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24 June 2019

Simon Adams
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Dear Simon

Crossrail PRep Project Status Report 125 – Period 2

Attached for your consideration is a copy of our Project Status Report 125, Period 2 FY 2019/20.

As highlighted in previous reports, optimism bias is still being exhibited by CRL, without the full root-cause of the underlying issue being fully understood; the IM's integration plan continues to be developed; and the mitigation plans for limiting the increasing AFCDC are still to be finalised.

I would also like to take this opportunity to highlight the key issues from the Period Report that we consider require further action or explanation to Sponsors by the CRL Leadership Team:

a) The actions taken to underpin the DCS and the associated AFCDC should result in a robust and predictable output. However, the buy-in of the Tier 1 contractors is still to be confirmed and this [redacted] How does CRL plan to develop an aligned supply-chain that is fully bought-into the opening dates?

b) The risk management approach which was reinstated in January 2019 is still considered to be immature for a programme of this, type at this stage of the delivery lifecycle. What is CRL's assessment of the current state of development of the approach being adopted, and what are the timescales to address the remaining issues?

Please let me know if you have any questions or concerns.

Yours sincerely,

[redacted]

[redacted]
Project Representative

JACOBS

Crossrail Project Representative

Crossrail Joint Sponsor Team

Project Status Report 125

Period 2 FY2019-20

28 April 2019 – 25 May 2019

Document No. B2111500/125/1.19

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Project Status Report 125

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Note: This report relies on the information set out in CRL's Period 2 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 25 May 2019. Note that information emerging after the close of Period 2 is subject to formal confirmation by CRL in its Period 3 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

Document history and status

Revision	Date	Description	By	Review	Approved
1	13 June 2019	PSR 125 Period 02 FY 2019-20 v1.11 ~ Draft	PRep Core Team		
2	24 June 2019	PSR 125 Period 02 FY 2019-20 v1.19 ~ Final	PRep Core Team	[redacted]	[redacted]

Contents

Key Points for Consideration

HEALTH and SAFETY PERFORMANCE

Overall it was a positive month for the programme, halting a run of 4 relatively poor periods of performance; unfortunately, 4 events caused the High Potential Near Miss rate to increase to 0.29. Whilst it is positive that incidents are being raised, as CRL would not want a culture of under-reporting or worse still suppressing information, the overall trend is still worrying. The delay to the agreement and roll-out of the forward-looking HSPI, is still ongoing and has been for a number of periods.

COMMERCIAL & RISK MANAGEMENT

The AFCDC at Period 2 remained at £14,819m, based upon CRL's top-down assessment. CRL expects the AFCDC to remain stable over the next few periods while the DCS QRA is completed and the DCS is supported by a robust 'bottom-up' cost baseline.

[redacted] are the two key risks to the delivery of the Crossrail Programme; further details are provided in the main body of the report. However, there are two fundamental principles that underpin the AFCDC and have the potential to introduce significant uncertainty to the current forecast.

Risk Management Approach Maturity - The re-instatement by CRL in January 2019 of risk management practices that were previously withdrawn, was one of the fundamental elements in the re-building of the Crossrail Programme. However, in Period 1, we stated: "We have strong concerns as to the robustness of the risk analysis so far and believe it should not be relied upon to provide confidence in the end date". Our current position remains unchanged from this statement and we do not believe the maturity of CRL's risk management approach has changed significantly during this period.

Some key headlines from our assessment of the CRL's Risk Management database include:

- While approximately 500 risks have been identified (up from 289 last period), very few of these identify the root-cause;
- [redacted]
- [redacted]
- [redacted] of the [redacted] of risk allowance is more likely to be required than not (probability ≥60%), and is therefore effectively committed cost, leaving [redacted] of true risk;
- 66 risks have been closed since Period 13, of which only 7 were actually mitigated (at a total value of [redacted]).

Contractor Buy-In to the DCS – Completion of the work by CRL to underpin the DCS will result in a more robust and deliverable schedule to meet the Staged Opening dates. However, a number of stakeholders, fundamental to delivery success are outside of CRL's direct control; the Tier 1 contractors are among the most significant of these.

While the Tier 1s have been engaged by CRL in the development of the DCS and remain contracted to deliver their contractual scope of works, there is, as yet, no formal commitment to the proposed DCS dates. [redacted] previous baselines have seen the contractors' reported dates being considerably later than CRL's assessment. However, as we have seen over the last 3 periods, milestone dates continue to slip at an average of [redacted] days/station, [redacted] with only one station holding its completion date. This has had the effect of eroding the float between [redacted] and if this trend were to continue, would undermine the delivery strategy.

CRL plans to engage the contractors and 'tighten-up' their programmes, but with [redacted] months to go before the proposed transition to ROGS, the ability to absorb delay is limited. The Common Incentive Framework may assist the collective alignment of the Tier 1 contractors, but this has not happened as quickly as CRL hoped, [redacted]

ASSURANCE DOCUMENATION and HANDOVER MATERIALS PRODUCTION

The production rate of regulatory safety and technical assurance documentation by the contractors and CRL must increase if the DCS completion dates are to be met. Handover materials such as O&M Manuals are also in delay, and their lack of delivery is now a significant risk to formal handover, unless acceptance rates are increased or the IMs and CRL work more collaboratively.

SIGNALLING and ROLLING STOCK SOFTWARE INTEGRATION

The production of a robust dynamic testing schedule can only be confirmed once the requirements of both Rolling Stock and Signalling have been incorporated; this schedule integration exercise continues. It is intended that agreements on signalling functionality and availability prior to Trial Running will be reached between CRL and Siemens, to allow the development of a fully integrated dynamic testing schedule by the end of June 2019. CRL's target date for incorporation into the DCS is 2 July 2019.

However, the Siemens proposals must be aligned and integrated with BT's software delivery plans, in order for the dynamic testing schedule and DCS to be considered truly robust and deliverable. This is one of the most urgent priorities for CRL in the finalisation of the DCS and the securing of the future assured delivery of the Crossrail Programme.

1 Programme Management

1.1 8-Week Mobilisation

It was recognised at the time the revised Stage 3 Opening date was announced that CRL had not completed the underpinning work to the DCS and the additional time was used to accommodate this approach. CRL has now undertaken the process to complete the underpinning of the DCS and titled this exercise 'Mobilisation'. The Senior Management Team meets daily at 8am to update progress. This has the advantage of:

- Great collaboration;
- Speed of decision making;
- Excellent communications.

The actions being undertaken, while ambitious in their timescales, should produce a robust product. The buy-in of the contractors to the DCS and the cost remains the highest risk to the successful delivery of the Crossrail Programme. The CRL teams are now engaging the Tier 1s to secure the necessary buy-in, however it is unclear how CRL will fully resolve this issue.

While this process was developed for the mobilisation period, it is our view that the benefits of this approach should be applied to the delivery phase, and through to completion.

1.2 Visualisation Management

We have observed that the implementation of Visualisation Management has, in our opinion, been a success in highlighting performance and improving the collaboration of the CRL teams. However, to increase current productivity scores, CRL needs to move quickly to embed the 'causation' and improvement culture.

1.3 Assurance

CRL's 2nd Line of Defence, 'internal assurance', has initiated two targeted reviews for: i) Schedule; ii) cost of the DCS. Due to the absence of CRL's 2nd Line of Defence, PRep has previously undertaken SSP[1]s, which are similar to the proposed targeted audits. We agreed with JST that PRep would not carry out further SSPs if the following conditions were met:

a) The target audits covered the areas PRep has highlighted;
b) The scope and methodologies of the audits are considered appropriate;
c) We were given the opportunity to comment on the outputs.

Following discussions with Deloitte (CRL's 2nd Line of Defence 'targeted assurance' team), we are concerned that the assurance process is being carried out in parallel with the production of the DCS, rather than on a finalised pack. We accept that the challenging timescales are driving this approach, but strongly advise Sponsors that the full assurance process is completed on a final version of the source documentation.

[1] Service Support Proposal.

The 1st Line of Defence includes the line management organisational structure and CRL's processes and procedures. Currently there are 543 active procedures, many of which are out of date or no longer required. An exercise is required to review the appropriateness of the procedures, noting that a large number of processes have recently changed. There must also be a benefits analysis of this update, noting the project is nearing completion. The intention is to provide a 'best practice' consistency to the way the CRL teams operate, but as a number of the procedures have not been updated, we are observing inconsistent approaches. An example of this is CRL's development of an AFC.

1.4 Underpinning of the DCS

1.4.1 DCS Baseline production

Interim baseline DCS v0.1 was issued on 28 April 2019, covering an 8 week look-ahead period only and not the entire schedule to completion. The forecast date for the DCS v1.0 was 28 May 2019, but this slipped to 13 June 2019 because more time was required to develop mitigation plans for Bond Street Station and Siemens functionality. The baseline DCS v1.1 will be released by CRL on 28 June 2019 for approval at CRL July Board, with the fully-costed DCS v1.2 being completed by the end of July 2019.

CRL confirms that the DCS will form part of a baseline pack that will include the following:

1. A full QSRA;
2. Schedule narrative;
3. Resource profile (Note: CRL and critical Tier 2/3 resources only);
4. Schedule assumptions list;
5. Key milestone summary;
6. Float assessment.

The DCS will not be cost-loaded. Costs will be applied outside the schedule by the Finance Team; [redacted].

1.4.2 [redacted]

[redacted]

- [redacted]
- [redacted]

[redacted]

- [redacted]
- [redacted]

A quality measure needs to be developed to define the criteria for a [redacted] to be claimed. This will provide clarity to all vested stakeholders and ensure expectations are met.

2 Cost

2.1 Summary

The AFCDC at Period 2 remains at £14,819m. CRL expects this not to change over the next few periods until the DCS QRA has been carried out and the DCS contains a robust cost baseline (see Section 1.4.1). Completion of the fully-costed DCS is currently expected to be at the end of July 2019.

Consequently, the Period 2 AFCDC is still regarded by us to be understated pending conclusion of CRL's detailed analysis and the necessary confirmation input from the Tier 1 contractors. We still expect further increases arising from DCS development, risk assessment and from the continuing cost growth trends, which will continue to challenge existing financial authorities.

CRL is reporting that the forecast CTG at Period 2 has decreased by £83m, comprising the full value of £83m attributed to cost of work performed (ACWP) in the period. However, the Period 2 ACWP was £17m below CRL's Period 1 forecast. We regard this to be deferred construction related costs, due to programme slippage and productivity issues that may give rise to further, as yet indeterminable, cost escalation.

2.2 AFCDC

CRL is reporting the AFCDC in Period 2 remaining at £14,819m, which should indicate a steady state. However, to achieve this CRL has drawn down £26m of risk from the EOP allowance and the transfer of £11m from the Indirects allowance. The increases of anticipated forecast recorded in the project AFCs are, in general, not a direct consequence of EOP. The Tier 1 financial impacts of EOP and DCS are yet to be established. These are expected to be fully reported in Periods 3 and 4.

Sponsor Delegated Authority has not changed, remaining at £14,200m. As last period, the AFCDC exceeds the proposed Sponsor Delegated Authority by £619m and AFCDC headroom to the CRL Funding Package remains at £144m.

The AFCDC period movement and elemental breakdown is shown in Figure 2 - 1.

(£ millions)	Period 1	Period 2	Delta	Movement
Forecast	[redacted]	[redacted]	**0**	same
Project QRA	[redacted]	[redacted]	**0**	same
AFCDC total	**14,819**	**14,819**	**0**	same
Sponsor Delegated Authority (SDA)	14,200	14,200	**0**	same
SDA Headroom	**-619**	**-619**	**0**	same
CRL Funding Package	14,963	14,963	**0**	same
FE Headroom	**144**	**144**	**0**	same

Figure 2 - 1 ~ AFCDC Period Movement and Breakdown

When the DCS detail is agreed by CRL with the Tier 1 contractors, further increases to the AFCDC are anticipated due to the number and complexity of the interfaces becoming clearer. The Period 2 AFCDC, in our opinion, continues to be understated and will remain so until the EOP and DCS has been fully aligned with the Tier 1 and 2 Contractors. In Period 2, CRL has reported that the AFCDC is based on the EOP P50 indicative estimate, and a QRA has not yet been carried out which might confirm the P50 position. Our concerns with increasing defined cost forecasts remain. The practice of balancing AFC project increases with Risk drawdown does not demonstrate that the residual Risk value is sufficient for the risks remaining, especially when quoting an AFCDC as P50. The impact of EOP and DCS has not been fully established, and the period spend is below forecast due to delay and deferment, rather than reducing cost.

CRL reported the actual spend rate in Period 2 is £17m less than planned, £83m versus £100m planned. The rate of ACWP is falling, but this reflects reduced performance. [redacted] During Period 2, Indirect Costs were below forecast by [redacted] and [redacted] of Indirect CTG [redacted]. We are also concerned that current productivity levels may not be adequate to support EOP and DCS delivery targets, and that productivity improvement measures are at risk of becoming exacerbated.

The differing forecasting approach across the project teams continues to cause us concern. In mitigation, a new Project AFC Review format has been established for Period 3 which CRL suggests will provide improvement. The CTG figures are understated this period, because the Project Teams are maintaining issues as Risk until the forecast impact cost is established, rather than trending the expected cost and recording the potential additional element within Risk. No allowance is evident within the Project Risk figures, or within the AFCDC, which recognises the differing Tier 1 opinions of AFC and ACWP. This must be taken into consideration with the commercial positioning also being seen from Tier 1s.

[redacted]

Our linear forecast at Period 2 continues to indicate that AFCDC and COWD do not become coincident, as illustrated in Figure 2 - 2. This is because of the many AFCDC increases since Period 5 2018/2019 and the expected future AFCDC increase as a consequence of the re-baselining of schedule, cost and risk.

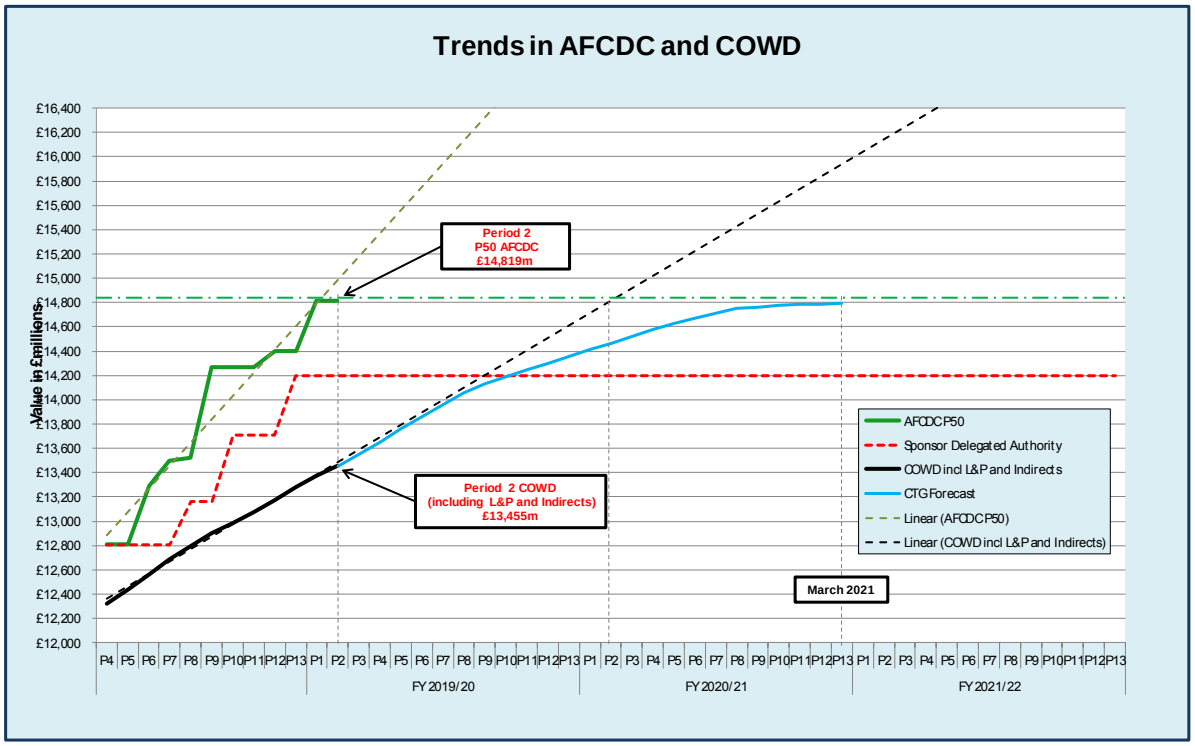


Figure 2 - 2 ~ AFCDC Headroom to Sponsor Delegated Authority

2.3 Cost: Central Operating Section (COS)

During Period 2, we continued to attend a number of meetings with the [redacted] commercial team. These meetings were intended to give us a better understanding of the robustness of the projected AFC. The initial meetings have provided the commercial background and history, focusing on the project evolution. We are progressing follow-up meetings to get a more detailed understanding of the cost to date, the cost to go, the commercial close-out process and status, potential risks and opportunities. These meetings will continue through Period 3. We will also look at the [redacted] arrangements being proposed for [redacted] once they are sufficiently developed. We are in the process of preparing an interim review paper which we anticipate we will be able to issue by the end of Period 3.

[redacted]

[redacted]

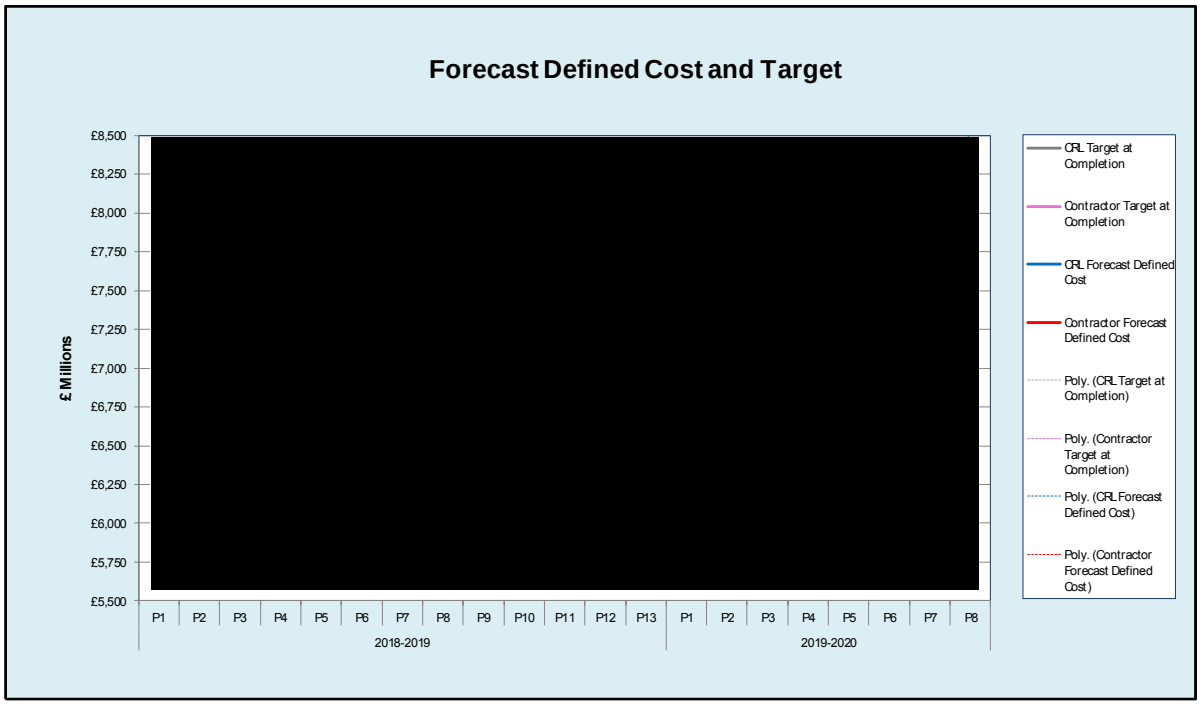


Figure 2 - 3 ~ Forecast Defined Cost and Target Cost

In summary, we highlight the principal indicators of potential cost escalation:

- The burn rates for COWD and CTG, which also include the forecast outturn for Defined Costs, indicate a continuing growth trend;
- The period spend rate for Period 1 and Period 2 are significantly below CRL forecasts. The deferment of this planned expenditure is signalling programme slippage and potential productivity issues;
- Consequently, the tracking of the TOSD demobilisation glide path and the management of the emerging cost component is indicating a trend of increasing emerging costs over a longer period;
- The lack of the DCS and associated cost plan and risk assessment is contributing to cost uncertainty.

CRL has set out its 8 Week Mobilisation Plan to deliver the EOP in manageable sections. The Cost and Risk elements fundamentally address the Tier 1 Schedules, to support the DCS AFCDC, AFC schedule, cost and risk review and analysis and risk mitigation through the CRL CIF initiative. However, with two weeks of the CRL 8 Week Mobilisation Plan completed, two principal areas of slippage are noted:

- The submission of contractor schedules is over a week late and buy-in from the contractors underpins the EOP/DCS. Close monitoring of schedule submissions and acceptance are critical to support the robust cost re-baseline;
- [redacted]

[redacted]

We continue to monitor and track progress.

2.4 Contingency and Risk

The total funding package reserved by Sponsors for CRL remains at £14,963m. At Period 2, CRL has allocated investment authority to £13,766m, an increase of £4m from Period 1. Consequently, the CRL total contingency has decreased by £4m in Period 2, to £434m.

[redacted]

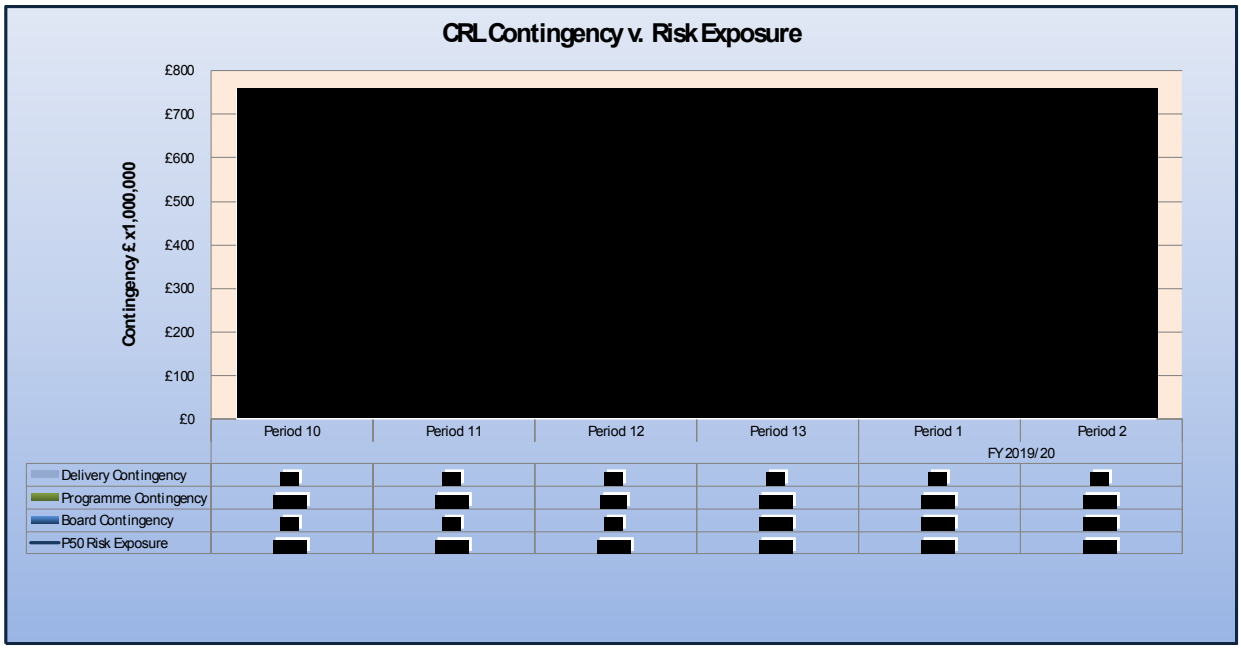


Figure 2 - 4 ~ Risk Exposure versus Contingency

[redacted]

[2] As at 5 June 2019.

Period	AFCDC	CTG	QRA	URTs	Project QRA	Pure Risk
	£m	£m	£m	£m	£m	£m
P12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
P13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
P1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
P2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Figure 2 - 5 ~ Elemental Breakdown of Risk Allowances

Risk continues to rise in both quantity and impact while overall contingency remains nominally the same. Since Period 13:

(i) there are currently 492 active Risks, having risen by 203;
(ii) there are only 155 mitigations, and only 50 of these are realistic (i.e. address the causal elements of the Risks);
(iii) [redacted]
(iv) only 66 Risks have been closed since Period 13, only 7 of which were actually mitigated (at a total value of [redacted]);
(v) of greater concern is that the average probability of unmitigated -v- mitigated risk is 70% -v- 62%, with similar cost values. This leads to an outcome (see Figure 2 - 6 below) below whereby the only logical conclusion is that current risk management strategies are ineffective.

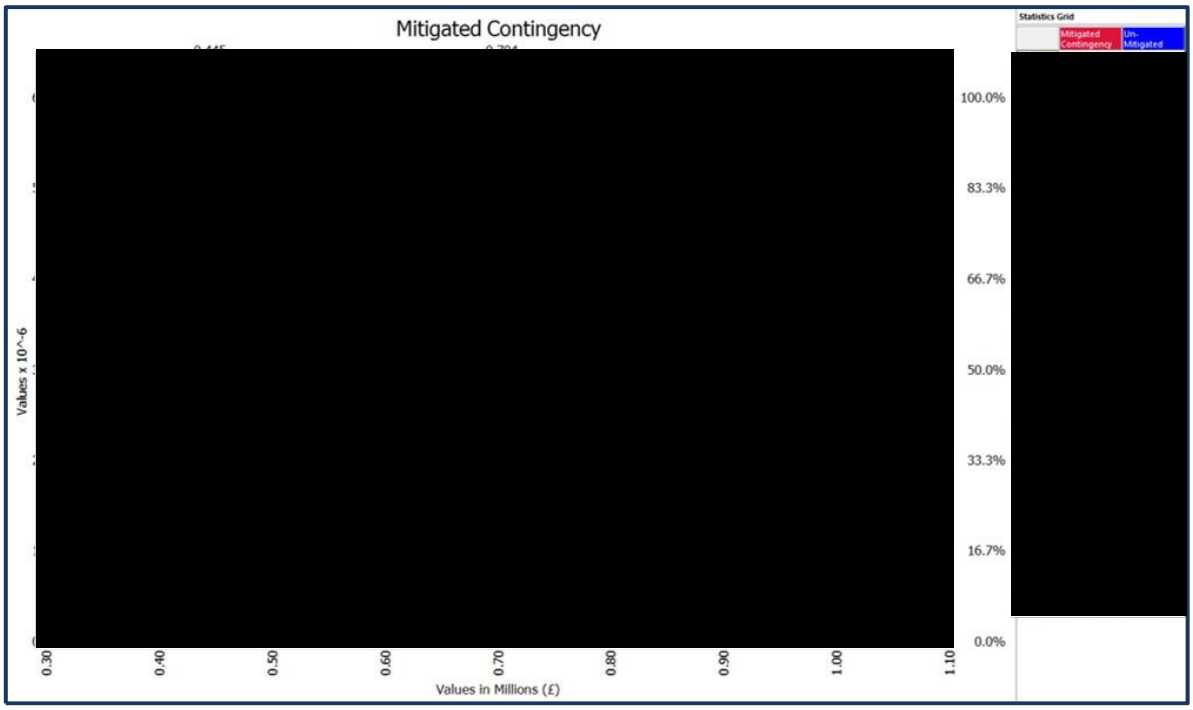


Figure 2 - 6 ~ Distributions showing the cost of pre-mitigated versus post-mitigated risk.

We are also concerned that CRL mitigations tend to lie in the areas of the greatest number of Risks, and not necessarily with the greatest impact. This highlights the concern that while supporting the overall communication of Risks, the use of Visualisation Management is inconsistent with effective risk management.

The primary area of risk is in programme synergy (i.e. business interfaces, rather than technical), which is an area which holding approximately [redacted] of risk. However, within CRL's mitigation strategies:

(i) there are not the centralised resources to solve the systemic issues with the contracts;
(ii) [redacted] and
(iii) the relationships do not seem to exist to overcome areas of friction.

There remain significant challenges within the schedule, particularly in the accurate modelling of site integration activities. This is evidenced not only in the Risks but also in the ongoing difficulties in practice, in providing access for site completion. Contractors might incur delay through trying faithfully to implement the DCS, rather than pragmatically and collaboratively managing site access.

2.5 On-Network Works

At Period 2, CRL is reporting ONW costs based on NR Period 1 data; all future ONW cost reports will also endure a four-week lag, due to the settlement of final accounts in CP5. From NR Period 1, the ONW is reported as a CP6 related project only. The overall result reduces the opportunities for cost escalation and provides improved cost certainty.

CRL and NR have agreed that the budget for the CP6 works is £252.8m; at NR Period 1, the AFC is reported by NR at £252.8m. However, NR is also reporting a [redacted] Forecast Final Cost (FFC) which includes £4m of Trends and [redacted] risk. The Period 2 (NR Period 1) ONW cost statement is tabulated in Figure 2 - 7 below.

	CRL Period 2 (NR P1) £m
CP6 Budget	£253
CP6 AFC	£253
AFC / CP6 Delta	£0
Total CP6 FFC	[redacted]
FFC / CP6 Budget Delta	[redacted]

Figure 2 - 7 ~ NR CP6 ONW Cost Statement

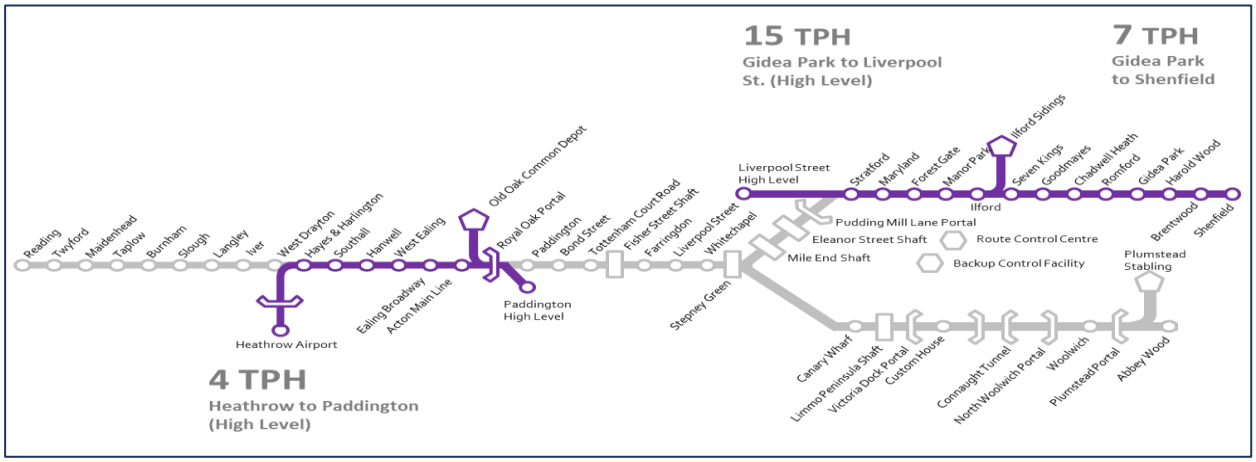
The total CRL ONW funding remains at £2,807m; the total secured funding at Period 2, including third party and cash funding supporting other projects, also remains at [redacted].

At NR Period 1 (CRL Period 2), NR reports the Forecast Final Outturn Cost (FFOC) at £2,587m. The comparative ONW funding and Cost movements are tabulated in Figure 2 - 8 below.

	CRL Period 1 £m	CRL Period 2 £m
Funding		
Total ONW Funding	£2,807	£2,807
[redacted]		
[redacted]		
[redacted]		

Figure 2 - 8 ~ Total NR ONW Funding and Cost

3 Stage 2 Phase 2: Paddington to Heathrow - Opening TBC



TPH figures based upon original programme – DCS may lead to change

3.1 Summary

There is currently no confirmed start date for Stage 2 Phase 2, but internally CRL is targeting [redacted] The principal risks to that date are delays in train software development (which has slipped further in the period), and safety authorisation. There are also issues with the ETCS wayside system that NR must resolve to avoid impact upon driver training.

There is a high risk of not achieving the target opening date. The length of delay remains uncertain at this time, and it is probably only at the point when driver training starts that an opening date can be given with some certainty. We continue to think it prudent to assume a period of up to 4 months delay. Accordingly, we believe it would be advisable to ensure appropriate [redacted] measures are available[3].

3.2 Operational Readiness Assessment

CRL's Period 2 Stage 2-2 Dashboard has retained an overall rating of 'red', with no date given for the start of passenger service. CRL is still targeting [redacted] however, one significant change from the Period 1 Dashboard Gantt Chart is that it no longer has durations for indicative risk included within it. This is because it is based upon the information contained within the latest BT programme[4]. We remain of the opinion that this date will be very difficult to achieve. The Dashboard ranks the issues in the following order of priority and they are further described in the Sections below.

1. Train software development and assurance programme;
2. Train software authorisation programme;
3. Trackside ETCS – resolution of issues arising from testing;
4. Finalisation of programme for formal ETCS integration tests, driver training and passenger services;
5. Trackside ETCS – Putting into Use.

[3] Primarily, [redacted] as described in previous reports.
[4] Released on 23 May 2019.

3.3 Phase 2 Opening

Rolling Stock

[redacted] revised programme dates for software configurations have changed from last period.

Config.	[redacted]		[redacted]		Comment
	P01	**P02**	P01	**PO2**	
Y 1.2	[redacted]	[redacted]	[redacted]	[redacted]	This config[5] allows testing to be carried out without requiring an SPZ. CRL is now also proposing to MTR-C that this config is suitable for driver training, a departure from the previous periods.
Y 1.3	[redacted]	[redacted]	[redacted]	[redacted]	This is the configuration that will be authorised by the ORR, and from which Driver Training was planned to start.
Z 1.0	[redacted]	[redacted]	[redacted]	[redacted]	Passenger service approved software.

Figure 3 - 1 ~ BT Software Configuration[7]

CRL has reported that testing on the Heathrow Spur in the period has produced some good results, but software development remains the most significant risk to the Stage 2-2 programme. As can be seen from the table, BT's at-risk date for Y1.2 completion has moved back by 10 weeks to 25 October 2019. This is due to the need to build an additional TCMS release to manage the issues arising from BT testing, together with the associated assurance approvals.

There is also a lack of clarity about the software authorisation process. This is because of the relative novelty of the software for the approving bodies[8]. Current issues with Stage 5A approvals, the software for which manages simpler technology, illustrate the difficulties of the approval process.

Despite the delay to software development, CRL's programme retains a [redacted] date of [redacted] with a [redacted] date of the end of [redacted] CRL has been able to do this by identifying the minimum numbers of drivers (62) required to be trained by start of service, which is fewer than previously envisaged. This reduces the training duration by 5-6 weeks to 9 weeks. More importantly, CRL and MTR-C are discussing starting driver training when configuration Y1.2 is stable, rather than Y1.3, which has been assumed up to now. This means that driver training would start at a similar time (late September 2019) to that proposed in Period 1. [redacted]

We recognise that CRL is prioritising Stage 2-2 Opening as soon as possible. However, we believe the issues will take longer to resolve than the [redacted]

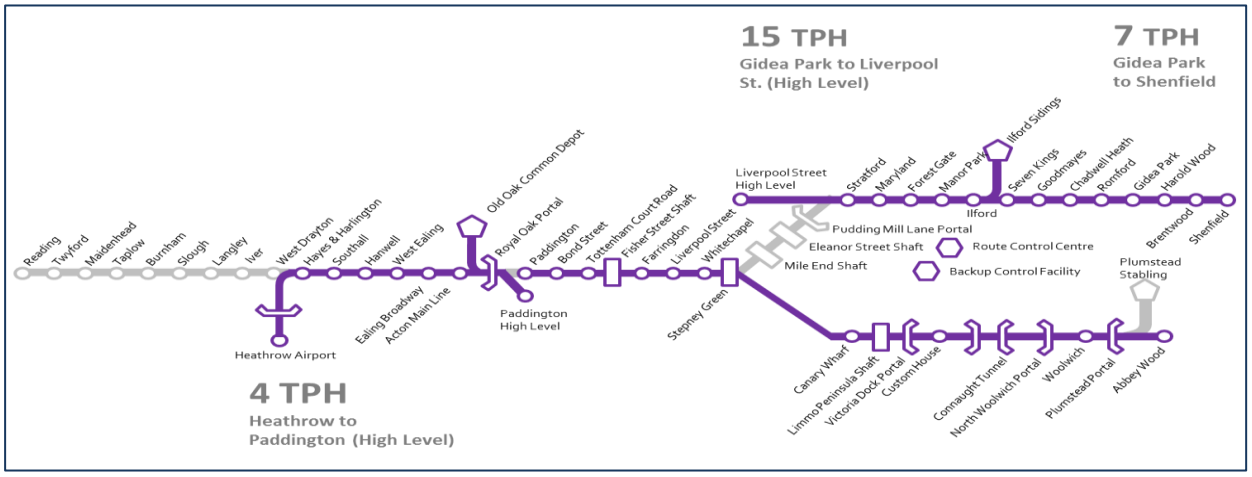
[5] Configuration comprises TCMS, ETCS, TPWS and CBTC.
[6] This was forecast to be end of [redacted] in Period 12. The Period 13 CRL Executive Board Report states it will be the end of [redacted]
[7] BT schedule dates.
[8] ORR, MTR-C, HALARP, NR.

Infrastructure

As described in our last report, the testing of the train has identified 3 faults with N[redacted] ETCS. These are: inadequate [redacted] The train position issue is expected to be fixed in June 2019, but the [redacted] issues are proving difficult to fix, with the current date of [redacted] at risk. This needs to be resolved before passenger service can begin. Lack of [redacted] at the start of driver training would require training runs to be repeated.

The position concerning the ETCS wayside receiving its 'Putting into Use' certificate from the W&W ETCS group remains unchanged. This has been outstand[redacted] since November 2018 and may not occur until the 39 tests are completed, currently scheduled for August 2019. CRL is aware of the issue

4 Stage 3: Paddington to Abbey Wood - Opening TBC



TPH figures based upon original programme – DCS may lead to change

4.1 Stations, Shafts and Portals (SSP)

4.1.1 General

The Central Section Stations are still failing to predictably achieve the levels of productivity necessary to meet both their forecast and planned installation (IRN) and T&C (PCC and PAC) certification sign-off targets. However, the gap between plan and actual delivery does appear to be narrowing. The Period 2 Vis-Board reviews suggest that the forecast dates for SSP Staged Completion (SC3) are under continued pressure, although most of the dates have been held during the period. However, we note that the [redacted] for the SC3 dates, which will be embedded in the DCS, are generally later than those reported at the Vis-Board reviews.

The tables showing forecast SC3 dates that follow in this report, also show the Cardinal Milestone dates. Tottenham Court Road, Farringdon and Whitechapel Stations forecast SC3 dates have slipped during the period. This situation may be revised when the fully-costed DCS is available. Forecast target dates for SC for the Stations (LUL and RfL), Portals and Shafts can be seen in Figure 4 - 1, Figure 4 - 2 and Figure 4 - 3.

Productivity of IRNs[9], PCCs and PAC[10]s remains low as installation, T&C and certification documentation submission continues to underperform against the DCS v0.1 interim baseline 8 week look-ahead. Physical installation and Testing and Commissioning activities are also taking longer than planned, and the subsequent forecast SC and HO dates are being impacted as a consequence. Progress made on actual completion of IRNs and PCCs/PACs against plan will become clearer with the release of the fully-costed DCS. However, CRL's productivity when trended forward continues to suggest that delays to the achievement of the sign-off of these documents continues and that key milestones could still be later than forecast. The current percentage completion of IRNs, PCCs and PACs, at the close of Period 2, for all Stations, Portals and Shafts, is set out in Figure 4 - 1 below.

[9] Installation Release Notes (Phase 2.1).
[10] Pre-Commissioning Certificates Phase 2.2 and Partial Acceptance Certificates Phase 2.3.

	% Complete		
	Period 13	Period 1	Period 2
IRNs	71%	72%	75%
PCCs	32%	38%	52%
PACs		27%	33%

Figure 4 - 1 ~ Percentage completion of IRNs, PCCs and PACs for all SSP contracts

The rate of production of IRNs has increased very slightly (3.4% of total IRNs for SSPs) during the period and the percentage completion is now 75%. The sign-off of PCCs has also shown an improvement in the period, but this has not been reflected in the completion of PACs.

Performance of the SSP sites against plan is starting to show some signs of improvement, with the exception of [redacted] still account for most of the shortfall in IRN submission against plan. All of the stations, with the exception of [redacted] have made little progress with PACs. This suggests that there remains a risk of further delays and date slippages to the Station SC and Handover dates. Appendix B contains a detailed breakdown of IRN, PCC and PAC testing and commissioning progress for each of the SSP sites. This shows that contractors need to substantially increase their levels of productivity on the station physical works, to close-out Phase 2.1 (IRN) and 2.2/2.3 (PCC/PAC) testing and handover.

We have received a draft copy of CRL's [redacted] report for Period 2 and have updated our summary of the current forecast SSP dates for Staged Completions (SC3) accordingly. Refer to Figure 4 - 2, Figure 4 - 3, Figure 4 - 4 below. [redacted] The forecast dates may be subject to change in the fully-costed DCS. [redacted]

CRL is working closely with the IMs (LUL and TfL) to establish a T-minus process for SC and the eventual handover of the SSP assets. The fully-costed DCS will help give greater visibility of the process, as each of the T-minus review dates will be incorporated as schedule milestones. This will provide greater detail and a measure of progress made towards HO, as each T-minus review will potentially act as a Go/No Go gate. However, the IMs continue to express concern that the lack of assurance documentation (FDO certification, PACs/ACs, O&Ms and As-Built Drawings etc.) will increase the risk of failing T-minus reviews. A failed T-minus review will be hard to accommodate in the DCS and will have an impact on the HO date. We await to see how the process works for the Portals and Shafts that are approaching HO and how the lessons learnt from this process can be passed on to the Stations.

[redacted] at Bond Street, Tottenham Court Road and Woolwich Stations have been investigated and modifications to the installation of connections are being made to rectify this problem. The resolution of this issue has reduced the risk of associated schedule delay that had been feared.

4.1.2 Stations – LU

LU is preparing its readiness indicators for the key dates SC1, SC2 and SC3 across all of its stations. The focus remains on SC3, but there is a need to consider SC1, particularly in respect of the anticipated documentation submission 'bow wave'. CRL believes that this issue will be dealt with through the T-minus reviews, but we believe this will only expose the magnitude of the documentation sign-off problem.

The forecast completion dates for SC3 reported for three of the stations are later than forecast in Period 1. With the exception of [redacted] the remaining three stations forecast SC3 date [redacted] Refer to Figure 4 - 2 below.

Contract	Location	TLA
C412	Bond Street	BOS
C422	Tottenham Court Road	TCR
C435	Farringdon	FAR
C502	Liverpool Street	LIS
C512	Whitechapel	WHI

Figure 4 - 2 ~ LU Stations – Forecast Staged Completion (SC3) Dates[11]

The **Bond Street Station** contractor has been asked by CRL to submit a detailed and fully-integrated programme for the works up to and including SC1, SC2, SC3 and HO. The contractor has yet to submit the information requested. The schedule implications of the forecast completion dates on the evolving DCS will remain unclear, until the contractor's submission is received and assessed. [redacted]

Permanent power supply to the ETH of **Bond Street Station** was commissioned on 20 May 2019. Permanent power for the WTH is forecast by the end of June 2019. [redacted]

There has been very little progress in the submission of testing and commissioning certification at **Bond Street Station**, during the period. The level of IRNs achieved remains at just fewer than 5%, with PCCs at 4% and no PACs submitted to date.

Physical installation of the MEP works at [redacted] is substantially complete. However, the submission of Phase 2.2 (PCC) and 2.3 (PAC) documentation, forecast for completion by mid-June 2019, appears overly optimistic, with the percentage completions only at 43% and 10% respectively (at close of Period 2). The completion of both PCCs and PACs is still low and remains a risk of further delaying SC at this station.

Considering its state of near substantial physical completion, it is difficult to understand why the forecast SC date for [redacted] is so late; we continue to investigate this. We note, however, that there remains a significant backlog of document submission. While steady progress is being achieved with the sign-off of the IRNs and the submission of the PCCs (now 80% complete), progress on the PACs remains low (still only 3% complete). The rate of PCC

[11] Draft dates pending release of the fully-costed DCS v1.2.

sign-off has improved during the period; however, we are concerned at the scale of effort that will be required to close out the PACs. The slow rate of document submission suggests that the assumptions made in targeting an earlier SC and HO may be overly optimistic and unachievable.

Forecast completion dates for Phase 2.1/2.2 testing at [redacted] are being held, but the dates for Phase 2.3 and SC are slipping as a result of delays to the BMS. C660's works (PAVA, Radio etc.) and its Phase 2.3 testing is nearing completion. This will release IRNs that have been blocked until the PAVA and Radio design models have been verified.

TOSD2 for the LU/LO platform works and the new concourse at [redacted] has been achieved one week ahead of plan[12]. However, possession access constraints and the slow rate of submission of certification documentation continue. We believe that these issues indicate an ongoing risk of further delays to completion of Phase 2.1 and 2.3 testing, if greater possession access is not granted, making it difficult to accurately forecast the station's SC and HO dates.

4.1.3 Stations – RfL

The process of review of handover documents, return of comments and close-out of certification for the RfL Stations, is taking much longer than has been assumed by CRL. Concern has been raised that the current rate of review (5 per week) of submissions will impact on station handover dates if the rate is not increased. RfL recognises that it needs to increase the level of resource available to achieve the required rate of review. We believe that CRL needs greater visibility of the number of documents and their review status, to closely monitor its progress towards achieving Code 1 acceptance status from RfL. Document trackers are being established by CRL, but these are large and complex, and do not always capture the status of documents held on eB. Refer also to Section 4.1.4 associated with RfL resource constraints and its impact on document review.

We note that the forecast dates for SC on each of the RfL stations have been held and, with the exception of [redacted] remain ahead of the [redacted] dates. Refer to Figure 4 - 3.

Contract	Location	TLA
C405	Paddington	PAD
M072	Canary Wharf	CWS
C520	Custom House (Incl full Handover)	CUH
C530	Woolwich	WOO

[redacted]

Figure 4 - 3 ~ RfL Stations – Forecast Staged Completion (SC3) Dates[13]

Causation effect tracking has been applied to the Visualisation Management process to help arrest the continued failure to achieve planned IRN targets on all of the stations, generating new KPIs that are tracked on a daily and weekly basis. The extremely steep curve for the forecast rate of PAC submissions at [redacted] needs to be challenged (a planned run rate of 14 per period required from mid-June 2019); particularly when no PACs have been submitted to date. The site has been challenged to ensure that its PAC forecasts are supported by real data, and to demonstrate that they are achievable. This review should be undertaken at other stations, where the forecast rates of production have not been achieved in the past.

[12] Whitechapel achieved its TOSD2 (LU/LO works) milestone on 24 May 2019. One week ahead of plan.
[13] Draft dates pending release of the fully-costed DCS v1.2.

We have previously reported that the inclusion of additional scope at [redacted] The T&C programme is well advanced, although some tests may need to be repeated on any equipment installations that have subsequently been modified, once the additional Project 4 works are complete. Phase 3 testing pass rates are lower than anticipated, and we note with concern that forecast completion of Phase 3 testing has slipped by 6 weeks to the end of July 2019. This will continue to impact on, and likely delay, the forecast SC date.

Acceptance certification for [redacted] is being delayed by the time being taken by CEG for documentation review. There is no float allowed for in the schedule for possible re-submission. The site team is relying on pre-reviews with the IM to help mitigate possible delays. A joint (CEG/IM) competence register could help ensure that appropriate resource is available for the review and that only unresolved issues are sent to CEG for decision. We understand that CRL is considering this option, as staff changes and resource leaving the project are impacting the review process. Both CRL and the IM are finding that the lack of availability of suitable staff in the market place is a major constraint.

C660 Radio network testing at [redacted] is still being delayed, due to failed tests. Replacement of the leaky feed cable has not resolved the issue and the cause of the test failures is still being investigated. [redacted]

4.1.4 Portals and Shafts – RfL

Testing [redacted]d Commissioning progress on the Portals and Shafts is still slow and delays are particularly evident in the forecast dates for completion of Phase 2.3 and 3 testing. Completion of these phases of testing is on the critical path, as they will underpin the railway safety case and application for ATU, prior to asset Handover. The forecast dates for HO have been held and [redacted] have improved on their forecast dates. In general, the [redacted] However, [redacted] Shaft are forecasting SC3 on or a few days later than shown for the [redacted] Refer to Figure 4 - 4 below. We remain concerned that the assumed rates for the submission of certification documentation on all Portals and Shafts may still be too optimistic and that further delays could still occur.

Contract	Location	TLA
C530	Connaught Tunnel	CON
C336	Royal Oak Portal	ROP
C530	North Woolwich Portal	NWP
C360	Mile End Shaft	MEP
C340	Victoria Dock Portal	VDP
C350	Pudding Mill Lane Portal	PML
C360	Fisher Street Shaft	FIS
C360	Limmo Peninsula Shaft	LIM
C530	Plumstead Portal	PLU
C360	Eleanour Street Shaft	ELS
C360	Stepney Green Shaft	STG

[redacted]

Figure 4 - 4 ~ Shafts and Portals – Forecast Staged Completion (SC3) / Handover Dates[14]

[14] Draft dates pending release of the fully-costed DCS v1.2.

Acceptance of the fire safety documentation, O&M Manuals and the Health & Safety Files for the Portals and Shafts is being delayed by a lack of appropriate RfL resource to undertake the necessary reviews. CRL has arranged a series of documentation review workshops to help mitigate some of the resultant delays. We have previously noted concerns that the 'bow-wave' of submissions will overwhelm both CRL and RfL fire safety teams, unless the level of resourcing is increased. Fire safety documentation sign-off to date remains slow and could threaten the forecast dates for ATU and HO across the Portals and Shafts.

CRL is closely monitoring the progress of the Shafts against the submission of the remaining assurance and testing documentation. RfL has started its T-minus process for the HO of the Portals and Shafts. Consideration is also being given to measuring the percentage completion of scenario testing and the number of approvals linked to ATUs. CRL will need raw data to help understand what underpins successful progress on these latter stages ahead of Handover and where support is, or may be, needed. The valuable lessons learnt from these handovers can then be applied to the larger stations. See Figure 4 - 4 above for current key Portals and Shafts handover dates.

4.2 Completion and Handover of Integrated Systems[15]

Rail Systems installation and integration on the Central Section continues in line with the unapproved MOHS dated November 2018. The MOHS still provides the strategic level schedule framework for delivery, pending the release of the fully-costed DCS.

The establishment of a Delivery Planning Centre (DPC) at Westferry Circus continues. Although some fit-out activities have still to be completed, the room is already increasingly functioning as the focus for CRL works planning. CRL plans to install a data link to the Romford RCC, in order to replicate live SCADA indications in the DPC. This will provide an up-to-date indication of the state of Rail Systems completion, energised systems and testing and commissioning completion, and will significantly assist the works planning process.

The Stage 3 Opening Programme Delivery Board (PDB) was not held as originally scheduled on 4 June 2019. Visualisation Management will become a significant feature of future Crossrail Programme governance and CRL has proposed that this PDB will no longer run. Our future reporting on Routeway delivery issues will be aligned with those considered by CRL in the Routeway Vis-Board reviews, as escalated from the specific Rail Systems Vis-Board reviews. A selection of issues from Period 2 is summarised below.

1. Completion of Routeway (C610)

Tunnel Lighting Power Panels (TLPPs) and Tunnel Pumped Drainage (TPD) still contain significant workloads. Custom House energisation has slipped to the end of [redacted]

Completion and availability of header tanks at some stations is [redacted] Close co-ordination with the SSP contractors is still required to facilitate technical support and site access for Phase 3 flow testing.

[15] The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.

2. Tunnel Ventilation (C610)

CRL's concerns with the completion of Tunnel Ventilation remain largely unchanged from last period. [redacted] Testing of Under-Platform Extracts (UPEs) has started and results are being evaluated following first-of-kind testing.

3. Radio (C660)

C660's radio priorities remain the completion of GSM-R radio and Fire Brigade radio (LFEPA), in the SSPs and along the route. The installation of LFEPA radio at Bond Street Station (to support passenger evacuation while the station remains operationally closed) has still to be resolved. LU is currently analysing the results from Phase 2 Connect radio system testing at Tottenham Court Road and Farringdon Stations.

GSM-R testing with NR support continues, with Network Functional Acceptance by NR (NFA) scheduled for November 2019. We do not believe that the use of GSM-R to support Trial Running and Trial Operations has yet been fully reviewed and the requirements scoped, although sufficient time remains to do this. However, we warn again of the need for formal arrangements to be put in place between Crossrail and NR, to ensure that NR supports the Crossrail GSM-R network (effectively still under test) as if it were a railway operational radio network.

4. Traction Power (C644)

Pudding Mill Lane Feeder Station has been re-energised, but RfL is the custodian while residual issues which prevent the take-over of control by NR are resolved. Handover of control to NR is now anticipated at the end of [redacted] This is later than planned, but the delay will have no material impact upon the supply of traction power for dynamic testing.

5. SCADA (C660)

Risks with SCADA completion remain because of incomplete M&E installations, and unreliable IRN delivery dates, principally associated with Stations; Shafts and Portals are in a much better state of completion.

Specific focus is necessary to establish the requirements and schedule for the completion of SCADA integration with C620 Signalling equipment. Siemens has yet to propose first-of-kind installations which will allow equipment interface and testing methodologies to be proved.

4.3 Dynamic Testing

4.3.1 Dynamic Testing Strategy

Plans are in place for the utilisation of test block MDT 12 for construction on the Central Section, effectively providing an uninterrupted schedule window for installation and static testing from 13 to 25 June 2019. New Siemens signalling software configuration P_D+8 will be loaded onto test trains and the Central Section infrastructure while dynamic testing is paused.

Thereafter, CRL proposes to continue the MDT regime largely in its current form until MDT 37[16], which is scheduled to start on 10 December 2019; this is based upon a simplistic extension of the current MDT regime. The progressively reducing demand for construction is expected to provide increased dynamic testing schedule flexibility, allowing greater opportunity for testing under specific controlled conditions (e.g. the whole-Railway testing and commissioning activities described below).

[16] T&C Visualisation Room, 13 June 2019.

Ultimately, a robust dynamic testing schedule can only be confirmed once the Rolling Stock and Signalling requirements have been incorporated. This schedule integration exercise has not yet been concluded, and CRL has recently applied considerable pressure to Siemens, in order to understand the extent of signalling functionality able to be delivered prior to the current Trial Running target of [redacted] It is intended that agreements on signalling functionality and availability prior to Trial Running will be reached between CRL and Siemens, to allow the development of a fully integrated dynamic testing schedule by the end of June 2019. CRL's target date for incorporation into the DCS is 2 July 2019[17].

[redacted]

Visualisation Management is facilitating improving collaboration between interfacing parties, resulting in the planning horizon for dynamic testing being 'pushed' into the future. The 'locking-down' of plans up to several weeks in advance is slowly becoming achievable, providing greater confidence in the dynamic testing planning process. While we raised concerns last period with the slow of emergence of potential benefits from the Westferry Circus T&C Visualisation Room, integrated planning is one area of improvement worthy of mention. However, some uncertainty will remain until the Siemens and BT requirements are fully integrated into the DCS.

The review of CEG's integration tests[18] 'for routeway systems and related installations' by the CRL Systemwide Delivery organisation is drawing to a close. While the requirements for these tests have been formally instructed to the SSP contractors, this has not yet been carried out for all of the Rail Systems contractors. Given the need for specific system completion conditions, we expect the DCS to show explicitly when these tests can be carried out.

4.3.2 Dynamic Testing Progress

Dynamic testing has been severely restricted during March, April and May 2019, awaiting the outcome of CRL's investigations into the significant signalling irregularities which occurred in February and March 2019. Ultimately, CRL was satisfied that sufficient progress had been made in the follow-up to each of the investigations to support the case for the resumption of limited multi-train testing (MTT) on the Central Section[19]. The subsequent achievement of RAB(C) acceptance was not without difficulty and details are provided in Section 4.4.1 below.

CRL's investigations also considered a number of previously-known underlying issues, which were shown to have contributed to the emergence of the irregularities. These issues had supposedly been mitigated prior to the development of permanent 'fixes', in the interests of maintaining dynamic testing progress. However, the aggregate effect of the mitigations, combined with poor communication of the specific conditions under which they were to be applied, contributed to the unexpected test outcomes. Not all of the permanent fixes built into software updates and new configurations have been delivered to site yet, and test mitigations and safety approval conditions will remain in place until they are.

[17] Signalling Visualisation Room, 13 June 2019.
[18] As described in the document 'Integration Tests for Routeway Systems and Related Installations' (CRL1-XRL-Z-RGN-CR001-50511 Rev. 3.0).
[19] CRL draft report "Signalling Multi-Train Testing Safety Review" (CRL1-XRL-R2-LRC-CR001-XXXX).

It is anticipated, once the necessary safety approvals are secured and access to the full functionality contained in P_D+8 is permitted, that a marked improvement in dynamic testing output will be realised.

4.4 Approvals, Assurance and Agreements

4.4.1 RAB(C)

The DTSRP considered and finally accepted the Statement of Safety[20] which summarised CRL's justification for the resumption of MTT on the Central Section. The Statement was considered alongside evidence which demonstrated that agreed remedial actions to the signalling irregularities had been completed. Correspondence from the Siemens ISA provided assurance that the basis of previous RAB(C) safety approvals had not been compromised. Formal acceptance was finally achieved on 6 June 2019, but only through good collaboration between parties which allowed the re-scheduling of reviews that day. This resulted in the release of a number of MTT test cases for implementation during MDTR 11. It was considered by CRL as a small but important achievement in the slow progression towards future 'full' MTT.

The Crossrail Programme continues to suffer from the need to produce fragmented submissions in order to support incremental, rather than wholesale changes to functionality. A further imminent example is the [redacted] proposal[21] to seek safety approval for dynamic testing with the P_D+8 signalling software in stages, because the Letter of Support from its ISA will not be available until early July 2019. This will allow early (albeit limited) access to MTT functionality on 25 June 2019, the software having been downloaded to the Central Section in mid-June 2019. DTSRP has indicated it is willing to support this approach, but success will require significant efforts by CRL and Siemens.

While this approach significantly increases the workload of document production and submission co-ordination, it continues to be done to overcome issues with [redacted] It is hoped that the progressive completion of works and the schedule framework of the DCS will stabilise this situation, and lead to improved efficiencies in document production and approval.

4.4.2 Regulatory Approvals

There is little change from the concerns raised in our last 4 reports. The production of the Safety and Technical assurance evidence must increase from its current pace so that it does not impact the start of Trial Running. Recognising that a rate improvement might not be achievable, CRL has already started exploring with the IMs to explore if there are areas which are 'negotiable'. An example might be RfL accepting O&M Manuals at Code 2 instead of Code 1 at Handover. Handover is likely to be delayed if a sensible compromise is not achieved.

Engineering Safety Management

There has been some improvement in the period regarding closing **Hazard Closure** for Shafts and Portals, but overall the current performance does not support approval of Safety Case for Trial Running in [redacted] Routeway requires a closure rate of an average 29 a week, Shafts & Portals 17 a week. These rates are not being achieved.

[20] Statement of Safety SS_016 Revision 2.0 issued on 22 May 2019, certified by DTSRP on 6 June 2019.
[21] Siemens presentation to DTSRP made on 10 June 2019.

The C620 **NR Signalling Interface Designs** are not complete (Degraded Mode & HF outstanding) thus delaying the completion of the transition safety cases.

As anticipated, there has been little progress with the delivery of **final safety submissions to RAB-C**, broadly reflecting the current state of incomplete installation. A draft submission schedule aligned with the EOP has been produced by CRL which shows that approximately 60 documents are planned to be completed in a 6-month period. This requires a rate of submission and approval not previously achieved.

The lack of T&C evidence to support **TSI Compliance** submissions has been a blocker to the NoBo completing the Technical File for the ORR. This is a consequence of the delay to the works, and the activity needs to be duly accounted for in the programme.

Technical Assurance

The IMs require an accepted design to go through the completion and Handover process. One of the 11 outstanding **FDO** reports was completed in the period.

Failure to deliver the required assurance products and to pass them in **CARE** will risk Handover of the assets to the IMs. CRL has not significantly raised the pace of production in this period. There also appear to be IT problems in transferring the deliverables between CRL and the IMs, but these are expected to be resolved during the next period.

A large number of **open concessions** needs to be submitted, and there is a risk that these may be late. This would leave the IM with little time to review, compromising the acceptance schedule.

4.5 Operational Readiness Assessment

In our last report, we described concerns with the delta between the designed and delivered railway, and the lack of a signalling simulator. These concerns remain, and a further two issues have emerged in the period:

Programme for T-Minus Reviews: As described in Section 4.1.1, the IMs and CRL have scheduled a series of T-minus reviews as part of the asset handover process. The IMs believe there is not a robust programme that specifies what is expected and what the pass criteria are. Their concerns are with what quality and level of Handover documentation (Red Line Drawings, O&M Manuals) will be offered by CRL, and with the scope being delivered. Three assets[22] have been nominated to undergo the process, in anticipation of lessons being learnt to be applied to the more complex (and critical path) stations. Otherwise, there is the risk of importing delay into the DCS.

IM Readiness during interim period: Some of the assets (e.g. [redacted] are planned to be handed over to LU well in advance of passenger service. LU will not immediately start operational familiarisation, because the process would need to be repeated. LU and RfL will need to ensure they implement interim arrangements (e.g. security contracts) that account for this pre-operational period, although the uncertainty of Handover dates complicates that process for them.

[22] Pudding Mill Lane, Victoria Dock Portal, and Mile End Shaft.

4.6 Rolling Stock

In our last report, we stated that software configuration Y0.380 was forecast to be authorised for Passenger Service (and Trial Running) by [redacted]

This represents an improvement, but the risks of the programme moving towards the late date have increased in the Period. This is because the ability to assure a key component of the software configuration P_D+8 is at risk. [redacted]

The chart below shows that reliability is improving, but of chief interest is the 'BT prediction' line. In our last report, BT was predicting circa 15,000 MTIN by Period 10. That has now been reduced to circa 9,000 MTIN. This, in part, reflects the delays to Stage 5A Opening and MTT in the Central Section, limiting train mileage accumulation and reducing the opportunity for fault finding and fixing.

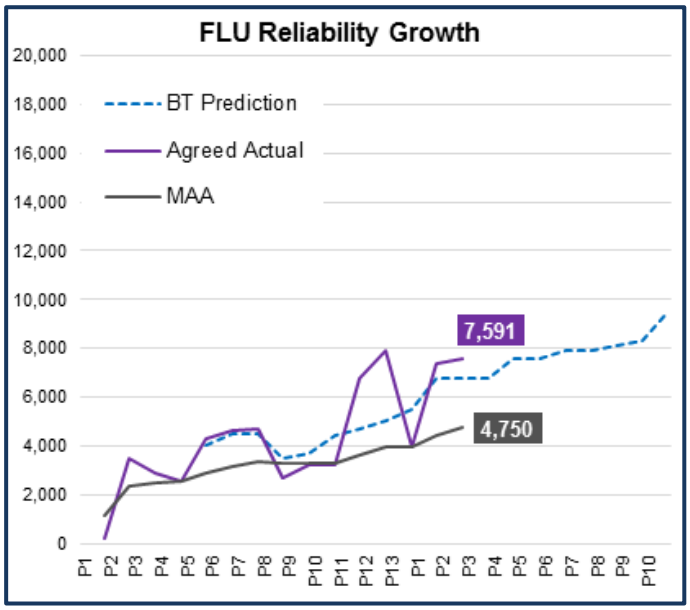


Figure 4 - 5 ~ FLU Reliability Growth Chart (MTIN)

4.7 Handover

As with our previous reports, the pace of delivery of Handover materials does not match that required by the schedule. We understand that the CRL Transition Director is now acting as a focal point for this issue and will be endeavouring to make the DCS take account of the actual durations of completing the necessary documentation.

The issues affecting the delivery of O&M Manuals that were described in our last report continue. Approximately 820 manuals are now expected, with 133 at Code 2 (Substantial Completion) and 38 accepted. We continue to advise that Contractors need to improve their quality and meet promised delivery dates and RfL needs to reduce its review time and assess what constitutes a

[23] Trial Running is preceded by the IM ramp-up in January, but the same system requirements apply.

material comment. The IMs have produced 'pull' programmes showing what they require and when, but the plans are not being met.

As-built Drawings remain well behind. Of the 24,000 MEPA and 5,000 C600 drawings, the accepted percentages of 11% and 3% remain unchanged from Period 1. The IMs will accept Red Line Drawings for Substantial Completion, but the current state of those is not clear.

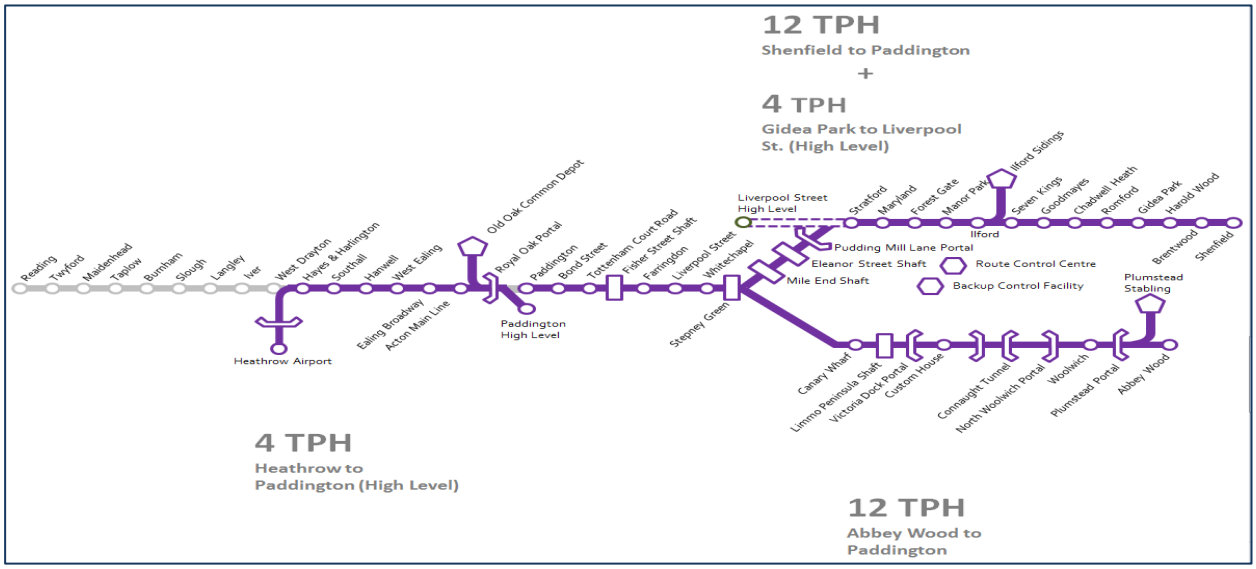
4.8 Trial Running and Trial Operations

The issues described in Section 4.5 have an influence on the success of Trial Running and Trial Operations. There are two further comments to make.

In our last report, we stated that the IMs should agree with CRL what the criteria are for entering Trial Running and Trial Operations. The IMs would then lead on what the criteria are for entering Passenger Service. There is now a workstream as part of the development of the DCS to define these criteria. We have seen drafts of the work undertaken and are satisfied that a logical approach is being taken at a generic level. These need to be translated into site specific criteria.

Complementing the above is the work undertaken in developing a Reliability Growth Strategy, which will be essential in improving performance through the development stages (end of Dynamic Testing, Trial Running, Trial Operations and initial Passenger Service).

5 Stage 4: Paddington to Abbey Wood & Shenfield - Opening TBC



TPH figures based upon original programme – DCS may lead to change

5.1 Summary

CRL has retained its overall RAG rating of 'red' for Stage 4 Opening. As we described in our last report, this is because the works are contracted between CRL and NR to complete in [redacted] but some are at risk of not meeting that date. However, in the context of the overall Crossrail Programme, Stage 4 is planned to open [redacted] This is likely to be in either [redacted] None of the at-risk works currently threaten the [redacted] date, so the actual risk of delay to Stage 4 probably merits a 'green' rating.

5.2 Operational Readiness Assessment

There are two significant issues of note:

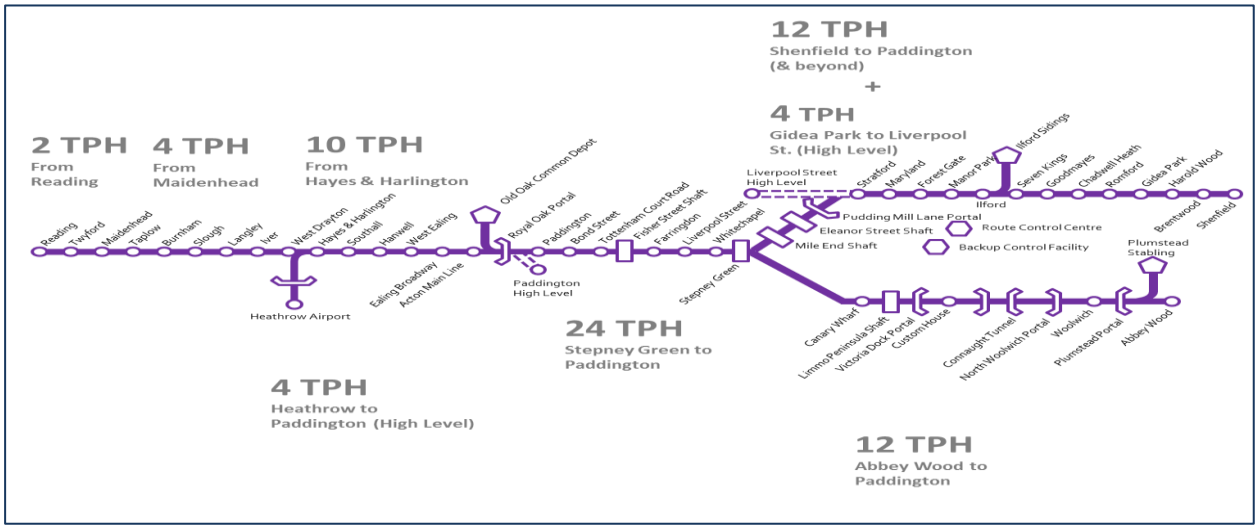
NR's surveys of the **Station Information and Security System (SISS)** works have been completed, and it is formulating a delivery strategy to install the equipment at the Stations. [redacted] We advise Sponsors that mitigating measures should be identified by RfL and MTR-C, should the facility not be available at time of Opening.

The other issue concerns the **GEML Traction Power Upgrade**. The commissioning of the route from Liverpool Street to Gidea Park was forecast to be concluded by December 2019, but it is now expected by April 2020. The project team is assessing whether there is any impact upon Trial Running when FLUs will be operating a 12 tph service for short periods. We will report further when the situation is clearer.

[24] The other constraint is that Opening must coincide with an NR timetable change in a May or December.

Other issues in the Stage 4 Operational Readiness Dashboard are DOO CCTV at Shenfield and Stratford; ticket offices and lifts at Gidea Park & Goodmayes. We will comment upon these in future reports if they become risks to Stage 4 Opening.

6 Stage 5: Reading & Heathrow to Abbey Wood - Opening TBC



TPH figures based upon original programme – DCS may lead to change

6.1 Summary

CRL has given an overall rating of 'red' for Stage 5A Opening in its Period 2 PDB Dashboard. The completion by NR of its works, most notably at Maidenhead, Twyford and Slough, remains key. Its works have generally proceeded to plan during this period, but temporary works will be required to maintain schedule.

The FLU has not been approved for the swap-out of RLUs, and BT is seeking approval again from MTR-C and the ORR during Period 3.

CRL has given an overall rating of 'green' for Stage 5B Opening in its Period 2 PDB Dashboard. This is because the activities required for the stage are all likely to be complete once the implementation date is confirmed. Confirmation of that date will come when there is greater certainty of a Stage 3 Opening date.

6.2 RLU – FLU Swap-Out

As we described in our Period 1 report, just prior to the MTR-C SVP meeting, the ORR decided not to provide a letter of no objection to BT and required the train to be re-authorised. BT has reported that it will comply with the ORR stipulation, and has now received the letter of no objection. In anticipation, BT has submitted a proposal to the SVP that FLUs with Y0.256 configuration be approved for both ECS movements to Reading, and passenger services to Hayes and Harlington. For that to happen, the SVP will want to see evidence that:

- A train has completed 1,250 fault-free miles;
- The list of driver defects and control measures is manageable, with a plan for rectification;
- ETCS resets have been eradicated;
- Technical assurance documentation is complete;
- The ORR letter of no objection has been issued (so any approval will be conditional until such letter has been produced);
- The RSSB deviation has been extended to December 2019. (This was extended on 6 June).

The defects and controls issue is the primary issue for us, as BT and MTR-C must agree on what is an acceptable number, and nature of them, to start operations with. This needs to be supported by a suitable rectification plan for dealing with them. The other concern is whether any key defects extend beyond the start of Stage 5A.

Achievement of the fault-free running target remains difficult, as there is a lack of sustained access to the GWML to test and accumulate the miles. CRL is assisting BT in obtaining greater access.

6.3 Stage 5A Opening

The critical path for Stage 5A service remains the delivery of the DOO CCTV. In Period 2, NR has reported that this workstream has remained on programme, with a small improvement of approximately a week for the approval of the last SAT documentation. This is helpful, but it is still too close to the start of service to provide confidence. An additional DOO CCTV testing team is now in place, which will deliver some efficiencies. However, there is little chance of further access being made available.

Many of the works, such as lighting and cabling, look likely to be completed in a temporary works condition rather than as permanent works. This is primarily due to conflicts with other programmes such as ONSIP. Temporary works should suffice for passenger service (although complications can arise) but it will mean that there will be additional costs associated with the replacement with permanent works, to be borne by NR. We recommend to Sponsors that NR should prioritise schedule if it is considering whether to install temporary works or complete with permanent works and risk delay.

Platform extensions are reported to be progressing well.

Considering the importance of Stage 5A Opening taking place on time, we would continue to advise Sponsors that NR and CRL have suitable contingencies, with timely decision points in place. These should cater for a station(s) being without DOO CCTV, or the FLUs not being available.

6.4 Stage 5B Opening

Stage 5B Opening is rated 'green' in the Period 2 PDB Dashboard, with a proposed opening date to be confirmed. We surmise that date to be December 2021, based on the assumption built into the EOP that it must occur 12 months after Stage 3 Opening. In that context, there are no workstreams that are on the critical path for that date, with all works expected to be completed by December 2020[25]. There is of course a cost imperative in completing them as soon as reasonably possible.

Both **Western Inner Station Enhancement** packages are scheduled to be substantially complete in July 2020. A risk to Southall, part of package 3, is completing the land handover in the time allowed.

NR has repeatedly stated that the **West Traction Power Upgrade** infrastructure is not required for the Stage 5B timetable, but it has not provided formal confirmation, as promised. We hope that formal confirmation is received as soon as possible, to allay concerns for the future service.

NR has not provided a schedule, as promised, for **residual works** (e.g. at Old Oak Common, Cripple Siding, Maidenhead Sidings and Stations SISS).

[25] Period 2 Stage 5B dashboard.

7 Health & Safety

7.1 Health & Safety Performance

The new H&S director was appointed was appointed in the period.

There were no RIDDORs in the period, which halts a run of 4 periods of poor performance. We are keen to see if this is a one-off or the start of a sustained period of good performance. The good performance in the period followed through to the Lost Time AFR, in which there was only one incident in the period.

The High Potential Near Miss rate increased to 0.29 (4 in the period), the highest ever recorded. While it is positive that incidents are being raised, as CRL would not want a culture of under-reporting or worse still suppressing information, the trend is worrying, as each incident could have resulted in serious injury or fatality. The delay to the agreement and roll-out of the forward looking HSPI, is still ongoing and is taking too long, as each intervention can result in the removal of a potential risk.

Health and Safety key performance indicators are shown below in Figure 7 - 1.

H&S KPI	Target	Aim	Period 1	Period 2
HSPI	2.20	-	2.62	2.69
PCs scoring over 2.20	11	11	11	11
RIDDOR AFR	0.15	0.06	0.09	0.09
LTC AFR	0.23	0.15	0.15	0.16

Figure 7 - 1~ Health and Safety Performance COS

8 Areas of Concern

The purpose of this section is to highlight areas of concern that do not warrant inclusion in the Executive Summary but are issues which, if left unresolved, have the potential to become a serious concern.

The Current Reference sign-posts the location in this report at which further information can be found.

	Issue	First Raised	Current Reference
1.	Completion of Phase 2 testing by SSP contractors is in delay and continues to be subject to optimistic forecasting.	PSR 117	PSR 125 Section 4.1.2
2.	Productivity is still well below desired levels and cannot be predicted by CRL.	PSR 122	PSR 125 Section 2.1
3.	392 vacant roles to fill – will take significant time to fill these.	PSR 121	PSR 125 Section 2.2
4.	Delivery of the Station Information and Security System for Stage 4 lacks a plan.	PSR 115	PSR 125 Section 5.2
5.	Liverpool Street High Level Platform Extensions completion.	PSR 116	-
6.	Development of a Service Level Agreement with NR for the provision GSM-R functionality and service to support CRL dynamic testing.	PSR 122	PSR 125 Section 4.2
7.	Future RAB(C) workload.	PSR 121	PSR 125 Section 4.4.1
8.	Schedule and cost impact of implementing CEG “Routeway Systems and Related Installations” tests.	PSR 121	PSR125 Section 4.3.1
9.	Train mileage accumulation and reliability growth.	PSR 119	PSR125 Section 4.6
10.	Completion of NR modifications to PML Feeder Station.	PSR 120	PSR 124 Section 4.2
11.	Process of IRN sign-off and use of IRN delivery as a KPI.	PSR 118	-
12.	Introduction by CEG of changes to fire management systems at Stations.	PSR 122	PSR 125 Section 4.1.4
13.	Exemption by ORR for Enhanced TPWS delayed until October 2019.	PSR 115	-
14.	Prioritisation to implement a forward-looking HSPI.	PSR123	PSR 125 Section 7.1
15.	Adoption of DCS development methodologies for Programme Delivery and Completion.	PSR 125	PSR 125 Section 1.1

Note: Not in order of priority.

Figure 8 - 1 ~ Areas of Concern

Appendices

Appendix A SSP IRN/PCC/PAC Performance & Target Dates

Installation, Testing and Commissioning - Stations

The Figures below summarise the current (Period 2) status of MEP installation (IRNs), testing and commissioning (PCCs/PACs), for each of the stations.

IRNs	% of IRNs Achieved		
Phase 2.1 Testing	Period 13	Period 1	Period 2
PAD	72	74	83
BOS	5	5	5
TCR	85	89	92
FAR	74	70	70
LIS	82	86	89
WHI	57	61	61
CWS	82	97	98
CUS	100	100	100
WOO	75	76	86

Total IRNs	4309
Achieved	3126
%	73%

PCCs	% of PCCs Achieved		
Phase 2.2 Testing	Period 13	Period 1	Period 2
PAD	26	28	44
BOS	1	1	4
TCR	18	27	43
FAR	28	46	80
LIS	61	51	54
WHI	0	0	0
CWS	89	92	93
CUS	99	100	100
WOO	55	64	77

Total PCCs	1739
Achieved	770
%	44%

PACs	% of PACs Achieved		
Phase 2.3 Testing	Period 13	Period 1	Period 2
PAD	0	0	0
BOS	0	30	0
TCR	0	0	10
FAR	3	3	3
LIS	2	10	16
WHI	6	6	6
CWS	66	75	79
CUS	50	67	74
WOO	17	16	20

Total PACs	663
Achieved	129
%	19%

Notes:

- The information contained in the tables has been abstracted from CRL's Period Handover Dashboards and the Period Vis-Board reviews. Please note that the count of PCCs and PACs includes both Tier 1 and C660 sign-offs.
- The forecast delay for completion of the station's IRNs, based on their current rate of delivery, is 9 Periods.
- The forecast delay for completion of the PCCs/PACs is 12 Periods.

Installation, Testing and Commissioning – Portals and Shafts

The Figures below summarise the current (Period 2) status of MEP installation (IRNs), testing and commissioning (PCCs/PACs), for each of the Portals and Shafts.

IRNs Phase 2.1 Testing		% of IRNs Achieved			
		Period 13	Period 1	Period 2	
Portals	ROP	94	93	0	
	VDP	96	97	97	Total IRNs 282
	PLU	85	86	90	Achieved 264
	NWP	87	89	100	% 94%
	PML	100	88	88	
Shafts	FSS	100	100	100	
	STG	83	85	85	Total IRNs 169
	LIM	77	97	100	Achieved 162
	MES	100	100	100	% 96%
	ESS	91	97	97	

PCCs Phase 2.2 Testing		% of PCCs Achieved			
		Period 13	Period 1	Period 2	
Portals	ROP	91	91	91	
	VDP	88	88	100	Total PCCs 282
	PLU	86	100	100	Achieved 264
	NWP	73	94	100	% 94%
	PML	100	100	100	
Shafts	FSS	100	100	100	
	STG	22	44	0	Total PCCs 43
	LIM	100	100	100	Achieved 38
	MES	100	100	100	% 88%
	ESS	100	100	100	

PACs Phase 2.3 Testing		% of PACs Achieved			
		Period 13	Period 1	Period 2	
Portals	ROP	15	20	45	
	VDP	62	69	77	Total PACs 111
	PLU	17	45	50	Achieved 109
	NWP	48	52	57	% 98%
	PML	60	83	83	
Shafts	FSS	63	63	69	
	STG	19	19	0	Total PACs 80
	LIM	56	63	0	Achieved 47
	MES	63	69	69	% 59%
	ESS	63	69	69	

Notes:
The information contained in the tables has been abstracted from CRL's Period Handover Dashboards and the Period Vis-Board reviews. Please note that the count of PCCs and PACs includes both Tier 1 and C660 sign-offs.

Forecast Staged Completion dates for Stations, Portals and Shafts

All baseline dates for Stations, Shafts and Portals are currently under review, pending completion and approval of the DCS. We will not make any further comparison to the MOHS (November 2018) [redacted] forecasts, but will resume once the DCS is released. The new baseline dates will be provided upon receipt and inserted into the new tables created below.

The following tables give forecast dates, as noted in the Period 2 Vis-Board reviews, CRL's Period 2 Handover Dashboard and the evolving DCS [redacted] The dates have been tabulated for comparison against the previous Period forecasts. Dates may also have been abstracted from the Vis-Board reviews held after Period Close. Our commentary regarding CRL forecasts is provided in Section 4.1.

Period forecasts highlighted in bold text reflect a change to the date reported in the previous Period. A red shaded cell indicates a delayed date and a green shaded cell an improved date.

SHAFTS AND PORTALS

TOSD has been achieved at CON, NWP, PML, MES, VDP, ESS, PLU, FIS, LIM and ROP. Stepney Green Shaft is the last site yet to achieve TOSD.

Contract	Location	TLA	[redacted]
C360	Stepney Green Shaft	STG	

Figure A - 1 ~ Shafts and Portals - Forecast TOSD dates

Contract	Location	TLA	[redacted]
C530	Connaught Tunnel	CON	
C336	Royal Oak Portal	ROP	
C530	North Woolwich Portal	NWP	
C360	Mile End Shaft	MEP	
C340	Victoria Dock Portal	VDP	
C350	Pudding Mill Lane Portal	PML	
C360	Fisher Street Shaft	FIS	
C360	Limmo Peninsula Shaft	LIM	
C530	Plumstead Portal	PLU	
C360	Eleanour Street Shaft	ELS	
C360	Stepney Green Shaft	STG	

Figure A - 2 ~ Shafts and Portals – Forecast Staged Completion (SC3) / Handover dates

LU STATIONS

LU Stations – TOSD achieved at FAR, WHI (CRL & LU/LO areas), TCR and LIS.

Contract	Location	TLA
C412	Bond Street WTH	BOS
C412	Bond Street ETH	BOS

[redacted]

Figure A - 3 ~ LUL Stations – Forecast TOSD dates

Contract	Location	TLA
C412	Bond Street	BOS
C422	Tottenham Court Road	TCR
C435	Farringdon	FAR
C502	Liverpool Street	LIS
C512	Whitechapel	WHI

[redacted]

Figure A - 4 ~ LUL Stations – Forecast Staged Completion (SC3) dates

RfL STATIONS

TOSD has been achieved at CUH, WOO and PAD.

Contract	Location	TLA
M072	Canary Wharf	CW

[redacted]

Figure A - 5 ~ RfL Stations – Forecast TOSD dates

Contract	Location	TLA
C405	Paddington	PAD
M072	Canary Wharf	CWS
C520	Custom House (Incl full Handover)	CUH
C530	Woolwich	WOO

[redacted]

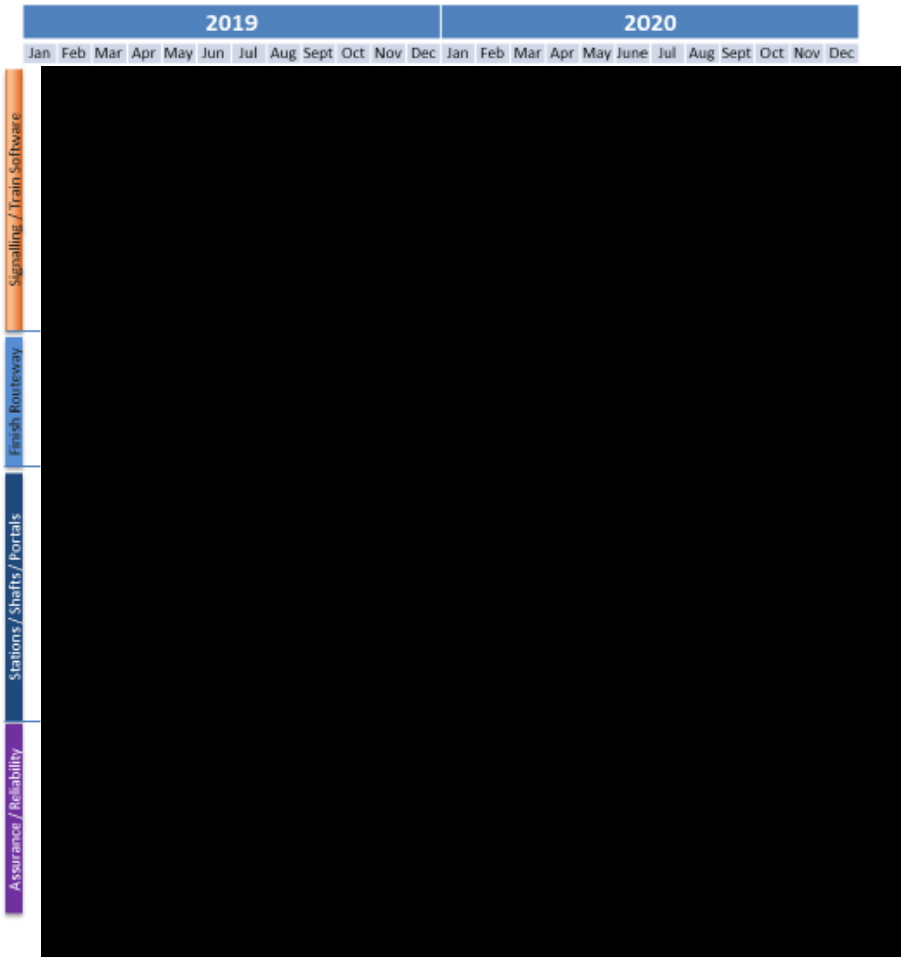
Figure A - 6 ~ RfL Stations – Forecast Staged Completion (SC3) dates

Appendix B CRL Period 1 Board Report Extract [26]

EARLIEST OPENING PROGRAMME

The Earliest Opening Programme (EOP) was approved by the Board at the end of the Period and subsequently an opening date range for Stage 3 was announced to the public of between September 2020 and March 2021. Work has now commenced on a bottom up exercise to create a more detailed schedule of work that will form the Delivery Control Schedule (DCS).

[redacted]



[redacted]

Crossrail Board Report P01 20

[26] No Period 2 update available in CRL Board Report.

Project Representative Team

Project Team

[redacted]	Project Representative, Programme Management, Safety
[redacted]	Signalling, Railway Systems, Integration, T&C
[redacted]	Compliance & Change, Operations, RSD, Assurance
[redacted]	Commercial, Cost Control, Financial
[redacted]	PM, Safety
[redacted]	Rail Systems and Rolling Stock
[redacted]	Stations
[redacted]	Cost Control
[redacted]	Cost Control
[redacted]	Risk
[redacted]	Schedule

Glossary of Terms and Contracts

Abbr.	Description	Abbr.	Description
3LoD IAF	Three Lines of Defence Integrated Assurance Framework	LDBL	Late Date Baseline
A&M	Access & Maintenance	LFB	London Fire Brigade
ABB	ASEA Brown Bovery	LFEPA	London Fire and Emergency Planning Authority
ABW	Abbey Wood	LIM	Limmo Peninsula Shaft
AC	Acceptance Certificate	LIS	Liverpool Street
ACBs	Air Circuit Breakers	LMU	London Metropolitan University
ACJV	Alstom Costain Joint Venture	LO	London Over ground
ACWP	Actual Cost of Work Performed	LoNo	Letter of No Objection
AEA	Abellio East Anglia	LoR	Line of Route
AEN	Adverse Event Notice	LTC	Lost Time Case
AFC	Anticipated Final Cost	LTIFR	Lost Time Incident Frequency Rate
AFC	Approved for Construction status	LU	London Underground
AFCDC	Anticipated Final Crossrail Direct Cost	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AHU	Air Handling Units	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AM	Anchor Milestones	MDT	Main Dynamic Testing
AMS	Agreements Management System	MDTR	Main Dynamic Testing Regime
APIS	Authorisation to Place into Service	MENTOR	Mobile Electrical Network Testing, Observation and Recording
ARS	Automatic Route Setting	MEP	Mechanical Electrical & Public Health
AsBo	Assurance Body - Ricardo Rail	MEPA	Mechanical, Electrical, Public Health, Architecture
ASLEF	Associated Society of Locomotive Engineers and Firemen	MES	Mile End Shaft
AT	Autotransformer	MFF	Multi-Functional Framework
ATC	Automatic Train Control	MIRP	Maintenance Integration Review Panel
ATF	Auto Transformer	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Technical Incident Number
ATS	Auto Transformer Station	MTR SMS	MTR Safety Management System.
ATU	Authority to Use	MTR-C	Mass Transit Railway - Crossrail
AWS	Automatic Warning System	MTT	Multi Train Testing
B&PC	Board & Programme Contingency	MV	Medium Voltage
BBMV	Balfour Beatty Morgan Vinci	MVP	Minimum Viable Product
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NEC	New Engineering Contract
BFK	Bam Ferrovial Kier	NG	National Grid
BH	Berkeley Homes	NGET	National Grid Electricity Transmission
BIU	Bringing Into Use	NKL	North Kent Line
BLL	Bakerloo Line Link	NoBo	Notified Body
BMS	Building Management Systems	NOW	North Woolwich
BOS	Bond Street Station	NR	Network Rail
BP	Business Plan	NR PDB	Network Rail Programme Delivery Board

BREEAM	Building Research Establishment Environmental Assessment Methodology	NSACS	New Sector Area Cost Summary
BSP	Bulk Power Supply Point	NWP	North Woolwich Portal
BT	Bombardier Transportation	O&M	Operations and Maintenance
BT / PC	Bombardier Transportation / Prime Contractor	OBCUs	On-Board Control Units
BTH	Blomfield Ticket Hall	OCS	Overhead Catenary Systems
BUCF	S	OLE	Overhead Line Equipment
BUF	Bottom Up Forecast	OMC Building	Operations Maintenance Centre
C&CSC	Commercial and Change Sub-committee	OME	Order of Magnitude Estimate
CAR	Corrective Action Report	ONFR	On Network Functional Requirements
CARE	Crossrail Assurance Reporting Environment	ONSIP	On Network Station Improvements Programme
CBTC	Communications Based Train Control	ONW	On Network Works
CCB	Current Control Budget	OOC	Old Oak Common
CCP	Commitments Compliance Plans	OOCPA	Old Oak Common Paddington Approaches
CCR	Consolidated Cost Report	OPEX	Operational Expenditure
CCRB	Construction and Commissioning Railway Rule Book	Ops	Operations
CCRRB	Crossrail Construction Railway Rule Book	ORAT	Operational Readiness & Transfer Group
CCSA	Contract Commercial Status Analysis	ORR	Office of Rail & Road
CCSC	Commercial & Change Sub-Committee	ORSG	Operational Readiness Steering Group
CCTV	Closed Circuit Television	OSD	Over Site Development
CD/RA	Closed Door / Right Away	OSP	Operations Safety Procedures
CDG	Competence Design Group	OTIS	OTIS escalators (company)
CDL	Central Door Locking	OTP	Overall Target Price
CDM	Construction Design & Management Regulations	P2R	Paddington to Reading
CDN	Crossrail Data Network	PA	Public Address
CDT	Commitments Delivery Tracker	PAC	Partial Acceptance Certificate
CE	Compensation Events	PAD	Paddington station
CEC	Chief Engineer's Communications	PC	Principal Contractors
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PCC	Pre-Commissioning Certificate
CEG	Central Engineering Group	PDA	Project Development Agreement
CEO	Chief Executive Officer	PDB	Programme Delivery Board
CER	Communications Equipment Room	PES	Platform Edge Screen
CFCCB	Contingency Finance Current Control Budget	PES	Permanent Earthed Sections
CFO	Chief Financial Officer	Ph3C	Phase 3 Complete
CIF	Crossrail Integration Facility	PIP	Paddington Integration Project
CIF	Common Incentive Framework	PIR	Potential Incident Report
CIM	Crossrail Investment Model	PLU	Plumstead
CIS	Customer Information System	PM	Project Manager
CMR	Crossrail Managed Risk	PMI	Project Manager Instruction
CMS	Central Management System	PML	Pudding Mill Lane
CoL	City of London	PMO	Project Management Office NR
CON	Connaught	PNY	Paddington New Yard
COS	Central Operating Section	PPE	Personal Protective Equipment
COWD	Cost of Work Done	PPF	Property Partnership Framework
CPFR	Crossrail Programme Functional Requirements	PPM	Passenger Performance Measurement
CPI	Cost Performance Index	PRep	Project Representative
CPO	Compulsory Purchase Order	PRISM	Cost Management Software
CRAF	Completion Readiness Assessment Framework	PRM	Persons of Reduced Mobility
CRL	Crossrail Limited	PSD	Platform Screen Door
CRV	Crossrail Requirements Variation	PSG	Performance Steering Group
CSCS	Construction Skills Certification Scheme	PSR	Project Status Report
CSDE	Correct Side Door Enabling	PTYSC	Property Sub-Committee
CSJV	Costain Skanska Joint Venture	PWay	Permanent Way
CSM	Construction Safety Management	PWHR	Project Wide Hazard Records

CSM-RA	Common Safety Method – Risk Assessment	QBR	Quarterly Baseline Review
CT	Computerized Tomography	QCRA	Quantified Cost Risk Assessment
CTG	Cost to Go	QRA	Quantified Risk Assessment
CTOC	Crossrail Train Operating Concession	QSRA	Quantified Schedule Risk Assessment
CUH / CHS	Custom House Station	RAB	Regulatory Asset Base
CW	Canary Wharf	RAB (C)	RfL Assurance Board for Crossrail
CWG	Canary Wharf Group	RAG	Red, Amber, Green Matrix
CWS	Canary Wharf Station	RAM	Route Asset Manage.
D&A	Drugs and Alcohol	RAP	Remedial Action Plan
DA	Development Agreement	RBC	Remote Block Computer
DCS	Delivery Control Schedule	RCA	Risk Control Actions
DeBo	Designated body	RCC	Route Control Centre
DESJs	Design Engineering Safety Justifications	RfL	Rail for London
DfT	Department for Transport	RfL-I	Rail for London - Infrastructure
DLO	Direct Labour Organisation	RFT	Right First Time
DLR	Docklands Light Railway	RIA	Railway Integration Authority
DMI	Driver Machine Interface	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DOO	Driver Only Operation	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DPS	Depot Protection System	RIRP	Railway Integration Review Point
DT	Dynamic Testing	RLU	Restricted Length Unit
DTSRP	Dynamic Testing Safety Review Panel	ROC	Rigid Overhead Conductor
Dwall	Diaphragm wall	ROC	Regional Operational Centre
DWWP	Delivery of Works Within Possession	ROGS	The Railways and Other Guided Transport Systems (Safety) Regulations 2006
E&B	Earthing & Bonding	ROP	Royal Oak Portal
EA	Environment Agency	RP4.2	Review Point 4.2
EAC	Estimate at Completion	RR	Ricardo Rail
EB	Eastbound	RRV	Road / Rail Vehicles
ECHR	Element Completion Handover Report	RS	Rolling Stock
ECI	Early Contractor Involvement	RSC	Return Screen Conductor
ECP	Employers Completion Process	RSD	Rolling Stock & Depot
ECS	Empty Coach Stock	RSSB	Rail Safety & Standards Board
EDBL	Early Date Baseline	RTU	Remote Telemetry Unit
EDORs	ETCS Data Only Radio	S&C	Switches & Crossings
EDT	Early Dynamic Testing	SA	Supplementary Agreement
EED	Emergency Exit Door	SACR	Semi Annual Construction Report
EFC	Estimated Final Cost	SAP	System Applications Products
EFC	Economic and Financial Committee	SAR	Safety Assessment Report
EiS	Entry into Service	SAT	Site Acceptance Test
ELCBT	Elizabeth Line Countdown Board Tracker	SC	Staged Completion
ELRSG	Elizabeth Line Readiness Steering Group	SCADA	Supervisory Control and Data Acquisition
ELSSG	Elizabeth Line Strategic Steering Group	SCL	Sprayed Concrete Lining
EMC	Electromagnetic Compatibility	SCN	Sponsor Change Notice
EMU	Electrical Multiple Unit	SDG	Signalling Design Group
EOP	Earliest Opening Programme	SDO	Selective Door Operation
EOWL	Element Outstanding Work List	SDS	Scheme Design Specification
ERTMS	European Rail Traffic Management Systems	SEJ	Safety Engineering Justification
ESJ	Engineering Safety Justification	SER	Signalling Equipment Room
ESM	Engineering Safety Management	SES	South East Service
ESS	Eleanor Street Shaft	SESR	South East Signalling Room
ETCS	European Train Control System	SFA	Sponsor Funding Account
ETH	Eastern Ticket Hall	SHELT	Safety and Health Leadership Team
EVM	Earned Value Management	SIM	Simulation Room

ExCom	Executive Committee	SIRP	Systems Integration Review Panel
FAR	Farringdon	SISS	Station Information and Security System
FCCB	Finance Current Control Budget	SJR	Safety Justification Report
FDC	Framework Design Consultant	SLD	Single Line Diagrams
FDO	Final Design Overview	SMS	Safety Management System
FDS	Final Design Statements	SMTA	Smithfield Market Traders Association
FFOC	Forecast Final Outturn Cost	SOC	Statement of Compatibility
FGW	First Great Western	SONIA	Sterling Overnight Index Average
FHO	Full Handover	SOR	Stations Operation Room
FIS	Fisher Street Shaft	SORBA	Shaping Architecture Company (sub cladding contractor)
FLU	Full Length Unit	SPI	Schedule Performance Index
FoI	Freedom of Information	SPS	Secondary Part Steel
FRAG	Fraud Risk Assurance Group	SPZ	Signal Protection Zone
FTS	Floating Track Slab	SR	Sponsors Requirement
GAF	Greater Anglia Franchisee	SRP	Safety Review Panel
GE	Great Eastern	SSE	Scottish & Southern Electricity
GEBR	Guaranteed Emergency Brake Rate	SSP	Stations, Shafts, Portals
GEFF	Great Eastern Furrer & Frey	STG	Stepney Green Shaft
GEML	Great Eastern Main Line	STS	Standard Track Slab
GFRC	Glassfibre Reinforced Concrete	SVP	Safety Verification Panel
GLA	Greater London Authority	T&C	Testing & Commissioning
GPE	Great Portland Estates	TAG	Technical Assurance Group
GRC	Glass Reinforced Concrete	TAP	Technical Assurance Plan
GRC	Governance, Risk management and Compliance	TBM	Tunnel Boring Machine
GRIP	Governance for Railway Investment Projects	TC&HSG	Testing, Commissioning and Handover Steering Group
GSM-R	Global System for Mobile Communication - Railway	TCCRP	Testing Commissioning Configuration Review Panel
GW	Great Western	TCMS	Train Control Management System
GWML	Great Western Main Line	TCR	Tottenham Court Road
GWR	Great Western Railway	TCRW	Tottenham Court Road West
H&S	Health & Safety	TDR	Technical Director's Report
HAL	Heathrow Airport Limited	TDY	Tunnel Drive Y
HALARP	Heathrow Airport Limited Assurance Review Panel	TfL	Transport for London
HAS	High Attenuation Sleeper	TLPPs	Tunnel Lighting Power Panels
HAVS	Hand Arm Vibration Syndrome	TO	Taken Over
HEP	Handover Execution Plans	TO	Trial Operations
HEX	Heathrow Express	TOC	Train Operating Company
HIA	Heathrow Implementation Agreement	TOSD	Tier One Substantial Demobilisation
HM	Her Majesty	TPA	Tunnel Planning Authority
HMDL	Handover Master Deliverable List	TPD	Tunnel Pumped Drainage
HO	Handover	TPH	Trains Per Hour
HPNM	High Potential Near Misses	TPS	Train Protection System
HRW	Heathrow Airport	TPWS	Train Protection & Warning System
HSPI	Health & Safety Performance Indicator	TR	Trial Running
HTR	Heathrow	TRAIL	Transport Reliability Availability Integrated Logistics
HV	High Voltage	TRH	Temporary Rehousing
HVAC	Heating Ventilation & Air Conditioning	TSI	Technical Standard for Interoperability
I/O	Input / Output	TTO	Temporary Ticket Office
IA	Interim Acceptance	TTVS / TVS	Temporary Tunnel Ventilation System
ICD	Interface Control Document	TUCA	Tunnelling & Underground Construction Academy
IDT	Interim Dynamic Testing	TWAO	Transport & Works Act Order
IECC	Integrated Electronic Control Centre	TXM	TXM Plant
IEP	Intercity Express Programme	U&A	Undertakings & Assurances
IFC	Issued For Construction	UKPN	UK Power Networks
IFD	Ilford Yard	UR	Urban Realm

IM	Infrastructure Manager	URT	Unresolved Trends
IOSH	Institution of Occupational Safety and Health	UTX	Under Track Crossings
IP	Intervention Point (0, 1, & 2)	VAP	Verification Assurance Procedure
IR35	Inland Revenue Taxation Regulation 35	VDP	Victoria Dock Portal
IRM	Incident Response Management	VERP	Value Engineering Review Panel
IRN	Installation Release Note	VFL	Volker Fitz Patrick
IRSG	International Regulatory Strategy Group	VN	Variation Notice
ISA	Independent Safety Assessment	VT	Voltage Transformer
ISJ	Interim Safety Justification	W&W	Wales & West
ISV	Intermediate Statements of Verification	WAD	Works Authorisation Document
ISV	Intermediate Statements of Verification	WBP	Westbourne Park
ITP	Inspection & Test Plan	WBS	Work Breakdown Structure
ITT	Invitation to Tender	WC	World Class
JST	Joint Sponsor Team	WCC	Westminster City Council
KBR	Knorr-Bremse Rail	WCCC	Whole Contract Construction Certificate
KD	Key Deliverable	WHI	Whitechapel
KE	Kinematic Envelope	WiFi	Wireless Fidelity
KG	Kensal Green	WITI	Western Inner Track Infrastructure
KO	Key Output	WOE	Western Outer Electrification
KPI	Key Performance Indicator	WOO	Woolwich Station
KPMG	Klynveld Peat Marwick Goerdeler	WOTI	Western Outer Track Infrastructure
L&P	Land and Property	WTH	Western Ticket Hall
LB	London Borough	YC	Yard Control
LBTH	London Borough of Tower Hamlets		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & DWall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & DWall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Pilling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU