

Date: 12 February 2015

Item10: Central Line Heavy Overhaul Programme Lift

This paper will be considered in public

1 Summary

- 1.1 This paper provides a summary of the forthcoming Heavy Overhaul Programme Lift (HOPL) project on 1992 Tube Stock (92TS). The project will ensure the continued safety of the fleet and improve reliability and availability.
- 1.2 The HOPL project forms a part of a comprehensive programme of works planned on the Central Line fleet between now and 2020. A summary of the projects that form this programme is provided in Appendix 1.

2 Recommendation

- 2.1 **The Panel is asked to note the paper.**

3 Context

- 3.1 The Central Line trains are twenty years old and are therefore approximately halfway through their design life. The fleet comprises 85 trains and 680 cars, making it one of the largest fleets in operation on the LU network. The problems experienced have their origins either in poor design or obsolescence, meaning that it is the worst performing fleet on the LU network.
- 3.2 In some ways the equipment on 92TS represents a transitional phase when railway technology was changing from traditional, long established electro-mechanical systems to modern microprocessor controlled systems. So whilst it is a comparatively modern train it contains technology that was innovative at the time but is now superseded and difficult to maintain.
- 3.3 The fleet is planned to be replaced during 2028 – 2031 as part of the New Tube for London (NTfL) Programme. The strategy for the existing fleet is to implement a programme of works that will enable it to operate safely and reliably until the planned upgrade.
- 3.4 Although originally designed for 127,000km per annum (pa), the fleet is currently operating around 155,000km pa (22 per cent higher). Investigations into key systems confirms that this utilisation is achievable, but it will manifest in higher operating costs which may become increasingly disproportionate. The demand for Central line tube services means that LU could easily justify further increases in timetable mileage of another 15 per cent, but this will have to be weighed up against the performance of the fleet and cost of meeting such demand.

3.5 Therefore as a minimum LU needs to maintain the present service levels and reliability, requiring core maintenance and overhauls (such as the HOPL). However, some components and systems are life expired and/or obsolete, resulting in deteriorating performance and increased costs meaning that modifications and system replacement projects are required. Furthermore legislation will necessitate changes to achieve Rail Vehicle Accessibility Regulations (RVAR) requirements. A summary of the main projects is provided in Appendix A.

4 HOPL Background

- 4.1 The Train Maintenance Regime (TMR) for 92TS prescribes the mandatory maintenance activities required on the fleet. This covers all daily, periodic, annual and less frequent maintenance required to ensure that the fleet operates safely and reliably.
- 4.2 Included within the TMR is a requirement to undertake Programme Lift and Heavy Overhaul at a frequency of six and 12 years respectively. Programme Lift primarily addresses the maintenance of bogie mounted equipment (e.g. motors, gearboxes, wheels and suspension), whilst Heavy Overhaul primarily addresses the maintenance of equipment attached to the car body (e.g. air supply and heating and ventilation systems). Every second cycle of Programme Lift coincides with a cycle of Heavy Overhaul. This combined activity is referred to as HOPL.

5 Scope and Benefits

- 5.1 The scope of HOPL comprises the heavy maintenance of the majority of train systems as prescribed by the TMR and summarised below:

| System | Overview of Work Content |
|-----------------------|--|
| Braking | Overhaul emergency and normal braking systems, replacing worn valves, hoses and switches. |
| Traction/Propulsion | Overhaul traction motors, circuit breakers, contactors and relays and replace switches. |
| Doors | Overhaul emergency and normal door valves and mechanisms. Overhaul all doors and door control panels. |
| Car body | Overhaul door tread-plates. |
| Bogie/Suspension | Overhaul equipment located on bogie frames, including wheels, axles, gearboxes, valves and switches. Replace suspension systems, including dampers, air bags and air suspension control units. |
| Couplings | Overhaul couplers. Replace bearings and air hoses. |
| Underframe | Replace life expired resilient mountings. |
| Auxiliaries | Overhaul control panels, speedometer and master control switch. Replace circuit breaker panel. Overhaul window wiper motors and whistle. |
| Heating & Ventilation | Overhaul saloon ventilation, control units and cab air-conditioning. Inspect hoses and temperature |

| System | Overview of Work Content |
|---------------------------|---|
| | sensors and replace on condition. |
| Air Supply | Overhaul pneumatic valves and switches. Replace hoses. |
| Electrical Distribution | Inspect inter-car distribution and replace on condition. |
| Fault Recording Equipment | Overhaul fault recording computers and modules. Replace fibre optic cables. |
| Automatic Train Control | Inspect antenna and replace on condition. |
| Communications | Overhaul emergency alarm switches, audio communications units and destination indicator. |
| Shoegear | Overhaul positive and negative shoegear and sleet brushes. Inspect arc barriers and replace on condition. |
| De-icing equipment | Overhaul de-icing equipment, including pumps and valves. Inspect de-ice tank and replace on condition. |

- 5.2 The benefit of the 92TS HOPL project is ensuring the continued safety, availability and reliability of the fleet to enable the service requirements of the Central Line to be met.
- 5.3 The TMR underpins the safety case of the rolling stock and defines the maximum permissible period between each scheduled maintenance activity. A train cannot be offered for service if any maintenance is overdue. Although additional maintenance, inspections or rectification work might be approved by the Principal Engineers as short term mitigations to maintain trains in service, these would be onerous on cost, labour and depot road capability and would not be sustainable for any significant period of time.
- 5.4 It is estimated that HOPL will improve the Mean Distance Between Failure (MDBF) of the stock by 1,000km (from approximately 8,000km) or 12 per cent and reduce Lost Customer Hours (LCH) by 18,000 per period. This equates to a financial customer benefit in excess of £2m per year.
- 5.5 Completion of the 92TS HOPL as planned would maximise availability from mid 2017. This is of crucial importance due to the pressure on 92TS availability between 2018 and 2020 resulting from other planned projects, summarised in Appendix A.

6 Delivery and Financial Implications

- 6.1 The HOPL will be delivered as a project by the Fleet maintenance organisation, supplemented with additional permanent staff employed on fixed term contracts. The project team will be provided with dedicated resources such as management, finance, procurement, quality control and planning.
- 6.2 The Central Line fleet will be lifted at Ruislip Depot and removed items, including complete bogies, will be dispatched to LU's Railway Engineering Workshops (REW) for overhaul. The REW will strip and rebuild the bogies and overhaul mechanical and electrical systems. Upon completion of the HOPL examinations

and the embodiment of modifications, units will be reassembled with overhauled or replacement components and tested prior to re-entering service.

6.3 Key milestones:

| Milestone | Target Date |
|---------------------------------|--------------------|
| First unit (2 cars) enters HOPL | 1 June 2015 |
| 25% of 92TS fleet complete | 15 January 2016 |
| 50 % of 92TS fleet complete | 13 May 2016 |
| 100% of 92TS fleet complete | 1 August 2017 |

6.4 The current projected EFC of the 92TS HOPL is £123.16m, including risk. The costs have been derived from detailed assessment of the scope of component and system overhaul and labour resources necessary to deliver all activities.

6.5 The authority submission will be presented to the TfL Board in March 2015.

List of appendices to this report:

Appendix 1 – Summary of Key Projects

List of Background Papers

None

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Appendix 1 – Summary of Key Projects

| Project and Date | Rationale | Benefits |
|---|---|--|
| Programme Lift and Heavy Overhaul 2015-2017 | Core maintenance to ensure safety & reliability | 234,000 LCH pa 1,000 km MDBF |
| Gearbox Overhauls 2013-2015 | Mitigate against premature failure of gearbox input bearing | Very high LCH avoidance |
| Floor Repairs and Handrails 2015-2017 | Address floor corrosion and apply new floor lining and recoat grab rails | Structural integrity and ambience |
| AC Traction 2015-2019 | Replace unreliable DC traction system and obsolete control electronics with a modern AC traction package | Opex savings 175,000 LCH and 3,000km MDBF |
| Door Overhaul 2018-2019 | Core maintenance. Includes fitment of inspection hatches for door pillar cracks | 23,000 LCH pa 300 km MDBF |
| DTS Replacement 2017-2020 | The DTS monitors train systems and provides information on asset health. It is increasingly unreliable meaning it is difficult to find faults | c25,000 LCH pa 300km MDBF |
| Mid Life Repairs and RVAR Compliance 2017-2020 | Comply with RVAR and address sub-standard condition and appearance | Legal obligation LCH, MDBF and Ambience benefits |