CAPITA

Highways Agency

Reducing Cost of Road Lighting Implementation Paper; Product ID 61

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Contents

1 INTRODUCTION

This Implementation Paper has been prepared by Capita Property and Infrastructure as a deliverable under Package Order 033(4/45/12)ARPS “Reducing Cost of Road Lighting”, referred to as the “project” herein.

The project involved five different sub-tasks under the same umbrella, each sub-task looking at a different change measure that could improve the effectiveness and value for money of the Highways Agency's (HA) road lighting asset.

This Implementation Paper summarises the undertaking and implementation of each change measure (WBS 1000 to WBS 5000), including the conclusions from off-road demonstrations and lessons learnt.

2 WBS 1000 - MIDNIGHT SWITCH OFF (MNSO) LITE

2.1 General

This WBS evolved the original full Midnight Switch-Off (MNSO) process into a smaller, simpler and cheaper option that achieves the midnight to 05:00am switch-off but without the additional technology to restore lights that is available with a full MNSO deployment. As well as the obvious benefit of energy savings, the MNSO Lite variant is considerably cheaper and easier to implement than full MNSO, making it suitable for smaller scale deployments.

This WBS paved the way for the first site deployment and operation of MNSO Lite and has produced guidance for the wider deployment of MNSO Lite sites. The key products delivered under this WBS are:

- Safe Decision Report
- Deployment Guidance.

2.2 Safe Decision Report

The Safe Decision Report is based on GD 04/12 and is informed by historical data and monitoring reports pertaining to all currently operating MNSO sites. This Safety Risk Assessment considers the risks associated with the implementation of MNSO Lite, that is to say turning off road lighting between Midnight and 5:00 in order to reduce CO2 emissions and energy costs. MNSO Lite differs from the original MNSO installations in that the switch off is implemented local to the site, by exchanging the original Photoelectric Control Unit (PECU) with a "Part Night PECU" at the group switching cabinet. This is much cheaper than full MNSO which is implemented through a Central Management System (CMS) typically requiring lamp gear to be upgraded as well as a group controller and instation.

From a safety viewpoint, the fundamental difference between MNSO and MNSO Lite is that with MNSO Lite the lighting cannot be restored remotely (or prevented from turning off in the first place). It is possible to override the PECU at the group switching cabinet but this requires a technician to attend site.

The risk assessment uses the same hazards originally used for the MNSO risk assessment as this assessment has been validated by the monitoring results from the original trials which show no significant change in accidents from the implementation of MNSO.

The assessment establishes that the only hazard which differs from MNSO is for Highways Agency Traffic Officers (HATO), recovery operatives and similar workers where the original

(uncosted) mitigation was to restore lighting when they are attending an incident. There was no additional cost in providing this mitigation for MNSO as it is inherent in the CMS based design.

A Cost Benefit Analysis for providing this facility was undertaken, using the perceived level of risk from the original risk assessment and the lowest priced remote restore; this showed that there is no clear financial case for providing this facility.

Further assessment identified that sites chosen for MNSO Lite will, by definition, have lower than average accident rates for unlit roads.

As HATOs working on non-lit roads are considered to be a population with a broadly acceptable risk profile, their safety risk working on a MNSO Lite road during MNSO operation must be considered as acceptable and no further risk controls are required (in accordance with Section 5.17 of GD 04/12). This suggests that the perceived level of risk is lower than assessed during the initial MNSO trials.

The safety risk assessment for MNSO Lite concludes that it should be safe to operate with no additional mitigations required, providing the sites are correctly selected.

2.3 Deployment Guidance

The Deployment Guidance is modelled on the existing MNSO guidance, taking into account lessons learned on this WBS. It comprises an Area Management Memo and supporting documents, including the Safe Decision Report.

3 WBS 2000 - ALTERNATIVES TO 400W+ LAMPS

3.1 General

The objective of this WBS was to assess options for reducing the energy consumption of existing 400W (or higher) luminaires on the network and present recommendations that offer safe alternatives with lower energy consumption (e.g. by installing power controllers, replacing luminaires, reducing lighting levels in accordance with recently published BS 5489-1, changing control gear etc.). The options needed to be sufficiently generic in concept to allow them to be suitable for multiple locations on the Highways Agency's network where lamps of 400W and higher are currently used. This WBS led to the development of guidance documentation for the deployment of reduced energy alternatives to 400W+ luminaires across the Highways Agency's network, with the emphasis on making better use of what is already installed.

The key products delivered under this WBS are:

- Options Report
- Alternative Design Solutions Report
- Deployment Guidance.

3.2 Options Report

It was found that there are approximately 13,500 400W+ lamps on the Strategic Road Network (SRN), mostly 400W high pressure sodium. Energy reducing measures must involve the minimum of intervention and cost in order to generate an immediate return on investment. The following interventions showed the most promise for significant energy savings:

- Reduce lighting levels where the 2013 version of BS 5489-1 recommends lower lighting levels than previously
- On D3M links which were lit to the old D4M standards in accordance with the former motorway widening programme, change the lighting to revert to current D3M standards
- Consider the use of LED lighting for both of the above scenarios.

From HA data on the distribution of 400W+ lamps on the SRN, two typical case study sites were selected for taking forward to the Alternative Design Solutions Report, these are:

- M5 Jcn. 17-18 (D3M opposite lighting), Area 2
- M4 Jcn. 19-20 (D3M twin central lighting), Area 2, which appears to have been designed in readiness for symmetrical widening to D4M.

3.3 Alternative Design Solutions Report

The Alternative Design Solutions Report identified that on sample sites that use 400W+ lamps historic lighting levels were too high compared with current standards. M5 Jnc. 17-18 was studied to determine whether alternative lamp sources could be used to reduce overall energy costs.

The Report investigated three different lamp sources: using lower wattage SON, Metal Halide and LED lamp sources. It determined whole life costs including design, procurement, installation, maintenance and disposal costs and undertook an economic assessment to validate if these alternative sources would provide a return on investment and value for money. The Report recommended replacing the current 400W SON-T Plus lamps with 250W SON-T Plus. This would require replacing existing control gear and lamp assembly to lower the energy costs whilst complying with current lighting levels set out in BS5489-1:2013. Apart from a reduction in lighting level, the lower wattage lamps would provide the same visual performance as the existing installation. The lamp and control gear replacement could also coincide with the lamp bulk change and clean maintenance programme and thus reduce the cost of conversion. Pay back periods as short as four years are achievable, depending on the particular circumstances of a scheme.

It was also found that some D3M motorways had in the past been lit to D4M using 400W+ lamps in anticipation of future symmetric widening which was never implemented. Here, too, lower wattage lamps would lead to lower energy costs.

3.4 Deployment Guidance

The Deployment Guidance comprises an Area Management Memo and supporting documents and process.

The Guidance states that on sites using 400W+ lamps, historic lighting levels are too high compared with current standards. For areas that are overlit it recommends that the Service Provider replaces the high wattage lamps with appropriate lower wattage lamps and control gear to meet correct lighting levels. This will require replacing existing control gear and lamp assembly or entire luminaires on a one for one basis to lower the energy costs whilst complying with current lighting levels set out in BS5489-1:2013. Lighting columns, cabling and other infrastructure would not be affected. A process is given for selecting and prioritising sites, and in each case a Lighting Design Engineer is required to carry out a lighting and economic assessment.

4 WBS 3000 - APTR AND INTERCHANGE LIGHTING

4.1 General

This WBS built upon previous research into the impact of road lighting on the number of darkness accidents on the motorway network by extending this to All Purpose Trunk Roads (APTR) and / or interchanges. The objective of this WBS was to identify the best solution for mitigating an above-average darkness accident rate on any given APTR site and thereby minimise whole life cost and / or achieve the largest reduction in accidents. This led to the development of documentation providing step-by-step guidance for deploying non-lighting safety measures on APTR sites.

The key products delivered under this WBS are:

- Case Study Report
- Options and Recommendations Report
- Deployment Guidance.

4.2 Case Study Report

This study established the road safety benefits and effects of road lighting by analysing road traffic collision (STATS 19) data and assessing the collision performance at existing junctions. The data was used to establish the proportion of darkness collisions and the differences in darkness collision proportions on lit and unlit Motorways, A(M) roads and Trunk Roads and at various junction types on these classes of road. The calculated darkness collision proportions and differences between lit and unlit roads were filtered and ranked to determine a list of potential sites for more detailed consideration. A final shortlist of sample sites on Motorway and All Purpose Trunk Road interchanges included locations where darkness collision proportions exceeded national average levels. Detailed analysis of the available STATS 19 data was undertaken for each of the ranked sites to determine the nature of the collisions and their frequency both in the hours of daylight and darkness.

This methodology highlighted three sites on Motorways and five sites on Trunk Roads where the collision proportions in daylight and darkness indicated potential darkness collision issues of value to this study. These sites, where possible, were compared against control data. Each of the highlighted sites was subsequently reviewed in greater detail by reference to its collision record and Google Street View to establish differences in layout, street lighting, signing and carriageway marking arrangements. The results of the analysis and studies undertaken showed

that some road layouts may encourage driver over-confidence and promote inappropriate traffic speeds under dark lit conditions, leading to road traffic collisions.

4.3 Options and Recommendations Report

The Options and Recommendations Report recommends engineering collision reduction measures for the sites identified in the Case Study Report and includes economic evaluation of these remedial measures. In total six sample sites were used, with two of them being unlit: three slip road junctions, two multiple junctions including slip roads and one roundabout approach. On the basis of the collision problems at the six sites, remedial measures were selected to treat the identified road safety concerns. Some of these measures involved either introduction or removal of street lighting. The main economic objective of the collision reduction measures is to provide good value for money. The Net Present Value economic assessment method was used to justify if a scheme is viable in economic terms. Each of the sites was assessed using this method. This assessment concluded that at five of the six sites existing non-provision of street lighting or switching off street lighting in conjunction with the introduction of other remedial measures, such as improved carriageway markings, signing and/or Intelligent Road Studs could be more economically worthwhile than providing or retaining the street lighting.

4.4 Deployment Guidance

The Deployment Guidance comprises an Area Management Memo and supporting documents and process.

The Guidance states that new or improvement highway schemes should be assessed for the need for road lighting or alternative treatments. The Service Provider should review the existing HA network to select possible lengths of road or junctions where road lighting could be switched off and removed, and then assess the likely effects using a standard collision investigation and economic evaluation approach and a parallel assessment of the road lighting implications.

Apart from the initial selection of those sites where road lighting on the existing HA network could be switched off, the Guidance states that the overall process should be led by the Watchman in consultation with the Road Safety and Road Lighting Engineers.

5 WBS 4000 - SOLAR ENERGY FOR LIGHTING

5.1 General

This WBS researched potential design solutions for the provision of solar panels to reduce the energy costs of road lighting. It focussed on the scenario where the Highways Agency manages routes adjoining Local Authority managed routes, where an LA decision to light their road can force the Highways Agency to light the adjoining part of their network (e.g. a major junction). This WBS looked to quantitatively assess (by off road deployment) the operational and service capability of solar technology to meet the needs of the Highways Agency and led to the development of guidance documentation for the wider deployment of this technology.

The key products delivered under this WBS are:

- Off / On-Road Capability Assessment
- Deployment Guidance.

5.2 Off / On-Road Capability Assessment

This Off / On-Road Capability Assessment provides an overview of the investigation into the latest solar powered street lighting solutions with a particular emphasis on columns with integrated solar panels. Following research into the current market the major suppliers of integrated solar columns were identified and an overview of the current solutions given. The market for integrated columns was limited, with just two suppliers having products suitable for Highways Agency roads.

Arising from the research element of the report, a trial setup was proposed for two sites, one in the North and one in the South of the country. A wind turbine element was also added to the trial as it is anticipated this will maximise energy production throughout the year.

The trial was initiated at two MAC depots in January 2014, one in Sowton, Exeter and one in Low Hurst, Carlisle.

5.3 Deployment Guidance

This Guidance recommends that, once the results of the two trials are known (around February 2015) and providing there is a clear benefit in using the technology, it should be introduced on the Network to offset increased energy costs necessitated by an adjoining local authority decision to light a road. This can be done by means of the Section 278 agreement with the local authority.

6 WBS 5000 - SAFETY REVIEW OF LIGHTING MAINTENANCE PRACTICES

6.1 General

Current Highways Agency reviews include looking at ways to ensure commonality of processes and procedures between the different maintenance contracts and network areas. In order to understand the Highways Agency's liabilities this WBS was aimed at reviewing MAC practices, assessing how safe these practices are and how they differ between Area MACs.

The key products delivered under this WBS are:

- Safe Maintenance Process Review
- Options and Recommendations Report
- Good Practice Guidance.

6.2 Safe Maintenance Process Review

This Street Lighting Safe Maintenance Process review provides a synopsis of the Street Lighting processes and activities utilised by four representative maintenance organisations maintaining Highways Agency Street Lighting assets. From the observations gathered during the review it is apparent that Street Lighting Maintenance has been well thought through, with effective Sector Schemes implemented, effective training and competence assessment and supporting documentation. This enables maintenance activities to be performed consistently in accordance with relevant legislation and Standards. Risk has been mitigated wherever possible such that Street Lighting personnel are exposed to no greater risk than other Road Maintenance personnel. Key mitigated residual risks are those resulting from Working at Height, Working adjacent to Live Traffic and Electrocution.

All maintainers interviewed actively pursue Innovation, assessing and introducing new technologies geared at improving performance, maintenance requirements and reducing road worker exposure to hazards.

There are opportunities for Street Lighting maintenance management to be enhanced, principally supporting areas such as regularised asset management standards, contractual governance of drawing records and consistent guidance regarding interfaces with adjacent highway authorities responsible for street lighting. Whilst these are improvement opportunities, the current Street Lighting management systems in place adequately mitigate the associated risks.

Street Lighting maintenance is hence considered to be as safe as reasonably practicable.

6.3 Options and Recommendations Report

This Options and Recommendations Report provides a summary of the lessons learnt, differences in practice across the network and areas of best practice that can be applied across the network.

Generally Street Lighting maintainers operate in very similar ways across the network. A small number of significant differences were identified, including inconsistencies in As-built drawing management. In addition, there are inconsistencies in the definition of boundaries between Highways Agency maintainers and maintainers responsible for adjoining areas.

It can be seen from the outcomes of the Safe Maintenance Process Review interviews, that maintainers generally operate in a manner akin to a Best Practice method, it is likely that other maintainers not interviewed operate similarly. Specific instances of Best Practice relate principally to Innovation.

Examples of Innovation include challenging maintenance standards and requirements with a view to reduce maintenance requirements utilising a risk-based maintenance identification method. Other Innovative ideas include non-destructive tests that if successful effectively extend the life of an asset by 5 years. Two maintainers are also in the process of developing advanced functionality Street Lighting Asset management systems.

Whilst not essential, a mechanism to share information throughout the maintenance community could be introduced to instigate information and knowledge sharing helping to contribute to continued safe operations.

6.4 Good Practice Guidance

This Good Practice Guidance document provides a summary of the lessons learnt, and areas of best practice that may be applied across the network following the completion of a Safe Maintenance Process Review (the Review) of Street Lighting conducted January to July 2013). It is closely based on the Options and Recommendations Report and is rewritten for use by Service Providers