on dwell times and therefore attractiveness of planned services.

It was found that the ALT layout with its lower capacity would be less attractive in the peaks, but its additional seating would be more attractive off-peak. There may be fewer travellers in off-peak times, but there are many more off-peak hours including weekends, and competing benefits were found to balance out. This was not the case on the Waterloo & City Line where half-length trains operate, so a 5-car NGT would fit, but a 4-car ALT would provide markedly lower capacity.

This draws attention to the fact that the calculations for the Central Line are based on the operation of identical trains to those ordered for the Piccadilly Line, although the current trains there are notably longer. Therefore a 5-car ALT would actually be shorter than the current trains on the Waterloo & City Line, as would a 10-car ALT on the Central Line. Similarly, a 6-car NGT would probably fit the Waterloo & City Line under full automatic operation, since the former National Rail rolling stock was longer than the current trains. An 11-car NGT would be shorter than the current trains on the Central Line. There may be advantage in having identical trains on three lines, but it is unlikely there would be much interchange of rolling stock. Maximising train capacity at all times would seem to me to be a higher priority. This can be decided when it's time to order Central Line trains, but it appears to be influencing the current decision between NGT and ALT options for the Piccadilly Line trains.

The S Stock fleet of 1,404 cars is smaller than the Standard Stock fleet of 1,466 cars back in 1934, but they could be dwarfed if this fleet is eventually delivered: 2,470 NGT cars or 2,220 ALT cars. I

calculate that a 10-car train would have similar gaps to current trains at double doors, although these gaps will grow when platforms are raised to provide level access with platform edge doors. Hence the fitting of gap fillers at the same time. What a project that will be!