

Date: 3 July 2018

Item: London Underground Power, Cooling and Energy Programme

This paper will be considered in public

## 1 Summary

LU Power, Cooling and Energy Programme					
Financial Authority	Estimated Final Cost (EFC)	Existing Programme and Project Authority	This Authority Request	Total Authority	Future Authority Requests
£181.98m	£179.72m	£45.19m	£44.39m	£89.58m	£91.52m

## 2 Recommendations

2.1 The Committee is asked to note the paper and approve additional Programme and Project Authority of £44.39m for the London Underground Power, Cooling and Energy Programme, increasing total Programme and Project Authority to £89.58m.

## 3 Background and Strategic Case

### Introduction

- 3.1 The successful management and running of the London Underground (LU) train service is dependent upon the supply of a safe and resilient power network. As the biggest consumer of electricity in London, LU has a responsibility to reduce the cost and impact of that consumption. As such, the LU Power, Cooling and Energy Portfolio has been established to:
- (a) undertake projects to improve reliability, safety and legislation compliance of the **power** asset base;
  - (b) undertake projects that improve the customer experience in key locations by introducing **cooling** where rising temperatures are experienced; and
  - (c) investigate and implement **energy** efficiency opportunities to reduce energy consumption of TfL assets.
- 3.2 The authority being requested will deliver a programme of essential asset stabilisation, obsolescence management and renewals to ensure the safety of our customers and staff. Further authority is to be directed towards development of projects aimed at reducing both the cost of LU's power and also its environmental impacts.

- 3.3 This Programme supports the strategic objective in the Mayor's Transport Strategy of 'providing a good public transport experience' and TfL's Scorecard measure of 'improving public transport services'.

### **Power**

- 3.4 To maintain acceptable levels of safety, legislative compliance and reliability of LU's power network, key components need to be systematically renewed. These components are identified through annual condition assessments and prioritised using defined criteria into a work bank for delivery.
- 3.5 To provide a 'smooth' supply of power across LU, three control systems, referred to as Supervisory Control and Data Acquisition (SCADA) systems, are used to remotely monitor and safely operate traction, station, signalling and depot power supplies. Core parts of all three SCADA systems are now obsolete and faults occur on a regular basis.

### **Cooling**

- 3.6 The LU network is not immune to rising ambient temperatures. This is further exacerbated in the tunnel environment by heat generated as a result of service level enhancements. As such, a heat mitigation strategy is under development to maintain a safe and comfortable environment for TfL's customers at the lowest whole life cost. In the meantime the poorest condition fans to maintain current cooling and ventilation capability across the network are to be targeted for renewal.

### **Energy**

- 3.7 A pan TfL Energy Strategy was considered by the Safety, Sustainability and Human Resources Panel on 20 June 2018 and a further update will be provided at a future meeting.
- 3.8 In support of the TfL Energy Strategy, a range of feasibility studies are to be undertaken to assess viability of energy generating (combined heat and power generators, solar panels) and energy storage systems at underutilised areas on the TfL estate. One such study is planned for LU's emergency power station at Greenwich to provide revenue generation capability by providing balancing services to the National Grid.
- 3.9 LU is also responding positively to the Mayor's London Environment Strategy and Draft Solar Action Plan via a series of projects and feasibility studies. For example, at a number of TfL sites (up to 24) we will install energy conservation measures such as LED lighting and solar panels reducing energy costs and CO2 emissions. Another project will redistribute waste LU heat to a third party at a site on the north end of the Victoria line.
- 3.10 Power upgrades and cooling works to support LU's line upgrades across the Four Line Modernisation and Deep Tube Upgrade Programmes are outside of scope for the LU Power, Cooling and Energy Programme, but considered in prioritisation decisions.

### **Previous submission**

3.11 In June 2017 the Committee approved:

- (a) authority of £22.98m for to enable the initiation of high priority initiatives in power asset obsolescence, compliance and life extension work bank;
- (b) authority of £0.25m to commission project feasibility studies for energy conservation measures (solar panels and waste heat utilisation);
- (c) authority of £1m for feasibility studies to progress Waste Heat Utilisation studies in line with the Mayor's Environment Strategy; and
- (d) authority of £0.3m to complete design on a proposal to install gas-powered turbines at Greenwich power station.

Progress on each of these elements is provided in Section 5.

### **This Submission**

3.12 This submission seeks £44.39m of Programme and Project Authority, bringing the total granted for this Programme to £89.58m. The additional authority requested is:

- (a) £25.51m for power asset obsolescence, compliance and life extension works;
- (b) £8.14m for SCADA obsolescence management;
- (c) £9.34m for energy conservation measures (solar panels and waste heat utilisation); and
- (d) £1.40m for feasibility studies to progress the Mayors' London Environment Strategy.

3.13 Further details on each of these elements are provided in Section 4. The authority requested in this submission is fully funded within the TfL Business Plan.

## 4 Proposal

4.1 The Power, Cooling and Energy Programme comprises of the following projects (all figures include risk and inflation). Projects for which authority is being sought in this submission are highlighted in bold, with further details of these being provided in Section 5.

Project Description	Financial Authority (£m)	Estimated Final Cost (£m)	Existing Programme and Project Authority (£m)	This Authority Request (£m)	Total Authority (£m)	Future Authority Requests (£m)
<b>Power Asset Renewals Work Bank: Programme of renewals to maintain safety, compliance and power asset reliability – Section 5.1</b>	<b>74.83</b>	<b>74.83</b>	<b>22.98</b>	<b>25.51</b>	<b>48.49</b>	<b>26.34</b>
<b>SCADA: Replacement of obsolete and failing components with modern equivalents – Section 5.2</b>	<b>29.08</b>	<b>29.08</b>	<b>6.30</b>	<b>8.14</b>	<b>14.44</b>	<b>14.64</b>
<b>RE:FIT 2 Solar Project: Installation of energy conservation measures (incl. solar panels) – Section 5.3</b>	<b>4.66</b>	<b>4.66</b>	<b>0.25</b>	<b>4.41</b>	<b>4.66</b>	<b>-</b>
<b>Waste Heat Utilisation: Capturing heat from LU tunnels to provide heat to third parties – Section 5.4</b>	<b>5.19</b>	<b>5.19</b>	<b>0.26</b>	<b>4.93</b>	<b>5.19</b>	<b>-</b>
<b>Greenwich Power Station: Installation of a grid-scale energy storage system – Section 5.5</b>	<b>34.46</b>	<b>33.24</b>	<b>0.78</b>	<b>0.50</b>	<b>1.28</b>	<b>31.96</b>
<b>Energy Centres: Installation of energy generating systems – Section 5.5</b>	<b>7.90</b>	<b>7.90</b>	<b>-</b>	<b>0.52</b>	<b>0.52</b>	<b>7.38</b>
<b>Energy Storage: Installation of energy storage facilities to take and store energy – Section 5.5</b>	<b>5.85</b>	<b>5.85</b>	<b>-</b>	<b>0.38</b>	<b>0.38</b>	<b>5.47</b>
<u>Other Power, Cooling and Energy Projects</u> No additional authority requested	20.01	18.98	14.62	-	14.62	5.73
<b>Total (£m)</b>	<b>181.98</b>	<b>179.72</b>	<b>45.19</b>	<b>44.39</b>	<b>89.58</b>	<b>91.52</b>

## 5 Authorities Sought

### 5.1 Power Asset Renewals Work Bank

#### Introduction

5.1.1 An on-going and prioritised Power Asset Renewals work bank is driven by the outcome of annual asset condition reviews. Assets and/or systems that pose risk are identified through this assessment, and ranked based on safety, compliance, reliability and obsolescence threat to form a prioritised work bank. The current work bank is due for completion in 2019. At the June 2017 meeting, the Committee granted Programme and Project Authority to enable the initiation of high priority initiatives in the work bank, the delivery of which is now the subject of this authority request.

#### Scope

5.1.2 Delivery of the scope will renew (low voltage) switches and circuit breakers and provide earthing in compliance with the Electricity at Work Regulations. It will renew substation battery chargers and off-line battery inverters that are reaching the end of their design life, renew central emergency power supply assets to address failures and obsolescence exposure, as well as renew degraded high voltage cables.

5.1.3 The aim is to deliver this scope with a mixture of internal resource and specialist external resource where appropriate.

#### Milestones

Milestone	Target Date
Conceptual Design Complete for Non-Compliant Earthing	October 2018
Conceptual Design Complete for Degraded High Voltage Cables	October 2018
Conceptual Design Complete for Non-Compliant Battery Chargers	October 2018
Market Engagement Complete for Off Line Battery Inverters	November 2018
Conceptual Design Complete for Holborn DC Switchgear Replacement	February 2019

#### Funding

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	19.94	3.04	-	-	-	-	22.98
This Authority Request	-	1.85	9.30	14.36	-	-	25.51
<b>Total Authority</b>	<b>19.94</b>	<b>4.89</b>	<b>9.30</b>	<b>14.36</b>	-	-	<b>48.49</b>
Future Requests	-	-	-	-	9.98	16.36	26.34
Financial Authority	19.94	4.89	9.30	14.36	9.98	16.36	74.83
Estimated Final Cost	19.94	4.89	9.30	14.36	9.98	16.36	74.83

## 5.2 Supervisory Control and Data Acquisition (SCADA)

### Introduction

- 5.2.1 The power asset base includes three SCADA systems which are used to remotely monitor and operate the LU power distribution network which supplies power for traction, stations, signalling and depots. All three systems are becoming increasingly difficult to repair due to the availability of hardware, operating system and software support.
- 5.2.2 In 2012, a project was initiated to upgrade and consolidate all three systems to a single system with increased functionality. As part of the Business Planning review in 2016, this project was deferred for two years. Since then to align with TfL's current priorities, a revised 'do-minimum' scope is now proposed that will ensure known obsolescence concerns are mitigated.

### Scope

- 5.2.3 The 'do-minimum' scope will not have the originally envisaged increased functionality, but will still deliver a consolidated SCADA system upgraded to the latest operating platform.

### Milestones

Milestone	Target Date
Core System Design Complete	September 2019
Northern Line Migrated	March 2019
Remaining Lines (excl. Central Line) Migrated	July 2019
Central Line Migrated	December 2020

### Funding

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	6.30	-	-	-	-	-	6.30
This Authority Request	-	3.30	3.79	0.57	0.48	-	8.14
<b>Total Authority</b>	<b>6.30</b>	<b>3.30</b>	<b>3.79</b>	<b>0.57</b>	<b>0.48</b>	-	<b>14.44</b>
Future Requests	-	-	-	-	-	14.64	14.64
<b>Financial Authority</b>							
Financial Authority	6.30	3.30	3.79	0.57	0.48	14.64	29.08
Estimated Final Cost	6.30	3.30	3.79	0.57	0.48	14.64	29.08

## 5.3 RE:FIT 2 Solar Project

### Introduction

- 5.3.1 The Mayor's London Environment Strategy commits the Greater London Authority to a zero carbon London by 2050. To contribute towards this target, the Mayor wishes to maximise solar installations across London through the use of the RE:FIT Programme as outlined in the Draft Solar Action Plan. Consequently LU has identified 24 potential sites across the TfL estate where opportunities exist to install solar panels. These sites have been prioritised based upon roof space, energy consumption, ease of installation and impact to TfL operation.
- 5.3.2 In April 2017, £0.25m authority was granted by the Committee to appoint a supplier and deliver investment grade proposals, provide a not-to-exceed price for the delivery of works and a guarantee of energy savings, and project feasibility studies.
- 5.3.3 The Railway Engineering Workshop (REW ), an LU owned train project and heavy maintenance shed at Acton, has since been selected as the first building to be delivered by the project, due to the size of solar install possible.

### Scope

- 5.3.4 Award of a design and build contract for solar panels at Acton REW, followed by an energy savings and payback period prioritisation of the remaining 23 potential TfL sites. The aim is to deliver a minimum of 1.1MWp of solar panels across TfL, reducing costs and emissions by approximately 1000 tonnes of CO2 per annum by March 2022.

### Milestones

Milestone	Target Date
Completion of Acton Railway Engineering Workshop Building Design	March 2019
Completion of Work on-site at Acton Railway Engineering Workshop Building	December 2019
Completion of Works at all viable Sites	March 2022

### Funding

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	0.05	0.20	-	-	-	-	0.25
This Authority Request	-	0.08	1.50	1.50	1.33	-	4.41
<b>Total Authority</b>	<b>0.05</b>	<b>0.28</b>	<b>1.50</b>	<b>1.50</b>	<b>1.33</b>	<b>-</b>	<b>4.66</b>
Future Requests	-	-	-	-	-	-	-
Financial Authority	0.05	0.28	1.50	1.50	1.33	-	4.66
Estimated Final Cost	0.05	0.28	1.50	1.50	1.33	-	4.66

## 5.4 Waste Heat Utilisation

### Introduction

- 5.4.1 The Mayor's London Environment Strategy set requirements to develop clean, integrated energy systems utilising local and renewable energy sources. LU will build on experience and lessons learnt in delivering a waste heat scheme at City Road / Bunhill (near Old Street, London) to deliver a further project; providing low carbon heat extracted from LU infrastructure to a third party.
- 5.4.2 In June 2017, £1m authority was granted by the Committee to assess opportunities for waste heat recovery across the network (completes June 18), progress a feasibility study into a second scheme at Forest Road vent shaft at the northern end of the Victoria line between Blackhorse Road and Walthamstow (completes September 2018), and progress a feasibility study to investigate district cooling of the network (completes September 2018).

### Scope

- 5.4.3 The project will deliver the waste heat scheme at Forest Road vent shaft (subject to successful feasibility). The project will also support a bid for EU funding for a waste heat scheme at York Road vent shaft (Piccadilly line) needed to enable the Piccadilly line upgrade, as part of the Deep Tube Upgrade Programme. The York Road waste heat scheme will be implemented in tandem with a planned fan upgrade to enable the supply of low grade heat to a nearby user.

### Milestones

Milestone	Target Date
Bid Submission for EU Funding	December 2018
Completion of Concept Design at Forest Road	May 2019
Completion of Forest Road Waste Heat Scheme	January 2020

### Funding

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	0.04	0.15	0.03	0.03	0.01	-	0.26
This Authority Request	-	0.25	1.43	1.05	2.20	-	4.93
<b>Total Authority</b>	<b>0.04</b>	<b>0.40</b>	<b>1.46</b>	<b>1.08</b>	<b>2.21</b>	-	<b>5.19</b>
Future Requests	-	-	-	-	-	-	-
Financial Authority	0.04	0.40	1.46	1.08	2.21	-	5.19
Estimated Final Cost	0.04	0.40	1.46	1.08	2.21	-	5.19



## 5.5 Energy Projects

### Introduction

- 5.5.1 The Mayor's Transport Strategy and The Mayor's London Environment Strategy sets out a vision for clean, integrated energy systems utilising local and renewable energy sources. As part of our response, in June 2017, £0.3m authority was granted by the Committee to complete a proposal to install gas-powered turbines at Greenwich power station. This option is no longer being pursued due to the adverse impact to local air quality and CO2 emissions.
- 5.5.2 It is now proposed that 'energy centres' that generate energy (combined heat and power generators, solar panels) on underutilised TfL land are investigated. Similarly 'energy storage' solutions are also to be explored in parallel.

### Scope

- 5.5.3 These feasibility studies will develop a holistic approach to energy generation and storage across the TfL estate (including at LU's Greenwich power station). This will include the investigation of deploying various technologies and the identification of sites to take forward for more detailed studies.
- 5.5.4 The aim is to facilitate flexibility for TfL to generate energy when it is cheapest to do so, store some of it (e.g. batteries) for TfL use and generate revenue by providing some energy to the National Grid.

### Milestones

Milestone	Target Date
Completion of Feasibility Studies	March 2019

### Funding

- 5.5.5 Feasibility funding of £1.40m is requested, of which £0.50m is proposed for Greenwich power station, whilst £0.52m and £0.38m is to investigate energy centres and energy storage respectively.

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	0.78	-	-	-	-	-	0.78
This Authority Request	-	1.40	-	-	-	-	1.40
<b>Total Authority</b>	<b>0.78</b>	<b>1.40</b>	-	-	-	-	<b>2.18</b>
Future Requests	-	-	7.67	16.94	20.20	-	44.81
<b>Financial Authority</b>							
Financial Authority	0.78	2.62	7.67	16.94	20.20	-	48.21
Estimated Final Cost	0.78	1.40	7.67	16.94	20.20	-	46.99

## 6 Financial implications

6.1 The table below provides a summary of the costs and funding for the Power, Cooling and Energy Programme.

Costs and Funding (£m)	Prior Years	2018/19	2019/20	2020/21	2021/22	Future Years	Total
Existing Programme and Project Authority	38.50	6.55	0.10	0.03	0.01	-	45.19
This Authority Request	-	6.88	16.02	17.48	4.01	-	44.39
<b>Total Authority</b>	<b>38.50</b>	<b>13.43</b>	<b>16.12</b>	<b>17.51</b>	<b>4.02</b>	-	<b>89.58</b>
Future Requests	-	-	8.71	19.01	32.80	31.00	91.52
<b>Financial Authority</b>							
Financial Authority	34.26	15.47	27.14	37.30	36.82	30.99	181.98
Estimated Final Cost	34.26	13.21	27.14	37.30	36.82	30.99	179.72

## 7 Equality Impact Assessment

- 7.1 The Programme will be delivered in accordance with the Equality Act 2010. Equality Impact Assessments are considered on all strategies, policies, business plans, change programmes or projects, with regard to our obligations under the public sector equality duty in section 149 throughout the delivery of the Programme.
- 7.2 As projects progress through feasibility and design, consideration will be given to the need for an Equality Impact Assessment.

## 8 Assurance

- 8.1 A TfL Project Assurance (PA) and Independent Investment Programme Advisory Group (IIPAG) Assurance Review of the portfolio took place in May 2018. This review did not identify any critical issues and the recommendations have been accepted as detailed in the management response.
- 8.2 An Integrated Assurance Plan for the Portfolio has been agreed with TfL PA and this plan details the project-level reviews that will take place over the course of the year.

### 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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