Finance and Policy Committee

Date: **8 July 2016**

Item: **Bakerloo Line Fleet Weld Repairs**

1 Summary

PVEC3088	Bakerloo Line Fleet Weld Repairs			
Existing Financial Authority	Estimated Final Cost (EFC)	Existing Project Authority	Additional Authority Requested	Total Authority
£70.26m	£60.01m	£20.77m	£39.24m	£60.01m

Authority Approval: The Committee is asked to approve additional budgeted Project Authority of £39.24m increasing the current authority of £20.77m to £60.01m.

Outputs and Schedule: The purpose of the project is to address the deteriorating condition of the Bakerloo line train carbody. The project comprises structural weld repairs and minor modifications to 36 trains, including all associated enabling works. This project will ensure that the fleet can continue to operate safely until its eventual replacement in 2028.

2 Recommendation

2.1 The Committee is asked to approve an increase in Project Authority of £39.24m (including £3.60m of risk), increasing the total Project Authority to £60.01m, to complete the remaining 29 trains of the Bakerloo line fleet weld repairs project.

3 Background

3.1 The Bakerloo line fleet comprises 36 trains of 1972 Tube Stock (72TS) and had a nominal design life of 40 years. The fleet is now 44 years old and suffers from age related failures impairing its structural integrity.

3.2 London Underground (LU) published a condition study in June 2013 that identified that substantial repairs were needed to ensure that the trains meet relevant safety standards regarding performance in a collision or derailment.

3.3 The conclusion of the study is that structural repairs are necessary to allow the fleet to remain in service until its scheduled complete replacement by New Tube for London in 2028.

3.4 Due to the variable condition of individual trains, a staged investment approach was advocated. Initial authority to repair three trains was granted in March 2014. The objective of this was to understand the train condition through intrusive investigation, develop suitable repair methods and to design a

methodology to deliver necessary works in the most efficient and effective manner.

3.5 During the repair of the first train, it became apparent that the condition of the carbody and underframe was considerably worse than anticipated. To allow more time the Project Authority was revised in June 2015 and included updated costs for the first seven trains. Four trains have now been repaired and there is greater confidence in the costs for the remaining trains, including project management and engineering.

3.6 LU has reviewed and finalised the repair processes based upon experience and lessons from the first four trains. LU has also engaged in a procurement exercise to bulk buy the remaining materials and complete the refurbishment of the facility at Acton Works. This will ensure that repairs are lean and efficient, undertaken in a dedicated facility applying a production line approach. As a consequence of these efficiencies the EFC has fallen by 13 per cent compared with the previous estimate.

4 Proposal

Preferred Option

4.1 The preferred option is to continue with the programme of weld repairs and complete all 36 trains. The scope of the project is summarised below.

Scope	Description
Swan necks	Repair of cracks in structural elements located at either end of a car (Appendix 1 Photographs 1 and 2)
Door pillars	Repair of cracks in structural elements around passenger door ways (Appendix 1 Photographs 7, 8 and 9)
Floor corrosion	Corrosion of floor plates (Appendix 1 Photograph 12) This includes replacement of the floor.
Corner posts	Repair of cracks and corrosion at the corners of the car
Roof, side and vent panel rivets	Replacement of corroded rivets and damaged roof and vent panels.
Asbestos removal	Removal of asbestos containing materials adjacent to other scope items
Solebar corrosion	Repair of corrosion of the floor support structure
Side panel stiffener	Repair of twisted and fractured structural reinforcements
Interior panel corrosion	Repair of corroded interior panels
Underframe bolsters	Repair of cracks within the bogie bolsters that link the bogie to the car
Tread plates	Repair of corrosion under tread plates within passenger doorways.

4.2 The project is delivering a single train at a time. However a holistic review of the delivery methodology, benefits and disbenefits has identified a better, more cost effective approach.

4.3 The recommended option is to repair two trains simultaneously. This will permit the programme to be completed nearly two years earlier, reducing the overall cost of the project by £8.65m.

4.4 This will require some additional enabling works to the facility in Acton Works to improve power supplies, air supplies and air extraction as well as improving welfare facilities to support the increase in labour.

Benefits

4.5 The key benefits from undertaking the project are:

Benefit	Description	Measure
Restore carbody structural integrity and condition	Restore the fleet condition and stop further deterioration to ensure the train fleet continues to remain in safe and reliable operation until replacement	Scope items complete and the fleet repaired to a satisfactory condition
Reduction in mitigation activities	Eliminate a number of Cases for Continued Safe Operation, demonstrating a net improvement in asset condition and safety, which is aligned to our asset strategy	Removal of asset risks associated with the project scope
Compliance	Fitment of Rail Vehicle Accessibility Regulations (RVAR) compliant floor covering design ahead of the 2020 mandatory date	New floor covering complete
Avoid unplanned repairs	Reduce Bakerloo line Lost Customer Hours (LCH) exposure, owing to service availability impact, by undertaking the repairs in a planned and controlled manner	No more than two trains out for repairs for project duration (excluding early emergency repairs)
New asset	Create new road ramp asset that will benefit future projects and initiatives such as New Tube for London, track maintenance and renewals	Asset in place and signed off ready for use
Bring back asset into use	Re-develop the Acton Works facility for this project to carry out repairs. The facility is set up to support future works and maintenance activities	Building used to carry out the repairs

4.6 The decision to work upon two trains simultaneously will require a change to the Bakerloo Line timetable. This is a new disbenefit not anticipated in the previous submission.

4.7 In collaboration with Transport Planning, LU has sought to reduce the impact on customers. From 8:00am the service will be reduced from 22 trains per hour to 21 trains per hour. The consequence is that for some passengers the platform waiting time will increase from typical 2 minutes 30 seconds to typically 3 minutes.

4.8 The timetable cannot be amended until May 2017 to coincide with Network Rail. A single planned cancellation (the last train to enter service) will take place from November 2016 to May 2017; the impact upon passengers is the same as the timetable change.

4.9 The impact of service reduction is £1.88m in social benefit (LCH) and £0.53m in lost revenue over the remaining three years of the project.

4.10 The economic appraisal and benefits for the preferred option against the base option of continuing the project at one train at a time is shown below. The best option is to complete the project, working on two trains simultaneously.

Present Value Analysis of Options & Incremental Effect[1] *(Cost)/ Revenue/ Benefits*	**Project Costs[3]** £000's	**Recover-able Costs** £000's	**Capital Costs** £000's	**Operating Costs** £000's	**Revenue** £000's	**Financial Effect** £000's	**Monetised Benefits** £000's	**Benefit/ Cost Ratio** £000's
Full Cost Analysis								
1: Proceed (1 Train)	(58,980)	-	-	(123)	-	(59,104)	-	n/a
2: Do Nothing	(63,301)	-	-	(123)	(62,471)	(125,896)	(232,968)	n/a
3: Proceed (2 Trains)	(57,814)	-	-	(123)	(488)	(58,426)	(1,743)	n/a
						-		
Incremental Effect[2]						-		
2: Do Nothing	(4,321)	-	-	-	(62,471)	(66,792)	(232,968)	-3.49 : 1
3: Proceed (2 Trains)	1,166	-	-	-	(488)	678	(1,743)	Fin Pos

[1]Figures stated in Present Value & include any prior submission costs if applicable; [2]Compares base option with the recommended option

[3]Includes Risk, Contingency and Project Working Capital Adjustments if applicable

Opportunities

4.11 The recommended option will allow LU to complete the work earlier than originally anticipated and therefore would allow RVAR work to be brought forward and completed in 2020. This is the subject of an ongoing discussion with the DfT and a separate investment proposal will be prepared. The RVAR project is fully budgeted within the business plan.

4.12 As part of the project there is an opportunity to replace the Reavell compressors with Westinghouse compressors on five units to provide consistency in compressor maintenance. The costs are approximately £65k and the case for replacing them is financially positive over the remaining life of the fleet.

Options Analysis

Discontinue project and carry out reactive repairs

4.13 The repairs are required to guarantee safe operation of the fleet, so an unplanned approach will have a much higher cost. Efficiencies in delivering the repairs on a dedicated production line as well as bulk buying of materials would be lost. LU's internal Trains Modification Unit would still be requested to provide labour to carry out the repairs (there is no welding resource within fleet maintenance to undertake the repairs), but it would be done in an unplanned manner, resulting in periods of low productivity.

4.14 This approach is estimated to take nearly nine years and has the potential to severely impact the train service, depending on how many trains needed to be taken out of service for vital repairs.

4.15 This option requires a lifting road at Stonebridge Park depot to be dedicated to the repairs. Stonebridge Park depot has no redundancy to support additional repair works. Allocating the lifting road to the repairs will cause a backlog in normal maintenance work resulting in trains being taken out of service.

4.16 This option costs more, will take longer and has the potential to significantly impact the availability of the fleet and is not recommended.

Continue the project at one train at a time

4.17 This option was recommended in the previous submission and completes the previously described scope of works on a single train only. The work will be undertaken at Acton Works allowing a production line approach, but will take approximately two years longer than the recommended option.

4.18 This option does not require a train to be removed from service so there is no impact on operations or our customers. As detailed in the economic analysis in paragraph 4.10, the higher costs of a single train approach substantially outweigh the disbenefits of reducing the service by a single train. In the light of affordability, this option is not recommended.

Alternate options

4.19 Alternative options were proposed and investigated but ultimately discounted. In particular, increasing the number of trains undergoing repairs to three or more would require the construction or hiring of a larger facility and would have significant disbenefits to our customers and was not investigated further. There is no benefit working on half a train at a time as the other half cannot be used in service.

Delivery of Preferred Option

4.20 The repairs are to be carried out in-house by LU's Trains Modification Unit and project managed by LU Capital Projects Directorate.

4.21 The forecast dates and Project Authority Milestones associated with the project are shown in the table below.

Milestone	Target Date
Two trains in production	30 November 2016
Completion of Train 18 (50 per cent Completion)	28 July 2017
Completion of Train 27 (75 per cent Completion)	16 March 2018
Completion of Train 36 (100 per cent Completion)	30 November 2018
Project Close	31 March 2019

4.22 All milestones within previous submissions have been completed except for the completion of the final train which has been brought forward from April 2020 to November 2018.

4.23 The five key risks are set out below. The P50 risk value of £3.60m (including outturn) is 10 per cent of this submission's EFC.

Risk	Risk Description	Mitigation Actions
100997	There is a risk that the number of production resources required may be underestimated to complete the project to optimal time and cost.	Resourcing based on the delivery of the first three trains. Review of production processes to keep production staff levels within headcount.
100991	Trains Modification Unit has estimated that for trains 8 to 36, there will be a seven weeks turn-around time; there is a risk that this can take longer.	Review of production processes through the project to reduce the production time.
100994	There is a risk that trains are not available when required.	The project will liaise with fleet maintenance to resolve any issues which may make a train unavailable to the project. This may included completing maintenance work at Acton Works.
100984	There is a risk that materials are not supplied to the project to meet required productivity rates.	Implementing material handling process.
100993	There is a risk of higher material costs than estimated due to higher material quantities required.	Bulk order of materials to stay within budgeted costs

4.24 The FTE for the project team is shown below. This is based on two trains being delivered at once and is therefore higher than the previous submission which showed an FTE of 79.5 which supported a single train being delivered.

Description	Type	Quantity
LTS - Project management team	Permanent	7.8
Trains Modification Unit Management (funded by project)	Permanent	5.3
LTS - Engineering Support	Permanent	2.7
Trains Division Support	Permanent	1.5
Trains Division labour	Permanent	20
Trains Division labour	Temporary / Contract	79
Asset Performance Engineering plus testing	Permanent	2.9
Emergency Repairs at Stonebridge Park	Permanent/ Temporary	3.3
Total		122.5

5 Financial Implications

5.1 The current Project Authority is £20.77m. The additional Project Authority of £39.24m is fully budgeted. The table below shows the budget breakdown for this submission.

Funding and Project Authority Breakdown (Outturn)	Prior Yrs £000's	2016/17 £000's	2017/18 £000's	2018/19 £000's	2019/20 £000's	Future £000's	Total £000's
Funding							
Budget/Plan	14,422	14,933	12,817	13,767	13,550	773	70,262
Estimated Final Cost	14,422	15,369	19,072	11,148	-	-	60,011
Budget/Plan Surplus/(Shortfa	-	(436)	(6,255)	2,620	13,550	773	10,252
Prior Submissions							
Existing Authority	14,422	6,348	-	-	-	-	20,770
Expenditure to date	14,422	6,348	-	-	-	-	20,770
Remaining Authority	-	-	-	-	-	-	-
Project Authority Breakdown							
Prior Submissions	14,422	6,348	-	-	-	-	20,770
This Submission Request		9,021	19,072	11,148	-	-	39,241
Future Submission Requests	-	-	-	-	-	-	-
Total EFC	14,422	15,369	19,072	11,148	-	-	60,011

5.2 Owing to the work undertaken to date and the change in the number of trains being worked upon simultaneously, the budget surplus of £10.25m is being offered as an efficiency.

5.3 The breakdown of costs for this submission is summarised below.

This Submission **Cost Breakdown** (Outturn)		2016/17 £000's	2017/18 £000's	2018/19 £000's	2019/20 £000's	2020/21 £000's	Future £000's	Total £000's
Project Base Costs								
Project Management		397	710	564	-	-	-	1,671
Project Engineering		123	194	147	-	-	-	465
TMU Management		307	573	386	-	-	-	1,266
TMU Labour		4,889	9,459	5,994	-	-	-	20,342
TMU Materials		2,015	5,561	2,338	-	-	-	9,914
Engineering Assurance		14	26	14	-	-	-	54
Enabling		105	-	-	-	-	-	105
Works at Stonebridge Park		190	279	200	-	-	-	668
Tools and Equipment		134	248	134	-	-	-	515
Non Destructive Testing (NDT)		20	63	37	-	-	-	121
Transportation		80	193	185	-	-	-	458
Compressor Conversion		16	32	17	-	-	-	65
Total Base Costs		8,289	17,338	10,017	-	-	-	35,644
	% of base							
Risk	10	732	1,734	1,131	-	-	-	3,597
Total This Submission		9,021	19,072	11,148	-	-	-	39,241

5.4 The estimate has been developed by the project team and Trains Modification Unit who have extensive experience and domain knowledge of legacy fleets and have been fully involved with the development of the weld repair processes and prototypes.

5.5 Due to the variable nature of the condition of each train, benchmarking has demonstrated that internal delivery of this project is more cost competitive than the external market. This has been reviewed by TfL Assurance and is supported.

5.6 The enabling works in Acton Works has resulted in new assets which require maintenance (e.g. electrical supplies, heating, air supply), estimated at circa

£10k per annum. Similarly, the new short track for the road ramp at Stonebridge Park Depot requires track inspections, estimated at £2.4k per annum. These assets have been handed over. Future operational costs are budgeted.

Commercial

5.7 LU's Trains Modification Unit will be managed under an internal Service Level Agreement. A process for communication and issue escalation/resolution has been agreed.

5.8 This submission includes funding for the procurement of materials for the remainder of the fleet. All materials and non-permanent labour will be procured through existing framework agreements.

6 Assurance

6.1 The project has been reviewed by TfL Project Assurance and IIPAG. The assurance report highlights that the delivery was worthy of the business' confidence and that the make or buy decision was the right one. There are no critical issues and management have responded to the recommendations made in these reports as detailed in their management response.

List of appendices to this paper:

Appendix 1: Photographs

Background papers:

Integrated Assurance Review
IIPAG Report
Management Response

Contact Officer: David Hughes, Director of Strategy & Service Development
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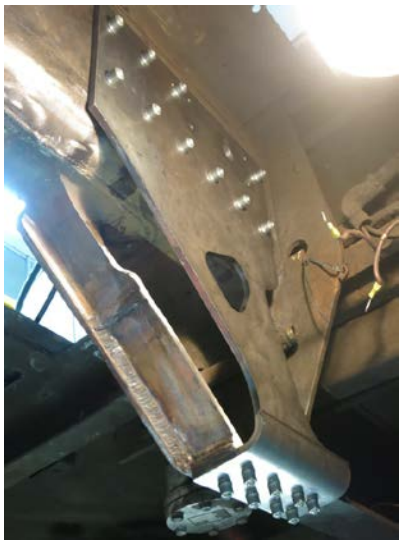
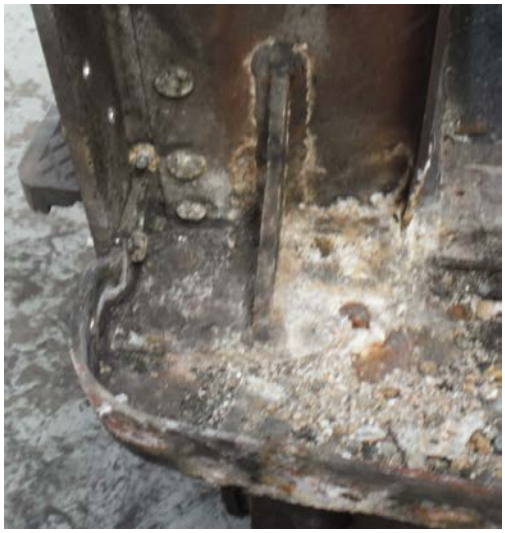
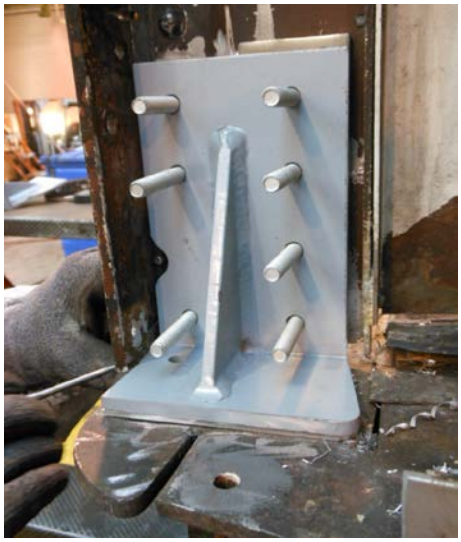
1 Swan neck crack



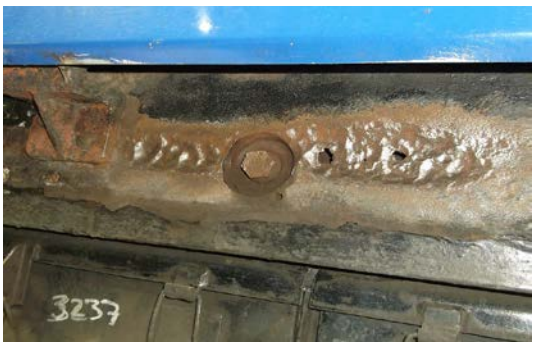
2 Swan neck repair (with bracket)



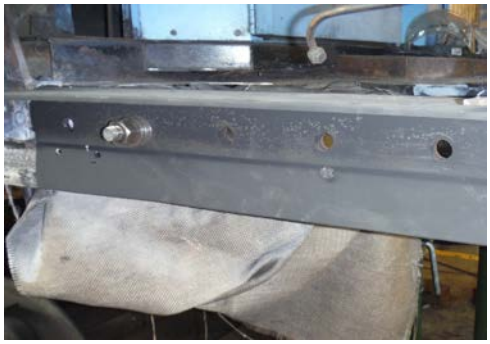
3 Car body corner post corrosion



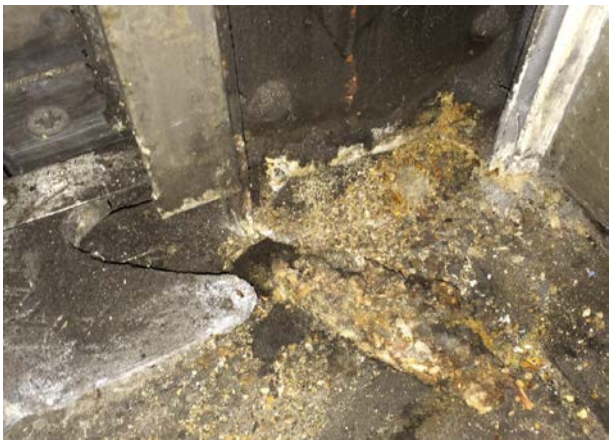
4 New car body corner post repair



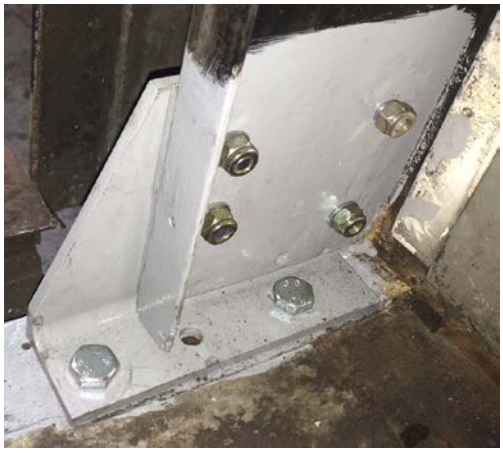
5 New sole bar holes and corrosion



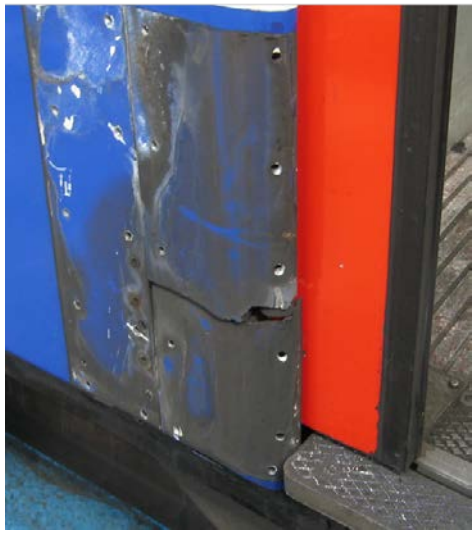
6 Sole bar repair



7 Internal door pillar corrosion



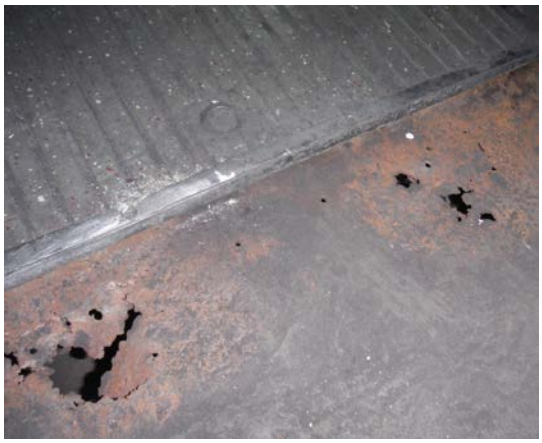
8 Internal door pillar repair



9 External door pillar crack

10 Failed car body side stiffener bracket

11 Kick plate corrosion



12 Saloon floor plate corrosion