

Date: 8 July 2016

Item: Central Line Improvement Programme

This paper will be considered in public

1 Summary

CENTRAL LINE IMPROVEMENT PROGRAMME				
Existing Financial Authority	EFC	Existing Project Authority	Additional Authority Requested	Total Programme Authority
£ 334.4m	£ 360.7m	£ 3.53m	£ 29.17m	£ 32.7m

Authority Approval: To approve budgeted Project Authority of £29.17m (outturn including risk) for the definition stage of the Central Line Improvement Programme, including programme and engineering management, the design of CCTV, LED lighting, a Passenger Information System (PIS) and works to comply with the Rail Vehicle Accessibility Regulations (RVAR) and the design, manufacture and supply of a replacement Data Transmission System (DTS) for the Central line fleet. The definition stage will be completed by 31 July 2017.

Outputs and Schedule: The objective of the Central Line Improvement Programme is, by 2022, to improve fleet performance and reduce operating costs. Beyond 2022, the objective is to build on the improved availability and reliability of the fleet to increase capacity on the line. The following outputs will be funded from the requested Project Authority:

- (a) design and prototyping of rolling stock modifications and repairs;
- (b) design, manufacture and supply of a replacement DTS for the Central line fleet;
- (c) development of line capacity optimisation works to enable up to five trains to be released concurrently for the delivery of these works; and
- (d) programme management and production planning:
 - (i) estimate and schedule for the programme's delivery stage; and
 - (ii) completion of all appropriate Pathway products for Stage Gate B.

Project and Procurement Authority will be sought for the design, manufacture, supply and installation of a replacement traction system for the Central line fleet on 15 December 2016. A third and final submission will be made to the Board in 2017 requesting the remaining budgeted Project Authority.

- 1.1 A paper is included on Part 2 of the agenda, which contains exempt supplementary information. The information is exempt by virtue of paragraph 3 of Schedule 12A of the Local Government Act 1972 in that it contains information relating to the business affairs of TfL.

2 Recommendation

- 2.1 **The Committee is asked to recommend that the Board:**

- (a) notes the contents of the paper; and**
- (b) approves Project Authority of £29.17m (outturn including risk) for the definition stage of the Central Line Improvement Programme and the design, manufacture and supply of a replacement DTS for the Central line fleet.**

3 Background

- 3.1 The 1992 Tube Stock (92TS) rolling stock used on the Central line entered service between 1993 and 1995 and are halfway through their 40 year nominal design life. Problems experienced with the fleet have their origins either in poor design, poor manufacture or obsolescence.
- 3.2 Whilst it is a comparatively modern train, it contains technology that was innovative at the time but which is now superseded and is difficult to maintain. The traction package was the last London Underground (LU) stock to use direct current motors and the first to use electronic rather than electromechanical control systems. Almost £8m per year is spent repairing and overhauling the traction motors and mitigating the frequency of motor 'flashovers'.
- 3.3 The Central line incurs a greater number of lost customer hours (LCH) than any other line due, in large part, to the poor reliability and availability of the 92TS trains. Capital investment is required to: improve reliability and availability of the fleet; address equipment obsolescence concerns; restore the structural integrity of the car bodies; and substantially reduce maintenance costs.
- 3.4 The Central line consistently scores lower than any other line in customer satisfaction surveys. Areas of concern include high saloon temperatures in the summer months, comfort levels, crowding, journey times and the lack of information displayed in the trains. Capital investment is required to improve these identified areas of customer dissatisfaction.
- 3.5 Modifications to the Central and Waterloo & City (W&C) lines are required to achieve a level of compliance with the RVAR 2010 legislation that would be acceptable to the Department for Transport.
- 3.6 The Central Line Improvement Programme (CLIP) aims to ensure that the 92TS trains operated on the Central and W&C lines remain safe and fit for purpose until they are replaced through the New Tube for London (NTfL) programme. On current plans, the W&C line will be upgraded in 2026 and the Central line fleet will remain in service until 2033.

- 3.7 This proposal contributes to Mayoral strategy by improving public transport reliability and customer satisfaction, reducing operating costs, and improving the accessibility of the transport system.
- 3.8 A series of projects has been initiated through the Legacy Train System Programme Board with a combined project authority of £3.53m. These projects have been brought together, with two other existing approved Central line fleet projects (traction card and gearbox bearing replacement), as a programme to maximise efficiencies during implementation, improve asset availability and to integrate the governance arrangements.
- 3.9 An Integrated Assurance Review of the options identification stage of CLIP has been completed and separate assurance reviews of the DTS and AC traction projects will be undertaken prior to the award of each contract. An assurance review of the programme's definition stage will be undertaken in 2017 to support the full authority submission. Thereafter, assurance reviews will be performed annually.
- 3.10 Business planning decisions, to be taken later this year, may reduce the proposed scope of CLIP. However, a substantial package of business critical works, including essential modifications to achieve legislative compliance, must be delivered. The outcome of the business planning process will be known before Project and Procurement Authority is requested for the replacement of the traction system.

4 Proposal

Preferred option

- 4.1 The proposed scope of works is to:
- (a) replace the unreliable and maintenance-intensive direct current (DC) traction system with a modern alternating current (AC) traction system;
 - (b) replace the unreliable and obsolete DTS;
 - (c) repair saloon floor corrosion damage and resolve door pillar cracking and water ingress concerns;
 - (d) achieve an acceptable level of RVAR compliance;
 - (e) install saloon CCTV and energy efficient LED lighting;
 - (f) capacity optimisation work to reinstate 100kph running on open sections of the Central line to improve line capacity and enable trains to be released for the delivery of the rolling stock works;
 - (g) introduce a shuttle service between Woodford and Hainault to mitigate the effect of reduced fleet availability and avoid the need for timetable reductions during the delivery of CLIP; and
 - (h) identify other opportunities to increase line capacity.
- 4.2 This paper is seeking authority for the definition stage of CLIP and the design, manufacture and supply of a replacement DTS for the Central line fleet. A further submission, requesting Project and Procurement Authority for the design,

manufacture, supply and installation of a replacement AC traction system, will be made in December 2016, once the tender evaluation process has been completed.

- 4.3 The definition stage of CLIP comprises the design and prototyping of the required rolling stock modifications and repairs and the development of mitigation measures to protect fleet availability during the programme's delivery stage. A primary output of this work will be a detailed estimate and schedule for undertaking the rolling stock works.
- 4.4 The estimates for the projects that comprise CLIP will be refined as they move through feasibility and design, as tenders are received from suppliers and through the application of lean production methods to the delivery phase. As necessary, scope management and prioritisation of the work will ensure that the EFC remains within the Financial Authority. The finalised scope and estimate of costs will be detailed within the request for the remaining budgeted Project Authority.

Benefits (and value)

- 4.5 The quantified analysis for CLIP shows that there is a financially positive business case for the preferred option which delivers the full proposed scope at the Financial Authority level of £334.4m (outturn including risk). Upon completion of the programme, fleet maintenance and operating costs would be reduced by £8.7m per year (current prices) and the monetised benefits from the programme would lead to increased revenue of £16m per year. Over the 17 year appraisal period to 2032/33, this option produces a total financial saving of £11m (present value) compared with doing nothing.
- 4.6 Doing nothing is not a viable option if the 92TS fleet is to continue in safe and reliable operation until its replacement. As a minimum it will be necessary to achieve an acceptable level of RVAR compliance, mitigate rolling stock electronics obsolescence risks and restore the structural integrity of the saloon car-bodies. It is estimated that the capital cost of this work would be £155.3m (outturn including risk) with a benefit to cost ratio of 1.9:1.
- 4.7 The preferred option incurs an additional investment of £131m (present value) above the cost of the minimum scope to realise net incremental monetised benefits valued at £465m and a net financial saving of £86m by 2033.
- 4.8 A significant proportion of the externally procured CLIP equipment, in particular the AC traction system, could be subject to a Government rebate through the Enhanced Capital Allowance scheme whereby up to 19 per cent of supply costs are recoverable. This potential income stream is not included in the CLIP estimate but is shown as a recoverable cost in the economic analysis table below.

4.9 A summary of the economic appraisal and benefits of the preferred option is tabulated below:

Economic Appraisal	Preferred option	Do minimum
Estimated Final Cost, £k (at outturn prices, including risk)	(334,348)	(155,326)
Net Present Values ,£k		
Discounted NPV EFC (including risk)	(250,739)	(119,773)
Other CAPEX	0	0
Other costs	0	0
OPEX (+ or -)	86,967	7,455
Third Party	0	0
Revenue	154,865	36,936
Other Income (recoverable costs)	19,885	0
Net Financial Effect	10,978	(75,382)
Payback Period	2032	N/A
Customer Benefits	611,131	181,575
Impacts during Implementation	0	(35,068)
Total Benefit		
Benefit : Cost Ratio	Financially Positive	1.9:1

4.10 The main benefits that the preferred option would deliver by 2022 are summarised in the table below:

Title	Description	Expected benefits (current prices) and measure
Reliability	Replacement of the unreliable DC traction system and DTS and the repair of floor corrosion and car body-ends will improve train reliability and availability.	An annual reduction of 836 service affecting failures attributed in the CuPID database to 'Central line Fleet', saving 631k LCH with a social benefit of £5.4m per year.
Fleet maintenance costs	Improved reliability will reduce casualty maintenance costs. DC traction motor flashover mitigation costs will be avoided.	An annual reduction of £8m in fleet maintenance costs (£6m material and £2m labour).
Energy consumption	The upgraded assets, eg AC traction motors and LED lighting, will be more energy efficient than the legacy equipment and the Central line's regenerative braking voltage cap will be increased, reducing energy consumption.	A net annual reduction in modelled energy consumption of 11GWh, valued at £0.7m, and an annual reduction in CO ₂ emissions of 5,000 tonnes, with a social value of £23k.

Title	Description	Expected benefits (current prices) and measure
Journey quality	<p>Reduced energy consumption will reduce peak tunnel temperatures.</p> <p>The internal condition of the trains will be improved, eg new floor coverings, and a passenger information system, saloon CCTV and multi-purpose areas will be introduced.</p>	<p>A 1°C reduction in modelled peak tunnel temperature delivering annual ambience benefits with a social value of £2m and safety benefits valued at £0.4m.</p> <p>An improvement in customer satisfaction survey scores equating to social benefits of 11.8 pence per customer (£32m per year).</p>
Journey time	<p>The AC traction upgrade will improve the acceleration profile of heavily laden trains and 100kph running will be reinstated in open sections of the line.</p>	<p>Interstation runtime improvements with an annual social benefit of £7.6m.</p>

Delivery of preferred option

- 4.11 Analysis has determined that the CLIP rolling stock works, including the AC traction and DTS upgrades, should be combined into a single installation package. This achieves the best balance between early benefits realisation and protecting train availability. The indicative schedule has installation taking place between mid 2018 and early 2022, with each train in work for 40 days and a maximum of five trains in work at any given time.
- 4.12 A range of delivery options has been analysed and benchmarking indicates that there would be a relatively small difference in cost (+/- 10 per cent) between internal and external delivery. However, a Quantified Risk Assessment has concluded that the risk profile for external delivery would be, at P80 confidence, 32 per cent higher than for internal delivery. This difference results from the estimated costs that LU would incur if the delivery of trains was delayed, if LU could not meet its obligations for the supply of materials and if contract variations were required. It is therefore intended that these works will be delivered internally by the Trains Modification Unit (TMU).
- 4.13 In addition to the DTS contract, the resources required for the definition stage of CLIP are summarised below:
- (a) A programme management team of 39 full-time equivalent staff has been formed from permanent staff employed in the Capital Programmes Directorate and up to three additional engineers will be recruited from the graduate training scheme. One or more contracts will be awarded to external suppliers for the design of the required train modifications and repairs. The designs will be tested on a prototype.

- (b) TMU will employ dedicated programme management resources, including finance, procurement and engineering, during the definition stage. By the end of this stage, the team will have built up to 10 staff. Funding is required for the backfill of some elements of internal TfL resource allocated to this team, the recruitment of external resource where internal resource is unavailable and for long lead-time enabling works.

4.14 Key milestones.

Milestone	Target Date
AC traction contract award	31 January 2017
92TS fleet works commence	1 July 2018
92TS fleet works complete	28 February 2022
Optimised Central line timetable implemented	1 December 2022

4.15 The top five risks are set out in the table below.

Risk No	Risk Description	Mitigation Actions
1	LU liable for interface issues that are identified between DTS and the AC traction system, passenger information system and CCTV.	Start replacement DTS design early. Equipment suppliers to agree interface control documents. Regular design reviews with equipment suppliers, rig testing and prototype testing.
2	New-build facilities at Acton Works not ready for planned start of rolling stock works.	Identify alternate facilities in which to deliver the ramp-up phase of CLIP to December 2018.
3	Train condition (wiring, structure and re-used equipment) worse than predicted.	Carry out train condition surveys. Conduct prototype testing of repair and modification schemes.
4	TMU unable to recruit, train and retain sufficient maintenance staff to deliver CLIP at the planned rate.	Manage the migration of staff from the 92TS heavy overhaul & programme lift and door overhaul projects. Planned recruitment and training campaign aligned to CLIP ramp-up schedule.
5	Movement of trains between Ruislip Depot and Acton Works delayed due to access constraints.	Bring forward the NTfL signal immunisation of the Piccadilly track between Hanger Lane junction and South Harrow and complete 92TS electromagnetic compatibility testing. Develop contingency plan for road movement of rolling stock.

- 4.16 A 15 per cent risk value of £49m has been included in the EFC of which £3.79m is included in this authority request. A bottom-up Quantified Cost Risk Analysis will be carried out during the definition stage to refine the risk estimate for the programme. A Quantified Schedule Risk Analysis of the suppliers' project plans for the design and manufacture of the AC traction system and replacement DTS will be completed prior to the award of the contracts.
- 4.17 A key area of uncertainty is the planned replacement date of the Central line fleet. If the do minimum option was selected and the fleet replacement date was deferred, additional investment would be required in the late 2020s to extend the asset life. In contrast, the preferred option would address the key reliability concerns now and maximise the benefit returned from the investment.

5 Financial implications

- 5.1 CLIP will be delivered within the existing Financial Authority of £334.4m. The EFC will be updated through the definition stage as feasibility studies are completed, tender prices are received from suppliers and the delivery plan is refined. Value for money will be demonstrated through competitive tendering.
- 5.2 Previous 'make-or-buy' analyses and benchmarking studies have demonstrated that TMU is a cost competitive option for the delivery of rolling stock works. TMU works are undertaken on a time and materials cost basis, reducing the commercial risk associated with contract scope variation. The benchmarking analysis will be updated in the definition phase to validate the assumption that internal delivery would achieve value for money.
- 5.3 A summary of the costs and funding is presented below.

Costs and Funding	Prior Yrs, £k	2016/17	2017/18	2018/19	2019/20	Future	Total
Cost (Outturn)							
Programme Management	852	1,309	2,600	2,600	2,600	5,200	15,161
Feasibility and Design	1,581	3,564	20,308	8,000	0	0	33,453
Implementation	0	0	11,773	21,388	73,055	129,981	236,197
Other costs	0	0	0	0	0	0	0
Risk	260	306	6,120	5,645	13,351	23,856	49,537
Estimated Final Cost	2,693	5,179	40,801	37,633	89,006	159,036	334,348
Investment Funding							
Budget/Plan	2,693	5,790	40,190	37,633	89,006	159,036	334,348
Third Party Funding	0	0	0	0	0	0	0
Plan Surplus/(Shortfall)	0	611	(611)	0	0	0	0
Current Authority	2,693	833	0	0	0	0	3,526
This Authority Request	0	4,346	7,529	4,186	4,273	8,835	29,169
Future Requests	0	0	33,272	33,447	84,733	150,201	301,653

- 5.4 The original budget for the Central line projects totalled £338.2m. Capital Programmes Directorate has so far identified management efficiencies totalling £3.8m from bringing these projects together as a programme. These savings have been removed from the SAP forecast, reducing the budget to £334.4m.
- 5.5 Further efficiencies will be identified and realised through the definition stage and opportunities will be sought to integrate planned LU Operations engineering activities with CLIP to achieve savings on implementation costs. The total forecast savings will be updated in future submissions.

Commercial

- 5.6 Procurement strategies have been approved for the competitive tendering of contracts for the design, development, test, manufacture and supply of the replacement traction system and DTS. Bespoke Manufacture and Supply Agreements have been developed. These contracts will ensure that LU has access to the technical information needed to maintain and reconfigure the systems for the remaining life of the fleet. Tender responses have been received and are currently being evaluated.
- 5.7 Milestone payments for the design, development and test stages of each contract will be aligned with the approval of design reviews and completion of prototype testing. Subsequent milestone payments, coupled with liquidated damage provisions, will incentivise the suppliers to meet the agreed equipment delivery schedules and the reliability performance targets. Post-delivery, long-term Support Services Agreements will be entered into with the equipment suppliers.
- 5.8 Procurement strategies are in preparation for the competitive tendering of contracts for the supply of other materials, including saloon CCTV equipment, the PIS and LED lighting.

6 Assurance

- 6.1 A TfL Project Assurance (PA) and Independent Investment Programme Advisory Group (IIPAG) Assurance Review took place on 22 April 2016. No critical issues were identified and the recommendations made are being addressed by the programme team.

List of appendices to this paper:

None

List of background papers:

IIPAG and PA Reports
Management response to IIPAG and PA Reports

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