Office of Rail Regulation

Advice on Network Rail's Strategic Business Plan for CP4

Engineering Consultancy Advice

Addendum Report

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Contents

1 Introduction

1.1 Chronology

1.1.1 Network Rail's Strategic Business Plan

In October 2007, Network Rail published a Strategic Business Plan (SBP), based on an initial SBP (ISBP) which was published in 2006.

1.1.2 Arup Reports

The ORR appointed Arup to provide engineering advice on enhancement schemes within the SBP. This resulted in the following three reports:

- Office of Rail Regulation, Engineering Advice on Network Rail's Enhancement Programme, Initial Report, October 2007.
- Office of Rail Regulation, Engineering Advice on Network Rail's Enhancement Programme, Interim Report, December 2007
- Office of Rail Regulation, Engineering Advice on Network Rail's Enhancement Programme, Draft Final Report, March 2008.

1.1.3 NR's SBP Update

In April 2008, Network Rail produced its Strategic Business Plan Update, and Arup subsequently produced a Final Report:

- Office of Rail Regulation, Engineering Advice on Network Rail's Enhancement Programme, Final Report, June 2008.

1.1.4 ORR Draft Determination

In June 2008, following consideration of this and other reports and information provided by Network Rail and other stakeholders, the ORR published its draft determination as part of the Periodic Review of Network Rail's access charges for CP4 (April 2009 to March 2014).

1.1.5 Network Rail's Response to the ORR Draft Determination

In September 2008, Network Rail published its response to the ORR draft determination. This response raised a number of issues with ORR's draft determinations, in part resulting from Arup's work.

The ORR therefore extended Arup's commission to address three issues:

- Platform lengthening;
- Power supply enhancements;
- The costs of Bromsgrove Station.

1.2 The Layout of this Addendum Report

This report is an Addendum to our June 2008 Final Report. It is laid out as follows:

- Chapter 1, this chapter, is introductory;
- Chapter 2 sets out our response in relation to platform lengthening;
- Chapter 3 sets out our response in relation to power supply enhancements;
- Chapter 4 addresses Bromsgrove.

2 Platform Lengthening Schemes

2.1 Network Rail's Unit Costs

For our Final Report, we undertook an independent review of Network Rail's costs, particularly in relation to the cost per metre run of lengthening works.

Network Rail advised that they had used a rate of £5,000 assuming a 2.5m width of extension; this figure is inclusive of preliminaries and other indirect costs (Network Rail costs) and inclusive of the civil engineering (building) costs, and platform lighting. This £5,000 figure excludes works to other "assets" (track works, signalling & E & P).

We prepared an independent assessment of £4,868 per metre, almost exactly in line with the NR (obviously rounded) £5,000 per metre.

Network Rail's unit rate was therefore used by the ORR in its determination.

2.2 Costs Consequential on the Extension

Network Rail provided data on the effects and costs of platform extensions on other assets such as signalling, permanent way, structures and electrification. We undertook an independent assessment using publicly-available satellite imagery to establish the effects. We then calculated the additional costs to compare with Network Rail's estimates.

In the vast majority of cases, we validated their data, and therefore used their "add-ons" despite their implied criticism of our methodology.

2.3 Quantities of Work – The Lengths Needed

There is a dispute regarding the methodology for assessing the length of extension required, and we comment on this as follows.

2.3.1 The Existing Platform Length

In terms of the length of existing platforms, Network Rail did not provide details of its assessment of platform length requirements, but stated the length it required to add to the existing platforms.

Arup's assessment was based on the Sectional Appendix data; this was criticised by Network Rail as not representing the operational lengths available. Network Rail said in its response:

Arup's use of data included in sectional appendices is also inappropriate. This information simply includes the physical length of the platform. It takes no account of areas that are currently out of use for either operational or safety reasons.

In fact (though we did not reference this in the Final Report), we took the operational platform lengths from both the Sectional Appendix and the Rules of the Plan (ROTP) 2009. These documents contain the relevant instructions for operators and train planners respectively, and in practice the stated platform lengths generally agree between the documents. The heading of the relevant section of ROTP (Section 5.4) states:

The table below shows the maximum length of train that may use each of the platforms at the following passenger stations. All lengths are in metres. Trains longer than the quoted lengths will only be accepted subject to the authority of the Route Director.

It is hard to understand Network Rail's statement that we should not place reliance on these documents, and in the absence of any further explanation or an indication of where the relevant data is located, we continue to use these figures to establish the current platform lengths. Our recommendation remains based on the data contained in these documents.

2.3.2 The Required Platform Length

Arup's assessment was derived from the length per car (i.e. 20m or 23m per vehicle) appropriate to the vehicle types used according to Network Rail's route data. We then used the dimensions quoted in "Railway Safety Principles and Guidance - Part 2 Section B Guidance on Stations", and assumed that the required length would be x metres per car, plus a 5m allowance; e.g. a 10-car requirement of 20m vehicles would be 200m + 5m = 205m. Network Rail criticised this "required length" on the basis that we had used a generic "20m" dimension rather than the true car length operating on some routes (e.g. Class 450 is 20.34m, West Anglia routes use 20.25m stock, while Kent, Sussex and Wessex routes use 20.40m stock). This criticism is accepted, and where differences are explained by this we have revised our figures accordingly. In extremis, this represents an underestimation of the required platform length of 5 metres.

Network Rail did not provide its preferred train length and actual operational platform length by routes; instead the newly-provided data contains the preferred platform extension length by route. In this case, we had to assume that the newly-provided platform extension length should have already included any allowance for train length assumptions, train joining and splitting requirements. In practice, in many cases, the Network Rail assessment compares exactly with Arup's assessment of the required platform length extension, which suggests that both the ROTP platform length data is correct, and that Network Rail has used the same train length assumptions as Arup.

Network Rail's extension length will be used for cost comparison.

2.3.3 Platforms for Joining and Splitting

In its response, Network Rail noted that we had omitted the need to increase lengths where splitting / joining were involved:

"Arup has made no allowance for locations where trains are to be split (requiring platforms to be extended by a further two metres) or joined (requiring platforms to be extended by a further six metres). Stations at which joining and splitting should be taken into account include Cheshunt, Dartford, West Croydon, Oxted, Ascot, Dorking, Guildford and Weybridge."

We believe that this list is Network Rail's comprehensive list of those stations where joining and splitting are either permitted or actually take place.

Most TOCs have now moved away from regular joining and splitting movements, and in many cases they are restricted either to forming or splitting empty movements, or to platform sharing, where a second unit occupies a platform without attaching (notably in the case of the failure of the first unit).

We believe that, of the list provided, such operations regularly take place only at Guildford, Dartford and possibly West Croydon, and that at other stations the facility exists within the signalling system but is not used on a regular basis. Network Rail has never notified us of the provision of such a facility being a key factor in a platform extension scheme.

At Guildford, Platforms 2 – 7 are already capable of 10-car operation at the maximum required length (215 metres inclusive of 6 metres allowance for joining). At Dartford and West Croydon (Platform 3), platform extensions were addressed as part of the Thameslink programme, which Arup was not requested to review, and therefore we made no comment on this station.

For the other stations listed, we believe that further extension of the platforms by 6m would be unnecessary for exceptional or emergency movements. There should already be a standback from the platform starting signal (the Group Standards normally require a standback of 25m though this may be reduced in appropriate circumstances) which would provide the signalling capability for such a move, and the only remaining issue is whether there is platform length for the additional vehicle standing space.

Given that the standard 5m additional allowance is included for every platform, splitting moves requiring an additional 2m will already be allowed for within the platform length. For joining moves, it would be possible for an incoming train to stand 6m back from the rear of the train, which in the worst possible circumstance would itself be 2.5m back from the stop board. The last 3.5m of the train could therefore be standing off the end of the platform. In such circumstances, the driver or conductor could elect to complete the attaching move before opening the doors. However, in all the stations mentioned, the standard unit door configuration is 1/3 & 2/3 or 1/4 & 3/4 along the carriage, and the rear doors would be at worst 1.5m within the platform end.

We have also compared our and Network Rail's assumptions on platform extensions at the locations where Network Rail identified joining and splitting may be required. Of the 8 locations identified, Network Rail's proposed extensions were longer at three locations, Guildford, where the difference was 1m, Ascot where Network Rail had assumed a total extension length of 150m compared to Arup's extensions of 33m for Platform 1 and 37m for Platform 2; and Weybridge where Network Rail assumed an additional 6m extension. On this basis it is unclear whether Network Rail has allowed for joining and splitting in their estimates.

In these circumstances, we do not believe that Network Rail's comments make any material difference to the advice we have provided, but would reiterate the point that none of the Network Rail documentation we have seen has previously mentioned any requirement for such splitting and joining operations to be included in project scope.

2.4 £46m Adjustments (CP4) on Platform Lengthening

The table below lists all cost adjustments to platform lengthening schemes by route. Network Rail has argued these adjustments are inappropriate and stated their view that the £46m reduction in ORR's draft determinations should be reinstated.

Route	NR SBP	ORR Draft Determination	Adjustments
Route 1 (Kent)	£37m	£32m	£-5m
Route 2 (Brighton Main Line and Sussex)	£76m	£75m	£-1m
Route 3 (South West Main Line)	£131m	£108m	£-23m
Route 5 (West Anglia)	£27m	£24m	£-3m
Route 6 (North London Line and Thames-side)	£20m	£19m	£-1m
Route 8 (East Coast Main Line)	£12m	£11m	£-1m
Route 11 (South Trans-Pennine, South Yorkshire and Lincolnshire)	£11m	£1m	£-10m
Route 16 (Chilterns)	£9m	£7m	£-2m
Route 19 (Midland Main Line and East Midlands)	£5m	£5m	£0m

The above cost adjustments are related to the platform extension lengths. The table below lists the Network Rail submitted extension length and Arup extension length used in our Final Report.

SBP Scheme Name	NR Submitted Extension Length	Arup Extension Length	Difference
Route1 12 car operations: Sidcup and Bexleyheath Routes	279m	0m	+279m
Route1 12 car operations: Dartford to Rochester including Gravesend	484m	453.1m	+30.9m
Route1 12 car operations: Greenwich and Woolwich Route	480m	455m	+25m
Route1 12 car operations: Hayes Line and Sevenoaks	0m	0m	
Route 2 Suburban 10 Car operations	4,720m	4,756m	-36m
Route 3 10 Car SW Suburban Railway	8,074m	6,276.5m	+1797.5m
Route 5 WA Outer 12-car	NR did not comment on Arup length	1622m	
Route 5 WA Inner 9 Coach Trains	399m	389m	+10m
Route 6 Tilbury Loop	NR did not comment on Arup length	1,594m	
Route 8 FCC	1359m	1365m	-6m
Route 10 West Yorkshire	673m	672m	+1m
Route 11 South Yorkshire	219m	215.1m	+3.9m
Route 16 Chiltern	NR did not comment on Arup length	978m	
Route 17 platform lengthening	NR did not comment on Arup length	2,019m	
Route 18 WCML	178m	0m	+178m
Route 20 North West	NR did not comment on Arup length	1214m	
Route 2: 8-Car Operations, Victoria Eastern to Bellingham	NR did not comment on Arup length	264m	
Route 1: 8-Car Operations, Swanley to Ramsgate (via Maidstone East and Ashford)	NR did not comment on Arup length	685m	
Route 1: 12-Car Operations, Swanley to Rochester	NR did not comment on Arup length	327m	
Route 10: Ilkely – Leeds Platform Extensions	NR did not comment on Arup length	326m	
Route 19: East Midlands Platform Extensions	NR did not comment on Arup length	209m	

2.5 Causes of the Adjustments by Route

The proposed adjustments are mainly due to reduced scope and removal of identified duplications. The detail of each adjustment and any revision to our original advice is detailed for each route below.

2.5.1 Route 1 (Kent)

The extension length difference between the Network Rail SBP and Arup's review was 334.9m and the costs reduction was £5m.

£4.908m (CP4) for Sidcup & Bexleyheath Line platform extensions was included in the Route 1 (Kent) schemes. Arup's Final Report pointed out that this scheme has been double-counted, and therefore should be removed from SBP. In the "Response to ORR's draft determinations" (page 62) Network Rail states that "*We agree that that this scheme is included as a part of the Thameslink scope for CP4 and should not be listed as a separate scheme.*" The double-counted £4.908m (CP4) cost reduction for Sidcup & Bexleyheath Line platform extensions should therefore be removed from the SBP estimate.

Apart from the Sidcup & Bexleyheath Line, the Network Rail preferred extension length on Kent route is 55.9m longer than Arup length. On the Dartford to Rochester section, Network Rail's assessment was that the Up and Down platforms at Higham each need 15m extension to accommodate a 12-car Class 365 Networker unit with an overall length of 246m plus the 5m allowance, or 251m in total. ROTP states that the current platform lengths are 300m (Up) and 286m (Down), and we therefore do not agree that platform extensions are required.

On the Greenwich line, Network Rail stated they require 5m platform extension at 3 stations (Gravesend, Deptford and Woolwich Arsenal) which already comfortably exceed 251m length. We reject this on the basis that the platforms are already long enough, though calculation differences between us and Network Rail added a net 5m to other platform extensions, making an overall reduction of 25m. We did however note that the preponderance of DOO issues on this route meant that our point estimate for works was in fact already slightly higher than Network Rail's estimate.

Incidentally, we note that Network Rail appears to have both used ROTP data and a total target length of 245m (20 x 12m + 5m) to calculate required lengths, in accordance with our previous basis of calculation.

As a result we recommend that the £5m saving identified in the Final Report should be maintained.

2.5.2 Route 2 (Brighton Main Line and Sussex)

Arup's estimated extension length was 36m longer than Network Rail submitted length, but the overall cost of the scheme within CP4 was estimated by us to be £1m lower than Network Rail's submission.

The cost adjustment is caused by removal of overlaps with the Thameslink programme. We pointed out that some stations on Route 2, such as Oxted and Sanderstead, are included in the Thameslink scope, and should therefore be removed from this scheme.

As a result we recommend that the £1m saving identified in the Final Report should be maintained.

2.5.3 Route 3 (South West Main Line)

The Route 3 platform extension scheme consists of two schemes, the 10-car SW Suburban Railway and Reading Southern Platforms. In our Final Report, we agreed that Reading Southern Platforms would require £21m in CP4. Our adjustment of £25m, the largest cost difference between us and Network Rail, was made to the 10 Car SW Suburban Railway scheme.

The 10 Car SW Suburban Railway scheme was estimated at £166m in the October 2007 SBP. We pointed out in our intermediate report that the unit rate used by Network Rail for this scheme was inappropriate as it included an allowance for indirect costs. Network Rail agreed to adjust the unit rate for platform extensions and remove Waterloo International from the scheme, and therefore reduced the scheme estimate to £117.5m (£110.4m in CP4) in SBP update. However, we identified in our Final Report that the scheme should only require £93.1m (£87.4m in CP4) based on the provided supporting data.

The large cost difference lies in the following area:

- Overlaps with other schemes.

Network Rail SBP information shows the scheme would affect 80 stations on Route 3. However Waterloo International and Clapham Junction have been included in other SBP schemes, and should therefore have been removed from the 10 car scheme. Therefore the scheme should involve platform works at 78 stations.

- Required extension length.

Network Rail's data showed that the planned platform extension on the 78 Route 3 stations would be 8,074m, 1,797m longer than our estimate of 6,277m in our Final Report.

Network Rail states that the required platform lengths based upon 10-car Class 450 rolling stock (10 x 20.4m) will be 209m, including 5m extra platform length required for stopping variations, rather than the 205m which we used. We have agreed that our original assumed train length was incorrect. Taking into account the train length difference, we agree that the platform extension length should be revised to 6,912.5m, and therefore £3.18m platform costs should be added to our original estimate.

There is still a 1161.5m difference in platform extension lengths between us and Network Rail. In our Final Report we used the operational platform lengths provided by Network Rail. In the latest response, Network Rail claims that longer extensions are proposed for future 12 car operations and cites specific cases where a simple platform extension may not be feasible.

- Add-ons

Another large difference (£14.4m) in the cost is due to a difference in treatment of add-on costs. We have used the same add-on unit rate as NR but adjusted for a number of quantity inconsistencies. These are explained in the following table.

Works	NR Quantity	Arup Agreed Quantity
Track slewing 300m per station	80	78
Signal move (no overlap alteration required)	60	46
Interlocking alteration	3	2

We used 78 stations to calculate the track slewing costs instead of 80 stations included in SBP as Waterloo International and Clapham Junction should be excluded.

Network Rail used a wrong quantity number of 60 signal moves for costs calculation. The number of signal moves (without overlap alteration) is 50 as shown in data NR provided, inclusive of 1 at Waterloo and 3 at Clapham Junction which were then removed from the calculation.

We consider that the £4.6m for signalling interlocking alteration included in the SBP Check Estimate supporting data should be reduced to £1.6m after subtracting the £3m planned at Waterloo International, which has now been excluded from this scheme.

We remain convinced that the previous calculations used to create the Final Report estimates remain valid, and that the only change that we would support is the alteration to platform lengths discussed above.

In summary, we have revised our costs to include an additional 4m of platform length for each of the Route 3 platforms to be extended, in line with Network Rail's response. The additional alterations are calculated in an unchanged way from the detail contained in the Final Report. As a result we recommend that the costings for this project should be increased by £3.18m.

2.6 Route 5 (West Anglia)

NR has made no comment on Arup's platform length calculations. It has however supplied revised platform lengths for Brimsdon, Ponders End, Enfield Lock, St Margaret's and Ware stations, all of which have been adjusted to 8-car capability (though this is in fact already confirmed in ROTP). This produced a total difference in platform extension lengths of 10m or £50,000 between Network Rail and Arup estimates, which we do not believe to be of significance.

Incidentally, we note that Network Rail appears to have used both ROTP data and a total target length of 245m (20x12 + 5 metres) or 185m (20x9 + 5 metres) for 12- and 9-car units respectively to calculate required lengths, in accordance with our previous basis of calculation, for which we were criticised.

However, we have reviewed again the estimates in our Final Report in the light of the further comments made by Network Rail and further consideration of the complexities of some of the station platforms where extensions are required. We agree with Network Rail that we had understated the complexity, and therefore have increased our estimate of add-on allowances to their original SBP request. We have however retained our method of calculation for direct platform costs.

As a result we recommend that the costings for this project should be increased by £4.90m to a total of £32.72m.

2.7 Route 6 (North London Line and Thameside)

NR has agreed the extension lengths, but has based its cost assessment on a 4.0m width of extension, contrary to all other routes, including equally busy locations. In the 2005 Arup report to the SRA, it was recommended that "at all other locations along the line, it was assumed that a 3m platform would be provided as it is generally agreed that this would be preferable to the minimum 2.5m width. The incremental work involved in providing a 3m platform over that required for a 2.5m width is minimal. We were not therefore convinced why Network Rail suggested 4.0m, and we recommend retention of the costs data based on our 3.0m assessment. We did however agree that Network Rail's estimate of £5.6m for the extension of Ockendon Loop was correct and endorsed this in our cost build up.

As a result we make no change to our original recommendation that the estimated scheme costs should be £20.67m, and the previous savings identified should be maintained.

2.8 Route 8 (East Coast Main Line)

NR did not make any comment on additional works on this scheme, and the platform length difference was very small. Network Rail's estimated length was actually slightly lower than Arup's in this instance.

As a result we make no change to our original recommendation that the estimated scheme costs should be £13.12m, and the previous savings identified should be maintained.

2.9 Route 11 (South Trans-Pennine, South Yorkshire and Lincolnshire)

The additional platform length difference is very small (Arup estimated length was 215m, Network Rail estimated 219m), but among other items Network Rail also requested £6m additional costs (£2m p-way plain lining at Kiveton Bridge and £4m signalling alterations at Kiveton Park). As noted in our Final Report Network Rail did not provide substantiated information to support these items. In both cases, the platform extensions required are between 21m and 23m, the costs were judged to be disproportionate to the benefit gained. As we noted before, it appears to us that there are alternatives that should be further explored to reduce the overall scheme scope and cost, and this explains the large variation in overall costs for Route 11.

As a result we make no change to our original recommendation that the estimated scheme costs should be £1.72m, and the previous savings identified should be maintained.

2.10 Route 16 (Chilterns)

NR made no comment on Arup's calculations of platform length contained in the Final Report. Although not made clear in our report, we had reviewed the Network Rail figures and reduced them by 5m per platform, as it was clear that Network Rail had used a 10m stopping tolerance rather than the standard 5m. This reduced the overall platform length by 70m (from 1,048m to 978m), and reduced capital cost by £350,000. We note that Network Rail used a total train length of 184m for an 8-car unit (23 x 8m).

We also estimated the scheme add-ons at £2.93m, and believe that this calculation was valid based on the information made available. As a result we make no change to our original recommendation that the estimated scheme costs should be £7.82m, and the previous savings identified should be maintained.

2.11 Route 18: West Coast Main Line

Network Rail's response to the ORR suggested that we had omitted four stations from our analysis:

"We also believe that Arup has incorrectly excluded platform extensions at four stations on Strategic Route 18 which has resulted in around £1.2 million being omitted from ORR's draft determinations".

We believe that the 4 stations are those at:

- Apsley;
- Kings Langley;
- Northampton;
- Tring.

The reason we did not address those stations was that they were not identified in either the SBP or SBP Update as being required to meet the HLOS. They were also not part of the cost submission for either the SBP or SBP update. The extensions were included in the London North Western Platform Lengthening Strategy which was submitted in support of the SBP update. However this report clearly states that the lengthening works were required to meet demand growth in CP5. On this basis we do not consider that these platforms formed part of Network Rail's requirements to meet the HLOS and so have not included them within our costs.

2.12 Route 19 (Midland Main Line and East Midlands)

Our review of this additional scheme in the Final Report produced an estimated cost of £5.67m, which is in line with the submission made by Network Rail. We therefore assume that no further comment on our project cost build up is required.

2.13 Platform Extension Schemes – Summary of Costings

The table below sets out compares Network Rail's and our revised costs estimate for each of the platform extension schemes.

As a result of all the changes described above, the table below re-presents the analysis for CP4.

SBP Scheme Name	Network Rail Point Estimate	Arup Point Estimate	Variance (+ is Arup higher)
Route1 12 car operations: Sidcup and Bexleyheath Routes	£5.986m	£0.000m	-100.0%
Route1 12 car operations: Dartford to Rochester including Gravesend	£15.925m	£15.666m	-1.6%
Route1 12 car operations: Greenwich and Woolwich Route	£2.910m	£3.305m	13.6%
Route1 12 car operations: Hayes Line and Sevenoaks	£0.548m	£0.035m	-93.6%
Route 2 Suburban 10 Car operations	£84.012m	£82.405m	-1.9%
Route 3 10 Car SW Suburban Railway	£117.546m	£96.255m	-18.1%
Route 5 WA Outer 12-car	£31.663m	£32.720m	3.3%
Route 5 WA Inner 9 Coach Trains	£33.190m	£11.245m	-66.1%
Route 6 Tilbury Loop	£22.210m	£20.670m	-6.9%
Route 8 FCC	£13.502m	£13.120m	-2.8%
Route 10 West Yorkshire	£12.677m	£5.376m	-57.6%
Route 11 South Yorkshire	£12.169m	£1.721m	-85.9%
Route 16 Chiltern	£9.634m	£7.824m	-18.8%
Route 17 platform lengthening	£33.340m	£23.352m	-30.0%
Route 20 North West	£24.818m	£9.712m	-60.9%
Route 2: 8-Car Operations, Victoria Eastern to Bellingham	£5.000m	£4.320m	-13.6%
Route 1: 8-Car Operations, Swanley to Ramsgate (via Maidstone East and Ashford)	£4.000m	£5.480m	37.0%
Route 1: 12-Car Operations, Swanley to Rochester	£5.000m	£2.616m	-47.7%
Route 10: Ilkely – Leeds Platform Extensions	£5.000m	£2.608m	-47.8%
Route 19: East Midlands Platform Extensions	£5.000m	£5.672m	13.4%
SAMPLE TOTAL	**£444.130m**	**£344.102m**	-22.5%

2.14 Comparison with June 2008 Recommendations

The table below shows a comparison between our current recommendations and those in June 2008.

SBP Scheme Name	Current Arup Point Estimate	Previous (June 2008) Arup Point Estimate	Variance
Route1 12 car operations: Sidcup and Bexleyheath	£0.000m	£0.000m	£0m

Routes			
Route1 12 car operations: Dartford to Rochester including Gravesend	£15.666m	£15.666m	£0m
Route1 12 car operations: Greenwich and Woolwich Route	£3.305m	£3.305m	£0m
Route1 12 car operations: Hayes Line and Sevenoaks	£0.035m	£0.035m	£0m
Route 2 Suburban 10 Car operations	£82.405m	£82.405m	£0m
Route 3 10 Car SW Suburban Railway	£96.255m	£93.075m	+ £3.180m
Route 5 WA Outer 12-car	£32.720m	£27.820m	+ £4.900m
Route 5 WA Inner 9 Coach Trains	£11.245m	£11.245m	£0m
Route 6 Tilbury Loop	£20.670m	£20.670m	£0m
Route 8 FCC	£13.120m	£13.120m	£0m
Route 10 West Yorkshire	£5.376m	£5.376m	£0m
Route 11 South Yorkshire	£1.721m	£1.721m	£0m
Route 16 Chiltern	£7.824m	£7.824m	£0m
Route 17 platform lengthening	£23.352m	£23.352m	£0m
Route 20 North West	£9.712m	£9.712m	£0m
Route 2: 8-Car Operations, Victoria Eastern to Bellingham	£4.320m	£4.320m	£0m
Route 1: 8-Car Operations, Swanley to Ramsgate (via Maidstone East and Ashford)	£5.480m	£5.480m	£0m
Route 1: 12-Car Operations, Swanley to Rochester	£2.616m	£2.616m	£0m
Route 10: Ilkely – Leeds Platform Extensions	£2.608m	£2.608m	£0m
Route 19: East Midlands Platform Extensions	£5.672m	£5.672m	£0m
SAMPLE TOTAL	**£344.102m**	**£336.022m**	**+ £8.080m**

3 Power Supply Enhancements

3.1 Introduction

In their response to ORR, Network Rail drew attention to the following issues:

- The treatment of risk and the skew of the risk distribution;
- The inclusion of Optimism Bias;
- Deletions from scope on Routes 5 and 7.

3.2 Risk and Risk Distribution

Arup followed the advice in GRIP. The text in italics below replicates that in our Final Report.

GRIP presents levels of confidence surrounding the Point Estimate. The key difference between our assessment of risk and that of Network Rail is that the GRIP confidence levels are symmetrical whereas Network Rail has used an asymmetrical distribution. The table below is taken from the GRIP Manual, and shows the anticipated confidence levels at different GRIP stages.

GRIP Stage	*1*	*2*	*3*	*4*	*5*
Level of confidence (guidance only)	*±40%*	*±30%*	*±20%*	*±15%*	*±10%*
From GRIP Manual PM04 (v7.01) p49					

The table shows a reducing range as the project becomes better defined as would be expected. We have therefore derived, for each GRIP stage, the ratio of a Point Estimate, which equates to a P(mean), and the P(80) value. Within a particular GRIP stage, there is a constant ratio between these figures, but it varies across the GRIP stages. The table below presents that discussion numerically.

GRIP Stage	*Confidence Range*	*Min*	*Mean*	*Max*	*P(80)*	*Ratio P(80) to P(mean)*
1	*±40%*	*60*	*100*	*140*	*114.702*	*1.147*
2	*±30%*	*70*	*100*	*130*	*111.026*	*1.110*
3	*±20%*	*80*	*100*	*120*	*107.351*	*1.074*
4	*±15%*	*85*	*100*	*115*	*105.513*	*1.055*
5	*±10%*	*90*	*100*	*110*	*103.675*	*1.037*

It can be seen that, as the scheme advances through the GRIP stages, the ratio of the P (80): P (mean) converges, as the scheme becomes more defined, and the risks are "captured" into the Point Estimate.

We then used this ratio, appropriate to Network Rail's GRIP Stage statement, to apply to the P (mean) to derive a P (80) for that scheme.

In terms of risk, Network Rail advised that they started from a Point Estimate, then applied an asymmetrical triangular distribution to give a P(mean) value, the asymmetry arising from the application of –10%/+35% or –25%/+50% values. This is not in accordance with GRIP

procedures, and it is not clear why GRIP was not followed. The argument that costs tend towards the upper end of ranges was made by Network Rail, but if that is Network Rail's belief, it suggests that GRIP should be re-written to incorporate that view and to ensure a consistent approach for the future.

We maintain our position vis-à-vis this issue.

If, for example, a scheme is estimated to have a Point Estimate of 100 units, the skewed risk distribution gives a cost range of 90 to 135 units, the mid-point value being 112.5. A symmetrical distribution retains the central value of 100, so NR's estimates are elevated by, typically, 12.5%. We have deducted this percentage on both DC and AC routes.

3.3 DC Routes

3.3.1 DC Routes

Network Rail provided a tabulation of the quantities and unit costs of the required equipment, in the form of a Bill of Quantities. We present these below, with our comments.

3.3.2 Route 1

Equipment	Quantity	Scope	Unit Cost	Total
New ESI	0		£6m	
Increase FSC	Route wide	Increases will require studies and some physical works	Varies	£2m
HV Cables	1	Elmers End to West Wickham	£1m	£1m
HV Equip. & Rect	3	New Beckham, Bromley, Knockholt	£1m	£3m
HV Equip. & Rect (inc renewal)*	2	Elmers End, Chelsfield	£250k	£500k
Convert TPH	4	Swanscombe, Gravesend, Uralite, Tunnel	£3m	£12m
New TPH	0			
ETE Equip & Protection mods	10%	Some works in locations overloaded not yet scoped	£40k per rtk for ETE	£2m
Total				£20.5m

*this is an incremental enhancement. A renewal is already separately funded

3.3.3 Route 2

Equipment	Quantity	Scope	Unit Cost	Total
New ESI	0		£6m	
Increase FSC	Route wide	Increases will require studies and some physical works	Varies	£2m
HV Cables	0		£1m	
HV Equip. & Rect	0		£1m	
HV Equip. & Rect (inc	2	Tulse Hill, Purley	£250k	£500k

renewal)*				
Convert TPH	1	Burgess Hill	£3m	£3m
New TPH	2	Hooley, Quarry	£3m	£6m
Amend TPH	1	Shepherd Hill	£1m	£1m
ETE Equip & Protection mods	20%	Some works in locations overloaded not yet scoped	£40k per rtk for ETE	£7m
Total				£19.5m

*this is an incremental enhancement. A renewal is already separately funded

3.3.4 Route 3

Equipment	Quantity	Scope	Unit Cost	Total
New ESI	1	Staines	£5m	£5m
Increase FSC	Route wide	Increases will require studies and some physical works	Varies	£1m
HV Cables	0		£1m	
HV Equip. & Rect	0		£1m	
HV Equip. & Rect (inc renewal)*	2	Leatherhead, Queens Rd	£250k	£500k
Convert TPH	5	Earley, Emmbrook, Buckhurst, Whitmoor, Sunningdale	£3m	£15m
Convert TPH (inc renewal)*	7	Addlestone, Glanty, Ashford, Feltham, Isleworth, Chiswick, Mortlake	£1m	£7m
Upgrade Switching Station	1	Twickenham	£1m	£1m
ETE Equip & Protection mods	20%	Some works in locations overloaded not yet scoped	£40k per rtk for ETE	£8m
Total				£37.5m

*this is an incremental enhancement. A renewal is already separately funded

3.3.5 Commentary on DC Routes

We have reviewed the "unit rates" on the NR document headed “Bill of Quantities by Route” and we provide the following commentary.

Generally speaking, power upgrade projects are awarded on a Target Cost basis, and we have little information on the specific unit cost elements that go towards creating that Target Cost. We noted this in our Final Report, and our observations are worth repeating, as follows:

There is surprisingly little detailed “hard” knowledge of what things actually cost, primarily by virtue of the drive towards Alliancing contracts, or Design and Build contracts. In many of these newer contract forms, the individual costs and unit rates are not visible to Network Rail, only the tendered Target Cost or an inclusive price for the design issues. It is also often

not clear how preliminaries in a contract are treated; are they a separate Bill of Quantity section, or subsumed into other rates.

The following suggestion is made as to a potential way forward. In order to aid efficiency, Network Rail could systematically award a number of contracts on a "Build Only" basis, with a traditional Bill of Quantity and a comprehensive definition of Item Coverage to correlate to the contractor's quoted price. If such knowledge were accumulated over a number of different discipline contracts, Network Rail would be in a much stronger position to challenge costs presented to it.

The other consequence of the Target Cost mechanism is that the post-contract settlements are based on out-turn, documented costs, but the link to units of work is lost.

The detail available to us for this study, given the timescales and resources, is insufficient to give a firm view on the Bill of Quantities. For example, on Route 3, there is 1 "Convert TPH" at £3m, and another at £1m. It may be true that there are significant site, access or possession difficulties which account for these differences, but we are unable to comment.

In other cases, for example on Route 1 HV cables, the length is unknown. Without more detailed investigation, we cannot sensibly comment.

The fact that the figures quoted are generally to the nearest also £250k suggests that they are very initial assessments, typically at the GRIP1 +/- 40% confidence stage.

Having said all of that, the costs are plausible. The cost estimates appear to be rounded versions of the estimates included in the SBP update. We have therefore retained Network Rail's cost estimates as described in the SBP update. Network Rail did not provide further information on New Cross power supply, but again the estimate appears reasonable.

Route	Network Rail Estimate	Arup Estimate
1	£20.35m	as NR
New Cross	£17.88m	As NR
2	£19.35m	As NR
3	£37.21m	As NR

3.4 25kV AC Routes

3.4.1 Optimism Bias - Introduction

The DfT's Transport Assessment Guidance (TAG) Unit 3.13.1 Guidance on Rail Appraisal (August 2007) covers the use of Optimism Bias in the economic assessment of schemes. The table below shows how risk and Optimism Bias should be treated through the early GRIP stages.

Table 2: Recommended risk and optimism bias adjustments					
Project Development Level*	Level 1	Level 2	Level 3	Level 4	Level 5
Activity	Pre-feasibility	Project Definition	Option Selection	Single Option Refinement	Design Development
	Capital Expenditure				
QRA	No	No	No	QRA at mean estimate	QRA at mean estimate
Optimism Bias (% of present value capex)	66%	50%	40%	18%	6%
	Operational Expenditure				
QRA	No	No	No	QRA at mean estimate	QRA at mean estimate
Optimism Bias	41% of present value opex	1.6% per annum#	1% per annum#	Evidence based	Evidence based

Sources: Mott MacDonald 2002, Review of Large Public Procurement in UK (HM Treasury website), SRA and Network Rail research
* Definition of project development levels is consistent with Network Rail's project development definition in GRIP (Guide to Rail Investment Projects)
# Added to each set of operational costs in the year that they occur. Not to be taken as a cumulative

3.4.2 Our Final Report

In Section 9.2 (The Background Assumptions) of our Final Report, we used the following text, in relation to AC routes: *"The 2007 RSSB report titled 'Study on Further Electrification of Britain's Railway Network' was used as a guide in assessing AC electrification costs. It states that 'an Optimism Bias has been applied in accordance with DfT guidelines the level of which, considering the detail of the estimates, is considered cautious'. The costs quoted in the RSSB report are thus higher than, and inconsistent with, Network Rail's cost estimates."*

We wish to make it clear that (for the AC routes) we meant that we had used the RSSB study although we acknowledge that the text could have been interpreted that NR had used the report, and had therefore implicitly included Optimism Bias. To clarify the issue, we meant that we used the RSSB report data, removed Optimism Bias, and still found that Network Rail's cost assessments were high.

The routes and cost recommendations were:

- Route 18 (AT): We recommended £182.240m in CP4, but we understand the ORR took advice on Route 18 from others;
- Route 5: NR requested £3.410m in CP4; we recommended £1.590m;
- Route 6: NR requested £0.496in CP4; we recommended £0.349m;
- Route 7: NR requested £5.779m in CP4; we recommended £2.046m.

The total sums under debate regarding Arup's recommendations were therefore in the order of £4m – £9m.

3.4.3 Update for this Report

Network Rail supplied new data for this update work, and advised that there are 3 types of works that are scoped for AC areas:

- New Supply Points – these are required where the existing supply point is not suitable and reinforcement is not practical. Network Rail has typically allowed £6m due to new substations and often overhead cable diversions;
- Upgrades to Supply Points – these are required where existing equipment is not suitable and amendments are needed to enable supplies to be taken. The cost estimates are based on the historic costs of transformer and cable replacement;

- Changes to Firm Service Capacity – these changes can be done with no infrastructure works but will often need detailed studies to ensure that the electrical system can accommodate the single phase traction power supplies. An allowance for studies around £50k has been made where difficulties are thought to exist.

Network Rail advised that there has been regular dialogue with the suppliers to understand their infrastructure works and that has helped to inform the costs and scope. More recent indications are that the submission is significantly less than the scope that is emerging from the more detailed work that has started. Until applications for increased supplies are made it is not possible to have real confidence in the amounts estimated.

3.4.4 Route 5

New Supply Points. NR advises that no new supply points are scoped but there is considerable risk that Northumberland Park will need to be replaced with a supply point at Waltham Cross or Hackney. This could be around £6m but an allowance of £2m is assumed. There is a possibility that increases at Ugley or Milton will not be possible and new supply point would be required. No provision for this supply point has been made. We assume that the £2m described for Northumberland Park is, as indeed described by Network Rail, "a risk" and should be deleted from the estimate. We have therefore deleted this £2m allowance from the Route 5 costs.

Upgrades to Supply Points. NR advises that an additional circuit is needed at Ugley to support the weak supply at Milton. An allowance of £1.5m has been used.

Changes to FSC. NR advises that studies will be needed at Northumberland Park, Rye House, Ugley, Milton. An allowance of £100k is proposed because the costs of studies at Northumberland Park and Ugley are assumed to be included in the scope for the infrastructure works.

NR calculates the route total as £3.6m.

3.4.5 Route 6

New Supply Points. NR proposes that a new supply point will be needed unless there are difficulties reinforcing existing supply points; therefore no allowance has been made. We agree no provision should be made.

Upgrades to Supply Points. NR advises that increases are required at Barking, Southend Central and West Ham. An allowance of £500k has been made for works at Barking.

Changes to FSC. FSC increase studies are required at Southend Central and West Ham. An allowance of £100k has been made. There is a small chance that these studies will lead to significant infrastructure works. NR assumes that the study costs are included in the allowance made for Barking.

NR wrongly calculates the route total as £525k; the correct total should be £600K.

3.4.6 Route 7

New Supply Points. NR proposes that a new supply point will be needed to reinforce the area because there are risks to the upgrades at Shenfield, Rayleigh, Springfield and Stowmarket. An allowance of £6m has only be made for 1 new supply point to replace Springfield but there is a risk that upgrades at other sites would not be possible and require a further new supply point. NR calculates £6m.

Upgrades to Supply Points. NR advises that the Shenfield cable is in poor condition but no allowance has been made for its upgrade because increases are within its current rating. Rayleigh will need to have transformers up-rated from 10MVA to 14MVA. An allowance of £50k has been made for this. New Transformers would cost around £3m. Stowmarket will need to have transformers up-rated from 10MVA to 14MVA. An allowance of £50k has been made for this. New Transformers would cost around £3m. NR calculates £100k.

Changes to FSC. NR advises that FSC increase studies are included in the allowances at the various supply points described above.

NR calculates the route total as £6.1m.

As with the estimates for the DC routes Network Rail's latest information appears to be a rounded version of that submitted with the SBP update. We have therefore based our estimate on the latter adjusted as described below

Route	Network Rail Estimate	Arup Estimate	Commentary
5	£3.573m	£1.44m	Delete £2m at Northumberland Park Remaining costs reduced by 10%.
6	£0.521m (but should be £0.600m)	£0.47m	Reduced by 10%.
7	£6.053m	£5.45m	Reduced by 10%.

3.5 Comparison with June 2008 Recommendations

The table below shows a comparison between our current recommendations and those in June 2008.

Route	Current Recommendation	June 2008 Recommendation	Difference
Route 18 (AT)	ORR took advice elsewhere	£182.480m	-
Route 1	£20.34m	£18.310m	£+2.030m
New Cross enhancement to power supply	£17.88m	£16.093m	£+1.787m
Route 2	£19.35m	£17.416m	£+1.934m
Route 3	£37.21m	£33.493m	£+3.717m
Route 5	£1.44m	£1.590m	£-0.150m
Route 6	£0.47m	£0.349m	£+0.121m
Route 7	£5.45m	£2.046m	£+3.404m
Total (routes 1 to 7)	**£102.14m**	**£89.297m**	**£+12.843m**

4 Cross City Services to Bromsgrove / Bromsgrove Station

4.1 Introduction

Bromsgrove has expanded rapidly in recent years and there is significant demand for rail passenger services, principally for commuting to Birmingham. Bromsgrove is located on the main line from Birmingham to Worcester, Cheltenham and Bristol and the current character and distribution of services on the routes makes it difficult to provide a satisfactory service to the town (impacts on longer distance journey times, crowding, etc). Service frequencies are currently generally hourly, with some additional peak period trains. A project is currently under way to relocate the station to provide longer platforms, improved park and ride facilities, and reduce rail capacity impacts. We assume this to be separately funded.

Further growth is predicted by the West Midlands Regional Spatial Strategy (RSS) which states that within the Bromsgrove, Worcester City and Malvern District Council areas, there are plans to develop a further combined 17,500 new dwellings within CP4 and 5.

Proposals have therefore been developed to extend the Birmingham Cross-city electrification from Barnt Green to Bromsgrove with three of the services which currently terminate at Longbridge being extended to Bromsgrove (see also Section 13.14 above regarding complimentary improvement of services to Redditch). Operation of electric services over the Lickey incline should also give some performance benefits.

Network Rail included £11.723m (£11.244m in CP4) in the SBP for this scheme.

4.2 Removal of Allowance for Station

The scheme is not required for the HLOS but is needed to meet local capacity and passenger demand issues. Network Rail has now advised that alternative funding for the station has been secured.

Our independent cost estimate for the full proposal, as reported in our Final Report, was £26.898m. Removing the cost of the station (and some consequential reductions in ancillary items) would reduce the estimate to £17.193m (overall scheme cost). Both figures are higher than the SBP allocation of £11.723m.