# **CHAPTER 8**

# **Highways Department**

Management of the public lighting system

Audit Commission Hong Kong 27 October 2015 This audit review was carried out under a set of guidelines tabled in the Provisional Legislative Council by the Chairman of the Public Accounts Committee on 11 February 1998. The guidelines were agreed between the Public Accounts Committee and the Director of Audit and accepted by the Government of the Hong Kong Special Administrative Region.

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# MANAGEMENT OF THE PUBLIC LIGHTING SYSTEM

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## MANAGEMENT OF THE PUBLIC LIGHTING SYSTEM

### **Executive Summary**

1. The Lighting Division of the Highways Department (HyD) with an establishment of 98 staff is responsible for the design standards, operation and maintenance, and the majority of design and construction of the public lighting the public 2015, system. As at April lighting system comprised 145,823 road lights (e.g. installed along public roads and carriageways), 79,225 special lights (e.g. installed at footbridges and subways) and 10,820 traffic bollards. The annual electricity charge was \$140 million. The HyD had awarded three contracts with a total contract value of \$693 million for the management, installation, operation and maintenance of road lights and traffic bollards (MOM contracts), each for a term of four years. For the provision of comprehensive maintenance for special lighting installations, the HyD has entered into a Service Level Agreement (SLA) with the Electrical and Mechanical Services Trading Fund (EMSTF) of the Electrical and Mechanical Services Department. In 2014-15, the HyD paid SLA charges totalling \$49 million to the EMSTF.

### **Operation and maintenance of road lighting**

2. Need to improve the scope and approach used in monitoring contractors' performance and road lighting availability. To ensure a high service level of road lighting, the contractors of the MOM contracts are required to maintain the monthly availability of the road lighting system in the designated contract areas at not lower than 99.5%. Besides the contractors' daily check on the road lighting system, the HyD carries out night inspections to monitor independently the road lighting availability and the contractors' performance. According to the HyD, the stipulated lighting availability of 99.5% had been met in the three MOM contracts in 2014. However, the Audit Commission (Audit) found that the HyD's 51 inspection routes only covered 93,391 (64%) of the total 145,823 road lighting points. There is a risk that any outage or substandard performance of the contractors in relation to the uninspected lighting points may not be detected.

Moreover, Audit's sample check revealed that the HyD's laid-down requirement for all 51 designated inspection routes to be covered at least once a month was not always followed. In June 2015, 4 out of 27 routes in one region were not inspected but another 17 routes were inspected twice. In 2008, the HyD put into trial use a remote control system to monitor road light operation. While the HyD's review of 2009 showed that the system was effective in reducing complaints, electricity consumption and monitoring manpower, the review of 2014 found it not cost-effective to further extend its use. In light of recent development (such as new technological advances), the HyD needs to re-examine the cost-effectiveness of extending the use of the system (paras. 2.2 to 2.7, 2.9 and 2.11 to 2.13).

3. Need to ensure compliance with time limits for responding to fault calls. From June 2014 to May 2015, 12,249 fault calls concerning road lighting, gantry sign and roadside directional sign lighting, and traffic bollards were received. The MOM contracts have specified time limits for responding to fault calls, including rectifying urgent faults within 3 hours for minor repairs and within 12 hours for all other urgent fault cases. The contractors reported that they met the fault rectification time limits for 98.8% of the calls. However, there is no definition of minor repairs in the contracts. Audit's sample check revealed that a contractor mainly used the within 3-hour fault rectification time limit for measuring compliance while the other two contractors always used the within 12-hour time limit. In addition, a contractor measured its response time to fault calls based on the time of its acknowledgement of a fault call instead of the time a fault call was received as laid down in the contract. As a result, non-compliance for 576 cases had not been reported from June 2014 to May 2015 (paras. 2.16, 2.18 and 2.19).

4. *Need to ensure compliance with stipulated maintenance frequencies.* The contractors are paid a monthly lump-sum fee to carry out scheduled maintenance works according to the frequencies stipulated in the MOM contracts (e.g. annual inspection of lighting equipment). However, as at April 2015, 14 types of scheduled maintenance works had not been carried out in accordance with the stipulated maintenance frequencies. In particular, some works had been outstanding for more than four years but payments for the works had already been made as part of the monthly lump-sum fees (paras. 2.27, 2.30 and 2.32).

### **Operation and maintenance of special lighting**

5. *Need to reflect SLA requirements in general special lighting subcontract.* The EMSTF has subcontracted the maintenance of 74% special lighting installations (including 62% relating to footbridge and subway lighting under a general special lighting subcontract). However, the 99.5% monthly equipment availability requirement stipulated in the SLA had not been incorporated in the general special lighting subcontract to ensure its enforceability on the subcontractor. Moreover, the subcontract had not always reflected the revised requirements of a new SLA, such as the 98.5% compliance level for fault call attendance requirement of the 2013 SLA and the reduced patrol frequency of the 2015 SLA (paras. 3.2, 3.5, 3.11 and 3.15).

6. *Need to closely monitor achievement of target equipment availability.* Before June 2015, the EMSTF calculated the monthly equipment availability of the special lighting system based on the number of faulty lights under complaint, which might not fully reflect the overall lighting operation. In response to Audit's enquiry, the EMSTF has since June 2015 used the number of faulty lights found during regular patrols for calculating the equipment availability. Based on the revised methodology, the monthly equipment availability figures for 2014-15 were below the SLA requirement of 99.5%, ranging from 98.7% to 99.4% (paras. 3.6 to 3.8).

7. *Need to improve regular patrol service.* According to the SLA, the regular patrol service on special lighting points should cover those listed in the SLA and subsequent additions during the agreement period. However, a total of 22 footbridges/subways/walkways (involving 1,887 special lighting points) were found by Audit to have been omitted from the patrol service. Moreover, in the absence of a laid-down time limit on rectifying faults identified during regular patrols, there were cases of delay. For example, as at June 2015, 325 general special lights had been repeatedly reported to be faulty, and the rectification works of some of these lights had been outstanding for more than two years. Delays in rectifying faulty lights could increase safety risks to pedestrians and other road users (paras. 3.9, 3.17 and 3.18).

8. *Need to carry out scheduled maintenance works according to stipulated frequencies.* Under the SLA, the EMSTF has to arrange periodic cleaning of lanterns and group replacement of lamps, ranging from once every six months to once every 36 months. During the period from April 2013 to March 2015, some of these maintenance works were not carried out in accordance with the stipulated frequencies (paras. 3.19 and 3.20).

### **Installation of public lights**

9. Need to monitor long outstanding installation works for road lights. Lighting installation works are mainly carried out under the Public Lighting Programme (PLP) approved by an inter-departmental Public Lighting Vetting Committee (PLVC) annually. The HyD had not compiled any ageing analysis to monitor the progress of road light installation works. As at March 2015, of the 1,534 approved road lights pending installation, 71 (5%) had been outstanding for more than three years and another 649 (42%) lights for one to three years. In September 2015, the HyD informed Audit that actions had been taken in respect of the 71 road lights. The HyD still needs to expedite action on the 649 outstanding lights (paras. 4.2 to 4.5).

10. *Need to expedite action on installation of village lights.* Having regard to the manpower resources and available funding, the HyD sets an annual quota for the number of village lights to be installed under the PLP. The Home Affairs Department (HAD) is responsible for coordinating village lighting applications and carrying out liaison work. During 2005-06 to 2015-16, the annual quotas of village lighting installation varying from 400 to 2,000 were insufficient to meet the village lighting applications. As at June 2015, the backlog of waitlisted village lights for inclusion in the PLP was 2,693. From 2005-06 to 2015-16, the PLVC approved the installation of 9,075 village lights, of which 1,461 approved village lights were pending installation as at October 2015. In particular, 553 (38%) had been outstanding for more than three years. Audit examination revealed that there were cases of delays in arranging site meetings and taking follow-up actions by the HAD and the HyD (paras. 4.8 to 4.11 and 4.13 to 4.16).

### Implementation of energy saving measures

11. Over the years, the HyD has made efforts to reduce energy consumption of the public lighting system, e.g. using high pressure sodium lamps to attain an energy saving of about 30%. From 2010-11 to 2014-15, while the number of public lights increased by 6% from 223,300 to 235,600, the electricity consumption decreased by 3% from 136.3 million kilowatt-hours (kWh) to 132.6 million kWh. In January 2015, the Government set a new target of achieving a 5% saving in electricity consumption for government buildings. To support the Government's energy saving initiative, the HyD needs to step up its efforts to implement energy saving measures for the public lighting system (paras. 5.2 and 5.4).

12. *Need to expedite action on installing electronic ballasts*. Non-dimmable electronic ballasts can be used to replace electromagnetic ballasts to reduce energy loss. In August 2008, the HyD issued an instruction requiring the replacement of failed electromagnetic ballasts on non-high-speed roads by non-dimmable electronic ballasts. However, Audit examination of 3,841 ballasts installed/replaced between 2009-10 and 2014-15 revealed that only 792 (21%) had complied with the laid-down requirement (paras. 5.5 and 5.6).

13. *Need to review the pace of adopting energy saving devices.* It is the HyD's practice to adopt energy saving devices (such as non-illuminated retro-reflective traffic bollards and T5 fluorescent tubes) for new installations and replacing failed or damaged devices. While this practice can avoid unnecessary disposal of existing devices, it takes a longer time to realise the benefits of the energy saving devices. For example, while the use of T5 fluorescent tubes to replace T8 fluorescent tubes could achieve an energy saving of 20% to 30%, only 18% of the T8 fluorescent tubes were replaced after a lapse of five years. The HyD needs to consider conducting a review of the cost-effectiveness of speeding up the use of energy saving devices in the public lighting system (paras. 5.9 and 5.10).

### Audit recommendations

14. Audit recommendations are made in the respective sections of this Audit Report. Only the key ones are highlighted in this Executive Summary. Audit has *recommended* that the Director of Highways should:

#### Operation and maintenance of road lighting

- (a) set adequate inspection routes for the night inspections of the MOM contract areas with a view to covering all the lighting points as far as possible (para. 2.14(a)(i));
- (b) review the cost-effectiveness of extending the use of the system for remote control of road light operation (para. 2.14(b));
- (c) clearly define the two time limits for completing different types of repair works for urgent faults (para. 2.25(a));
- (d) address the inadequacies in monitoring the contractors' performance in attending to fault calls (para. 2.25(e));
- (e) step up monitoring of the contractors' scheduled maintenance works and follow up outstanding maintenance works with contractors concerned for completed contracts (para. 2.37(a) and (c));

#### Installation of public lights

- (f) step up monitoring of the progress of road light installation works and expedite action on the outstanding road lights (para. 4.6);
- (g) take measures to meet the demand for village lighting in good time (para. 4.18(a));
- (h) in collaboration with the Director of Home Affairs, step up monitoring of the progress of the approved village lighting installation works (para. 4.18(c));

#### Implementation of energy saving measures

(i) take measures to ensure that the requirement on replacing electromagnetic ballasts by non-dimmable electronic ones is complied with (para. 5.11(a)); and (j) consider conducting a review of the cost-effectiveness of speeding up the use of energy saving devices (para. 5.11(c)).

15. Audit has also *recommended* that the Director of Electrical and Mechanical Services should:

#### Operation and maintenance of special lighting

- (a) incorporate the target equipment availability requirement and fault attendance service standard of the SLA in the general special lighting subcontract (para. 3.21(a));
- (b) closely monitor the achievement of the target equipment availability requirement (para. 3.21(b)(i));
- (c) incorporate the omitted footbridges/subways/walkways in the SLA/subcontract for providing the regular patrol service and speed up rectification of faulty lights found during regular patrols (para. 3.21(b)(ii) and 3.21(e));
- (d) tighten control to ensure that any revised service requirements of a new SLA are promptly reflected in the subcontracts (para. 3.21(b)(iii)); and
- (e) tighten control to ensure that scheduled maintenance works are carried out in accordance with the stipulated frequencies (para. 3.21(f)).

### **Response from the Government**

16. The Government agrees with the audit recommendations.

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### **PART 1: INTRODUCTION**

1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

#### Background

1.2 Public lighting system is an auxiliary facility of the road network in Hong Kong. The authorities for the provision of public lighting and the protection of associated appliances are vested in the Director of Highways under the Public Lighting Ordinance (Cap. 105). As at April 2015, the public lighting system comprised 235,868 public lights, as follows:

- (a) *Road lighting.* It included conventional column lights, wall lights and soffit lights installed along public roads, carriageways, cycle tracks and village accesses. There were 145,823 road lights;
- (b) *Special lighting.* It included footbridge lighting, subway lighting, ferry concourse/walkway lighting, tram shelter lighting, high mast lighting, high bay lighting at public transport interchanges, underpass lighting and noise enclosure lighting. There were 79,225 special lights; and
- (c) *Traffic bollards.* There were 10,820 traffic bollards installed at road junctions and refuge islands. They are used to provide a visual cue to approaching drivers ahead of a road junction or a refuge island. Most of the traffic bollards are illuminated by their internal light sources for their bodies to be seen conspicuously at night time.

Photographs 1(a) to (h) show some public lighting features referred to in this report.

#### Photographs 1(a) to (h)

### Some public lighting features

(a) Road lights along a carriageway



(c) An illuminated traffic bollard (ITB) at a refuge island (b) A roadside public lighting control cubicle



(d) A cable drawpit





#### Photographs 1(a) to (h) (Cont'd)



(e) High mast lighting

(f) High bay lights at a public transport interchange



- (g) Gantry sign lighting
- (h) Roadside directional sign lighting



Source: HyD records



#### Introduction

1.3 *Operation of public lighting system.* The switching on/off of road lighting is controlled by photo-electric controllers installed in roadside public lighting control cubicles. Road lighting and traffic bollards will be automatically switched on when the ambient brightness falls to 55 lux (Note 1) and switched off when it rises to 83 lux. Under normal weather conditions, road lighting operates around 8 minutes after sunset to around 15 minutes before sunrise. Special lighting for subways and underpasses however operates nonstop around the clock.

1.4 The Lighting Division of the Highways Department (HyD) is responsible for the design standards, operation and maintenance, as well as the majority of design and construction of the public lighting system to provide the community with reliable, safe, comfortable and environmentally friendly public lighting. Under the supervision of the Assistant Director/Technical of the HyD and headed by a Chief Engineer, the Lighting Division had an establishment of 98 staff working in four Sections (see Appendix A for an organisation chart). In 2014-15, the expenditure of the HyD on the maintenance of the public lighting system was \$124 million (excluding staff cost) and the electricity charge was \$140 million.

#### Provision of public lighting

1.5 **Design standards for public lighting system.** The design of the public lighting system in Hong Kong is based on the Public Lighting Design Manual published by the HyD, with the illumination levels selected according to various factors, such as function, traffic volume, pedestrian volume and ambient brightness of the roads. The design standards stipulated in the Manual are developed according to the most common international road lighting standard widely adopted in various European and Asian countries. The current Manual was published in 2006. According to the HyD, a new version of the Manual will be issued in 2016.

**Note 1:** *Lux is an international illumination unit. The illumination level of road lighting is generally about 10-30 lux.* 

1.6 Lighting installation works under Public Lighting Programme. Lighting installation works are mainly carried out under the Public Lighting Programme (PLP). The PLP covers different lighting initiatives, such as road lighting schemes under government projects, new installations or improvements on existing roads and lighting installations for villages (Note 2). Each year, the Lighting Division invites works departments and related government departments to submit public lighting proposals or requirements for the following financial year. Justified proposals, together with other proposals initiated by the Lighting Division, are included in a proposed PLP for submission to the Public Lighting Vetting Committee (PLVC -Note 3) for approval. The total estimated cost of works in the PLP for 2015-16 is \$66.57 million (of which \$29.73 million for government projects is funded under relevant capital works projects, \$35.75 million for other lighting initiatives is funded under a non-recurrent expenditure subhead (Note 4) of the Capital Works Reserve Fund and \$1.09 million for private projects is funded by the private sector). Apart from the PLP, lighting installation works may also be carried out to meet urgent needs (e.g. additional lighting arising from complaints) upon approval by senior officers of the HyD (Note 5).

- **Note 2:** *Provision and maintenance of lighting in public housing estates under the purview of the Hong Kong Housing Authority is not covered in this audit review.*
- **Note 3:** The Committee is chaired by the Assistant Director/Technical of the HyD and comprises representatives from the Home Affairs Department and the Hong Kong Police Force.
- **Note 4:** The expenditure subhead covers highways, railways and railways development, bridges, subways, footways, street lighting as well as feasibility studies and site investigations in respect of highway projects. For 2015-16, the approved allocation under the purview of the Director of Highways is \$680 million.
- **Note 5:** The Chief Engineer of the Lighting Division and the directorate officers of the HyD at D3 level or above may approve individual public lighting works items up to \$5 million and \$10 million respectively.

#### **Operation and maintenance of road lighting**

1.7 *Management-operation-maintenance contracts (MOM contracts).* As at April 2015, the HyD had awarded three contracts for the management, installation, operation and maintenance of road lighting and traffic bollards (hereinafter collectively referred to as road lighting) with a total contract value of \$693 million. Each MOM contract is for a term of four years and covers different areas of Hong Kong (Note 6). The scope of work of the MOM contracts includes the following:

- (a) **Design.** The contractor shall carry out detailed design for the installation and maintenance of the road lighting system;
- (b) *Installation.* This includes planning, investigation, storage, removal, disposal, supply, installation, testing and commissioning of the road lighting system;
- (c) *Operation.* This includes routine inspection, patrolling, night scouting to ensure the availability of road lighting and attendance in response to fault calls; and
- (d) *Maintenance*. This includes scheduled maintenance works (e.g. regular cleaning of lanterns and group replacement of lamps), specified unscheduled maintenance works (e.g. fault finding and repair) and other as-required maintenance works (e.g. replacement of damaged lighting columns due to traffic accidents).

1.8 Under the MOM contracts, the contractors are paid for the design, operation, and scheduled and specified unscheduled maintenance works on a monthly lump-sum basis in accordance with a schedule of fees, subject to payment deductions in case of non-compliance with the performance requirements. They are required to maintain the monthly availability of the road lighting system at the contract specified level of not lower than 99.5%. New installation works, improvements and other as-required maintenance works are ordered by the HyD through the issue of works orders and are paid on a re-measurement basis.

Note 6: As at April 2015, the MOM contracts for New Territories West region, Hong Kong Island and Lamma Island region, and Kowloon and New Territories East region would expire in September 2015, September 2017 and September 2018 respectively. 1.9 The Lighting Division conducts field inspections to monitor the contractors' performance in various aspects. The contractors' performance is assessed quarterly in accordance with the procedures specified in the Contractor Management Handbook.

#### **Operation and maintenance of special lighting**

1.10 For the provision of comprehensive maintenance services for special lighting installations, the HyD has entered into a Service Level Agreement (SLA) with the Electrical and Mechanical Services Trading Fund (EMSTF — Note 7) of the Electrical and Mechanical Services Department (EMSD). The scope of work under the SLA covers the following:

- (a) General special lighting maintenance. Preventive maintenance, corrective maintenance, fault attendance and replies to public complaints for general special lighting installations (Note 8) are undertaken by an outsourced contractor. Besides providing professional advice, the EMSTF arranges and manages the outsourced services;
- (b) *Other special lighting maintenance.* The EMSTF provides comprehensive maintenance services, such as patrolling, fault attendance, preventive maintenance and corrective maintenance for other special lighting installations (Note 9);
- (c) *Provision of contract management and supervisory service.* The EMSTF provides the service to the lighting installations specified in the SLA through a dedicated team (Note 10); and
- **Note 7:** The EMSTF is the trading arm of the EMSD which provides electrical and mechanical services to government departments.
- **Note 8:** These include footbridge, subway, ferry concourse/walkway lighting and tram shelter lighting. There were 49,109 such special lights.
- **Note 9:** These include underpass, noise enclosure, high mast and high bay lighting. There were 30,116 such special lights.
- **Note 10:** The dedicated team, comprising lighting specialists and technicians, provides professional advice on lighting matters, initiates proposals to improve existing public lighting, provides design inputs for lighting projects, handles public complaints and monitors maintenance contractors/agents.

(d) *Group lamp replacement.* The EMSTF is responsible for group replacement of lamps on all special lighting.

Again, the EMSTF is required to maintain the monthly availability of the special lighting system at the SLA specified level of not lower than 99.5%.

1.11 In 2014-15, the HyD paid SLA charges (Note 11) totalling \$49 million to the EMSTF. According to the HyD, the SLA services are monitored through monthly performance reports submitted by the EMSTF. If there are any identified deficiencies in performance, the HyD will raise the issues at monthly meetings with the EMSTF. In May 2015, the SLA was renewed for another service period of four years up to March 2019.

#### Energy saving measures

1.12 At present, high pressure sodium lamps are adopted in the road lighting system. According to the HyD, these lamps have attained an energy saving of about 30% as compared to the electricity consumption of road lighting equipment used in the past. To enhance energy saving in public lighting, the HyD has conducted trials on using new energy-efficient road lighting products, e.g. Ceramic Discharge Metal Halide (CDM) lamps and Light Emitting Diode (LED) lamps.

### Audit review

1.13 In May 2015, the Audit Commission (Audit) commenced a review of the management of public lighting system with a view to identifying room for improvement. The review has focused on the following areas:

- (a) operation and maintenance of road lighting (PART 2);
- (b) operation and maintenance of special lighting (PART 3);
- **Note 11:** The SLA charges included contract payment for the outsourced general special lighting maintenance services mentioned in paragraph 1.10(a) plus 16% thereof being contract management fees and fixed fees for the EMSTF's services mentioned in paragraph 1.10(b) to (d).

- (c) installation of public lights (PART 4); and
- (d) implementation of energy saving measures (PART 5).

Audit has found room for improvement in the above areas and has made a number of recommendations to address the issues.

### Acknowledgement

1.14 Audit would like to acknowledge with gratitude the full cooperation of the staff of the HyD, the EMSD and the Home Affairs Department (HAD) during the course of the audit review.

### PART 2: OPERATION AND MAINTENANCE OF ROAD LIGHTING

2.1 This PART examines the following issues relating to the operation and maintenance of road lighting under the MOM contracts:

- (a) availability of the road lighting system (paras. 2.2 to 2.15);
- (b) attendance to fault calls (paras. 2.16 to 2.26);
- (c) management of maintenance works (paras. 2.27 to 2.38); and
- (d) management of the Public Lighting Information System (PLIS) (paras. 2.39 to 2.47).

### Availability of the road lighting system

2.2 Three MOM contracts with a total value of \$693 million were awarded to contractors for a term of four years. To ensure a high service level of road lighting, the HyD has laid down the following operational requirements in the MOM contracts:

- (a) the contractors shall ensure that the monthly availability of the road lighting system in the designated contract areas is maintained at not lower than 99.5%. Deductions will be made from the monthly lump-sum payment if the monthly availability is lower than that level; and
- (b) the contractors shall carry out night scouting daily to achieve a 100% check on the road lighting system within the designated contract areas on a weekly basis (except village lighting inaccessible by vehicles for safety reasons). The night scouting routes shall be pre-approved by the HyD. All lamp failures shall be reported to the HyD and repair works shall be completed within two days upon identification. Monthly reports on the scouting work planned and carried out shall be submitted to the HyD.

2.3 For the purpose of establishing the monthly availability of the road lighting system, the MOM contracts also provide that:

- (a) the HyD should carry out night inspections from time to time to determine the number of lighting points that are not properly and continuously lit. The level of outages shall exclude those caused by third party works/damage, power supply faults of the power companies and natural disasters; and
- (b) the monthly availability shall be calculated as follows:

100% - <u>100 x (total outages found by the HyD - excluded outages)</u> Total number of lighting points inspected by the HyD %

#### Monitoring the availability of road lighting system

2.4 *HyD's night inspection.* The purpose of the HyD's inspection is to monitor independently the availability of the road lighting system and the MOM contractors' performance. The HyD has issued the following instructions for its staff on night inspection arrangements:

(a) *Inspection route planning.* The scope of night inspections shall cover all lighting points that can be inspected by driving along vehicular routes. The inspection routes shall be designed to such an extent that the designated contract areas can be covered as much as possible and the inspection can be completed within the inspection time. In the first quarter of each year, an annual review of the inspection routes shall be carried out to cater for any new roads developed; and

(b) *Night inspection arrangements.* Night inspections shall be carried out by staff undertaking night-shift duties from Monday to Friday except public holidays. The routes to be inspected each night should be randomly selected (Note 12) by a designated officer (at the rank of engineer or above) using a computer programme such that the contractors would not know in advance of the routes to be inspected. Except under special circumstances which should be documented, all routes shall be inspected at least once a month.

2.5 According to the HyD's inspection reports, the stipulated monthly lighting availability of 99.5% had been met under the three MOM contracts in 2014. The availability ranged from 99.51% to 99.97%. However, Audit examination revealed room for improvement in monitoring the road lighting availability as detailed in paragraphs 2.6 to 2.13.

2.6 Inadequate coverage of lighting points in inspection routes. The HyD has set 51 vehicular routes for conducting night inspections since December 2013, i.e. 27 routes for the MOM contract of New Territories West region, 18 for Kowloon and New Territories East region, and 6 for Hong Kong Island and Lamma Island region. Audit found that as at April 2015, these 51 vehicular routes only covered 93,391 lighting points (i.e. 64% of the 145,823 lighting points within the three MOM contract areas — see Table 1 for details). There is a risk that any outage or substandard performance of the contractors in relation to the uninspected lighting points may not be detected.

**Note 12:** The random selection of routes was based on the Independent Commission Against Corruption's recommendation in 2012.

#### Table 1

	Number of lighting points		
Region	in the MOM contract area	covered by the HyD's inspection routes	not covered by the HyD's inspection routes
Hong Kong Island	18,841	15,399	3,442
and Lamma Island	(100%)	(82%)	(18%)
Kowloon and New	56,215	31,416	24,799
Territories East	(100%)	(56%)	(44%)
New Territories	70,767	46,576	24,191
West	(100%)	(66%)	(34%)
Overall	145,823	93,391 (Note)	52,432
	(100%)	(64%)	(36%)

#### Analysis of lighting point coverage of the HyD's inspection routes (April 2015)

Source: Audit analysis of HyD records

2.7 Audit sample checked some lighting points outside the 51 inspection routes and found that they were in fact accessible by vehicles (see Figure 1). According to the HyD, amongst the 52,432 lights not covered by its inspection routes, 38,032 (73%) were village lights or rear-lane and pedestrian-way lights not accessible by vehicles, i.e. the remaining 14,400 (27%) were directly accessible by vehicles. In Audit's view, the HyD needs to set adequate inspection routes to cover all the lighting points within the contract areas as far as possible.

*Note:* The HyD's inspection records showed that in 2014, on average, the 93,391 lighting points were each inspected 18.6 times.

#### Figure 1



#### HyD's inspection route (extract)

Source: Audit analysis of HyD records

*Remarks:* Roads accessible by vehicles but not covered by the HyD's inspection route

*HyD's inspection route* 

*Roads with lighting points not managed by the HyD (see Note 2 to para. 1.6)* 

2.8 *New roads not included in inspection routes.* According to the HyD's instructions for its staff, an annual review on the inspection routes shall be conducted in the first quarter of a year to cater for any new roads developed (see para. 2.4(a)). However, there was no record to show that such reviews had been conducted in 2014 and 2015. Audit found cases whereby lighting points installed on new roads were not covered in the inspection routes. For example, 241 lighting points installed on five new roads in Kai Tak area from November 2012 to December 2014 were not covered in the HyD's inspection routes (see Figure 2).

#### Figure 2



#### Lighting points on new roads not covered by HyD's inspection routes

Source: GeoInfo Map (www.map.gov.hk)

2.9 **Inadequate coverage of all routes in monthly inspections.** Audit examined the HyD's night inspection records for the period from July 2014 to June 2015 and found that the laid-down requirement for all designated routes to be inspected at least once a month (see para. 2.4(b)) was not always followed. The frequency of non-compliance was the highest for New Territories West region (ten out of 12 months — see details in Appendix B), followed by Hong Kong Island and Lamma Island region (two out of 12 months) and Kowloon and New Territories East region (one out of 12 months). Audit noted from a sample check that while 4 out of 27 routes in New Territories West region were not inspected in June 2015, another 17 routes were each inspected twice (the remaining 6 routes were each inspected once) in the same month. According to the HyD, the random nature of the route selection by a computer programme (see para. 2.4(b)) had led to the uneven coverage. Audit considers that the HyD needs to enhance the route selection

computer programme to cater for both the randomness of selection and the laid-down requirement of all designated routes to be selected for inspections at least once a month.

#### Use of remote control system to monitor road lighting

2.10 While the HyD has used automatic devices such as photo-electric controllers and timers to control the switching on/off of road lighting, adjustment of the pre-set illumination level and time due to changing circumstances still requires manual operation. For example, the normal operation of photo-electric controllers may be affected by the blockage of sunlight due to high rise buildings or tampering. The timer has to be adjusted according to the seasonal variations in sunlight durations.

2.11 In 2008, the HyD put into trial use a Public Lighting Control and Monitoring System (PLCMS — Note 13) to remotely monitor and control the on/off conditions of about 6,300 road lights. In a review of 2009, the HyD found that the PLCMS was effective in reducing the number of complaints (by 25% in comparison with road lights not monitored by the system), electricity consumption (by 4%) and manpower for monitoring road lights and resetting the timer. Since then, the use of the PLCMS had been extended. As at April 2015, the PLCMS covered 16,667 (11%) of 145,823 road lights.

2.12 In another review of 2014, the HyD considered it not cost-effective to further extend the use of the PLCMS to all road lights notwithstanding the expected reduction in the number of complaints by 50%. The HyD estimated that the capital cost and annual recurrent cost for the full implementation would amount to \$30 million and \$24.2 million respectively while the savings in the contractors' patrol cost would only be \$4.2 million. Moreover, the effectiveness of the PLCMS in detecting the outages was limited to two or more road light bulbs connected by the same control cubicle (see Photograph 1(b) in para. 1.2) whereas annually over 60% of the outage cases only involved a single light bulb.

**Note 13:** The system consists of local control units installed at the roadside public lighting control cubicles, which communicate via the cell phone network with the control centre such that the HyD's contractors can receive fault reports promptly for arranging repair works in a timely manner.

2.13 In reviewing the recent development in the PLCMS, Audit has found that the HyD needs to re-examine the cost-effectiveness of extending its use because:

- (a) in the 2014 review, the estimated annual recurrent cost of \$24.2 million was based on the monthly maintenance cost of \$0.25 million for 14,240 road lights controlled by 200 control units for the trial use of the PLCMS (see para. 2.11) under the previous MOM contract for Kowloon and New Territories East region. However, the monthly maintenance cost has been reduced by 89% from \$0.25 million to \$28,500 under the current MOM contract (Note 14);
- (b) the estimated capital cost of \$30 million was based on the installation of 3,840 new control units for about 140,000 road lights. According to the MOM contractor for Kowloon and New Territories East region, the design life of the existing 200 control units (mentioned in (a) above plus another 50 similar control units under the other two MOM contracts) is about 20 years and hence they can continue to be used without replacement;
- (c) the estimated savings only included the contractors' patrol cost while the savings in energy cost (see para. 2.11) and the HyD's inspection cost had not been taken into account; and
- (d) according to the technical proposal submitted by an MOM contractor, there is new technology in the market which enables the PLCMS to detect the fault of individual road lights.

**Note 14:** The monthly maintenance costs of \$0.25 million and \$28,500 were estimated by the HyD in 2010 and 2014 respectively, and included in the tender documents for the MOM contract for Kowloon and New Territories East region. Tenderers were requested to indicate 'plus' or 'minus' percentages for the HyD's estimated costs which would become the tenderers' tender price.

### Audit recommendations

- 2.14 Audit has *recommended* that the Director of Highways should:
  - (a) improve the monitoring of road lighting availability by:
    - (i) setting adequate inspection routes for the night inspections of the MOM contract areas with a view to covering all the lighting points as far as possible;
    - (ii) tightening control over the annual review of inspection routes to ensure that new roads are duly included in the routes; and
    - (iii) enhancing the route selection computer programme to cater for both the randomness of selection and the laid-down requirement for all designated routes to be selected for inspections at least once a month; and
  - (b) review the cost-effectiveness of extending the use of the PLCMS, taking into account factors such as changes in maintenance costs and advancement in technology.

### **Response from the Government**

2.15 The Director of Highways agrees with the audit recommendations.

### Attendance to fault calls

2.16 According to the operational requirements of the MOM contracts, the contractors shall set up 24-hour-operating call handling teams to receive fault calls referred by the 1823 Call Centre (Note 15). Upon receipt of fault calls, the

Note 15: The 1823 Call Centre of the Efficiency Unit operates Hotline 1823 to provide a 24-hour one-stop service for handling public enquiries on behalf of 22 departments (including the HyD) and public complaints against the Government.

contractors are required to arrive on site and to resume the operation of the road lighting equipment within the time limits specified in the contracts (see Table 2). From June 2014 to May 2015, 12,249 fault calls concerning road lighting, gantry sign and roadside directional sign lighting (see Photographs 1(g) and (h) in para. 1.2) and traffic bollards were received.

#### Table 2

#### Time limits for responding to fault calls

Type of work	Time limit (from the time the fault call is received)	
Response time (i.e. arrival time on site):		
Urgent fault call (Note)	Less than 2 hours	
Other fault call including fault call of outlying islands, except remote areas to be approved by the HyD	Less than 12 hours	
Time for fault rectification:		
Urgent fault repair involving minor adjustment or replacement of minor components	Less than 3 hours	
Other urgent fault repair	Less than 12 hours	
Non-urgent fault repair	Less than 24 hours	

#### Source: HyD records

Note: Urgent fault calls include those with safety implications or seriously affecting the operation of nearby road lighting system, such as leakage of electricity, falling columns/damaged columns due to traffic accidents, missing/loosen doors of public lighting control cubicles, cables or road lighting system equipment on fire and consecutive or multiple failures of more than 10 lamps from the same incoming power supply point.

2.17 After completion of fault rectification, the MOM contractors are required to provide a confirmation to the 1823 Call Centre (Note 16) within three calendar days. The contractors are paid for their attendance to fault calls on a lump-sum basis each month. Deductions will be made from the payments to the contractors if they fail to:

- (a) meet the specified fault rectification time limits (see Table 2 in para. 2.16); or
- (b) provide confirmations of fault rectification within three calendar days for 95% of the fault calls received in a month;

unless the failure is exempted by the HyD for reasons such as works on expressways or difficult locations, or irresolvable technical difficulties.

#### Time limits for rectifying faults not properly applied

2.18 At present, there are two time limits for rectifying urgent faults depending on the nature of repair required, i.e. less than 3 hours if the repair only involves minor adjustment or replacement of minor components and less than 12 hours for all other urgent fault cases. However, there is no definition of minor adjustment or replacement of minor components in the MOM contracts to differentiate them from other types of repair works. This could give rise to different interpretations which could be taken advantage of by a contractor to escape penalty for delays in completing fault rectification works.

2.19 From June 2014 to May 2015, the 1823 Call Centre referred a total of 12,249 fault calls (comprising 1,229 urgent calls and 11,020 non-urgent calls) to the three MOM contractors. According to the contractors' monthly reports of follow-up actions on these fault calls, the stipulated fault rectification time limits had been met for 12,102 (98.8%) fault calls. However, Audit examination of the case details attached to the monthly reports revealed the following issues:

**Note 16:** Since November 2014, the HyD has required the contractors to submit the confirmation of fault rectification within 3 calendar days for its vetting before replying to the 1823 Call Centre within 7 working days.

- (a) while one contractor used within 3-hour fault rectification time limit for measuring compliance for over 98% of its 511 urgent fault call cases, the other two contractors used within 12-hour time limit for measuring all their urgent fault call cases (i.e. 58 and 660 respectively). Audit considers that the HyD needs to review the different time limits used for measuring urgent fault call cases by the three contractors to see if they are fully justified having regard to the nature of the repair works required; and
- (b) according to the MOM contracts, the time limit for fault rectification shall commence from the time a fault call is received (see para. 2.16). While two of the three MOM contractors adhered to these rules in measuring their compliance, the remaining one failed to do so. Instead, the contractor used the time of its acknowledgement of the 1823 Call Centre's referral as the commencement point of the time limit. As there was a time lag between the 1823 Call Centre's referral and the contractor's acknowledgement, a number of the reported compliant cases had in fact exceeded the time limits counting from the times the fault calls were referred by the 1823 Call Centre. Audit found that the contractor had not reported its non-compliance in this way for 576 cases from June 2014 to May 2015 (see Table 3 for details).

#### Table 3

#### Unreported cases of non-compliance with time limits on fault call attendance (June 2014 to May 2015)

Turne of morth	Number of cases of non-compliance with the time limits			
Type of work	Urgent fault call	Non-urgent fault call	Total	
Arrival on site	46	292	338	
Fault rectification	82	156	238	
Total	128	448	576	

Source: Audit analysis of HyD records

# Non-compliance with time limit for providing confirmation of fault rectification

2.20 According to the contractors' monthly reports of follow-up actions on the fault calls from June 2014 to May 2015, the stipulated requirement to provide confirmation on fault rectification within three calendar days for 95% of the cases was fully met in all three MOM contracts. However, in examining the case details attached to the monthly reports, Audit again found instances of non-compliance. In fact, one contractor had not complied with the requirement throughout the 12-month period. The actual compliance rates ranged from 5% to 85% of the fault call cases. According to the MOM contract, payment may be deducted from the contractor for non-compliance. However, up to August 2015, no record was available to show that the HyD had enforced the payment deduction provisions against the contractor for the non-compliance.

2.21 In light of audit observations in paragraphs 2.18 to 2.20, the HyD needs to address the inadequacies in monitoring the contractors' performance in attending to fault calls. There is also a need to verify the accuracy of the monthly reports submitted by the contractors against the attached case details and enforce the payment deduction provisions where appropriate.

#### Inadequacies in HyD's site inspections of fault call cases

2.22 As part of the mechanism for monitoring the contractors' attendance to fault calls, the HyD requires its works supervisors for each MOM contract to conduct site inspections on selected cases to ascertain the completion of the repair works. However, in the absence of inspection guidelines, inconsistencies and inadequacies in the site inspection arrangements were noted. For one of the three contracts (i.e. Kowloon and New Territories East region), site inspection records were not maintained for supervisory review. Audit's sample check of the inspection records of the other two contracts for six selected months from January 2013 to May 2015 revealed marked variations in the frequency of inspection (i.e. ranging from 26% to 56% of the fault call cases received in a month for Hong Kong Island and Lamma Island region, and 0% to 19% for New Territories West region). There is a need to rationalise the frequency of inspection.
2.23 Since November 2014, the HyD has requested the contractors to submit photographs of their completed repair works as supporting documents. As these photographs serve similar purpose to the HyD's site inspections (i.e. ascertaining the completion of works), there may be scope for reducing the frequency of inspection if this new arrangement is formalised as a contractual requirement. However, the HyD had not incorporated such a requirement in the contract for New Territories West region commencing in October 2015. There is a need to formalise such requirement in future contracts. Moreover, in view of the greater reliance placed on the contractors' submitted photographs as evidence of their fault rectification works, there is a need to build in adequate safeguards (such as the new mobile reporting technology to be used by the EMSTF — see para. 3.23(d)) to ensure the authenticity of these photographs.

#### Performance pledge on fault calls

2.24 While the HyD has specified in the MOM contracts time limits for the contractors to respond to fault calls and rectify faults, it has not translated such service levels into performance pledges as commitments to the public. The HyD has only published the performance pledge for providing replies to public enquiries and complaints within seven working days. However, for special lighting in subways, footbridges and public transport interchanges which is maintained by the EMSTF under an SLA, the EMSD has published on its website the target response times to fault calls as a performance pledge. To enhance transparency and improve accountability, the HyD should consider doing the same.

#### Audit recommendations

- 2.25 Audit has *recommended* that the Director of Highways should:
  - (a) clearly define the two time limits for completing different types of repair works for urgent faults for the effective monitoring of contractors' performance in attending to fault calls;
  - (b) review the different time limits used for measuring urgent fault call cases by the three contractors (see para. 2.19(a)) to see if they are fully justified having regard to the nature of repair works involved and take appropriate action if there is any irregularity found;

- (c) seek explanations from the contractor concerned (see para. 2.19(b)) for not following the rules in measuring its compliance with the time limits for completing fault rectification works and take regulatory actions on confirmed cases of non-compliance in accordance with the contract provisions;
- (d) seek explanations from the contractor concerned (see para. 2.20) for stating in its monthly reports full compliance with the time limit in providing confirmation on fault rectification which was not substantiated by the case details and take regulatory actions on confirmed cases of non-compliance in accordance with the contract provisions;
- (e) address the inadequacies in monitoring the contractors' performance in attending to fault calls and verify the accuracy of contractors' monthly reports against the case details;
- (f) issue guidelines on site inspections of fault call cases to require staff concerned to:
  - (i) maintain proper records of their inspections;
  - (ii) rationalise the frequency of inspection, taking into account the assurance already provided by the contractors' photographs of their completed fault rectification works; and
  - (iii) **build in adequate safeguards to ensure the authenticity of the contractors' photographs of completed fault rectification works;**
- (g) formalise the arrangements for contractors to submit photographs of their completed fault rectification works as a contractual requirement; and
- (h) consider publishing performance pledges on target response times to fault call attendance and fault rectification under the MOM contracts to improve accountability and transparency.

# **Response from the Government**

2.26 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the HyD has been monitoring and will continue to closely monitor the contractors' performance and ensure their compliance with the time limits specified in the contracts;
- (b) regarding site inspections of fault call cases, since November 2014, the HyD has requested the contractors to report completion of fault repairs together with photographs of completed works (see para. 2.23) directly to the HyD's engineers who will check the compliance of all fault call cases handled by the contractors. The HyD will incorporate the relevant requirements in future contracts. Surprise checks have been conducted to verify the authenticity of the contractors' photographs. The HyD will review the frequency of site inspections so as to save resources and devise a standardised record format for site staff to record the inspection results; and
- (c) the HyD will explore the possibility of devising a performance pledge covering its responses to the public reports of faulty road lights that can be easily understood by the public.

# Management of maintenance works

2.27 Under the MOM contracts, the contractors are paid a monthly lump-sum fee to carry out the following maintenance works:

(a) *Scheduled maintenance works.* They mainly include annual inspection of all lighting equipment, periodic cleaning of lanterns and photo-electric controllers, and group replacement of lamps. The works shall be scheduled in an evenly distributed manner. The contractors are required to submit a programme (with the proposed dates and routes for the scheduled works) for approval by the HyD and monthly maintenance reports with details of works completed during the month; and

(b) *Specified unscheduled maintenance works*. They cover works such as fault repair, temporary restoration of lighting services and ad-hoc cleaning of graffiti as identified during the contractors' inspections or notified by the HyD. The contractors are required to complete the works within a specified time limit and report to the HyD on a monthly basis the works completed.

2.28 According to the MOM contracts, the HyD shall normally carry out inspections on 10% of the completed works to determine the items or quantities of scheduled maintenance works that are not in compliance with the contract requirements. Default notices will be issued to the contractors for the non-compliant items identified and deductions from the lump-sum payments will be made accordingly.

2.29 The HyD uses a computerised PLIS for managing information (such as location, specification, maintenance and fault history) of all its road lighting equipment. The MOM contractors are required to update information in the PLIS based on records of completed maintenance works.

# Scheduled maintenance works not carried out in accordance with stipulated frequencies

2.30 In their monthly reports submitted to the HyD, the contractors are required to state the reasons for any outstanding scheduled maintenance works and seek the HyD's agreement to reschedule the works with a view to completing them within a reasonable time. Audit examination of monthly reports from August 2014 to January 2015 revealed that some of the scheduled maintenance works could not be carried out mainly due to access problems such as obstructions by scaffolding, work sites, vegetation and locked gates. To ascertain whether such outstanding works have subsequently been completed to meet the stipulated maintenance frequency requirement, Audit analysed the last completion dates of the scheduled maintenance works as recorded in the PLIS as at 30 April 2015. As shown in Table 4, 14 types of scheduled maintenance works have been found not complying with the stipulated maintenance frequencies.

#### Table 4

### Types and number of works not complying with stipulated maintenance frequencies (30 April 2015)

Item	Type of scheduled maintenance works	Predetermined cycle	Total number of installations	Installations not maintained per predetermined cycles		
				Number	%	
Inspec	ctions of:					
1	lighting columns		131,152	9,304	7.1	
2	control cubicles	$O_{naa} o u \sigma \pi 12$	3,925	335	8.5	
3	traffic bollards	months	10,820	2,826	26.1	
4	gantry sign and roadside directional sign lighting		1,617	290	17.9	
Cleaning of:						
5	lanterns	Once every 6 months	98,165	10,260	10.5	
		Once every 12 months	43,141	914	2.1	
6	lighting columns with silicone painting or anti-graffiti coating		39,760	2,092	5.3	
7	control cubicles with silicone painting or anti-graffiti coating	Once every 6	593 (Note 1)	127	21.4	
8	photo-electric controllers	months	503 (Note 1)	15	3.0	
9	traffic bollards		10,820	536	5.0	
10	gantry sign and roadside directional sign lighting		1,617	625	38.7	

Item	Type of scheduled maintenance works	Predetermined cycle	Total number of installations	Installations not maintained per predetermined cycles	
				Number	%
Group	o replacement of lamps for:				
11		Once every 16 months	525	136	25.9
	read lights (Note 2)	Once every 18 months	19	0	0.0
	road lights (Note 2)	Once every 24 months	65,910	8,894	13.5
		Once every 36 months	74,686	21,658	29.0
12	ITTD-	Once every 16 months	6,194	730	11.8
	1188	Once every 18 months	3,706	51	1.4
13	gantry sign and roadside directional sign lighting	Once every 24 months	1,617	632	39.1
14	group re-painting of lighting columns	Once during the contract period	46,829	5,288 (Note 3)	11.3

#### Table 4 (Cont'd)

- Source: Audit analysis of HyD records
- *Note 1: The figures represented those for one region only as the dates of last cleaning of control cubicles were not recorded in the PLIS for the other two regions.*
- Note 2: 166 LED lamps were not subject to group replacement.
- *Note 3: These represented outstanding repainting works for lighting columns of completed contracts.*

As shown in item (1) of Table 4, of the 131,152 lighting columns, 9,304 (7.1%) were not inspected according to the predetermined cycle (i.e. once every 12 months). Ageing analysis of these 9,304 columns revealed that 941 (10.1%) had not been inspected for 3 years or more. Another example of non-compliant maintenance works which had been outstanding for a number of years related to cleaning of lanterns (see Appendix C for details). Audit considers that the situation is unsatisfactory as the scheduled maintenance works are important to keep the road lighting system working properly. The HyD needs to step up monitoring of the contractors' scheduled maintenance works to ensure that they are carried out in accordance with the stipulated frequencies.

2.32 As shown in Appendix C, there were cases of delay in carrying out the scheduled maintenance works by more than four years, i.e. before the terms of the current MOM contracts. For outstanding works arising from previous MOM contracts but for which payments had already been made as part of the monthly lump-sum fees, the HyD needs to follow up with contractors concerned on the remedial measures, seeking legal views where necessary. To prevent recurrence of similar problems, the HyD needs to consider incorporating suitable provisions in future MOM contracts for making deductions from the monthly lump-sum fees for the non-performance of maintenance works.

#### Need to review the replacement cycles of lamps

2.33 As can be seen in item (11) of Table 4, the replacement cycle of lamps ranged from 16 to 36 months depending on their types. Audit examined the current and the previous MOM contracts for the three regions and found that:

- (a) the replacement cycle for low wattage high pressure sodium lamps had been revised from once every 36 months to once every 24 months for MOM contracts commencing in October 2010 and thereafter;
- (b) the replacement cycle for fluorescent lamps had been revised from once every 24 months to once every 16 months for MOM contracts commencing in October 2013 and thereafter; and

(c) while the HyD's decisions to shorten the replacement cycles carried additional cost implication, justifications were not documented (Note 17).

2.34 Audit analyses of the last replacement dates for the two types of lamps recorded in the PLIS as at 30 April 2015 revealed that 8,093 lamps (comprising 7,957 low wattage high pressure sodium lamps and 136 florescent lamps) had not been replaced in accordance with the stipulated cycles (see Appendix D for details). The reported road lighting availability (ranging from 99.43% to 99.97%) from 2013 to 2014 suggests that the unreplaced lamps had worked longer than the existing Audit's field inspections of 8 of these lamps during replacement cycles. August 2015 revealed that all of them were still in working condition. In this connection, Audit noted that the HyD had excluded group replacement of lamps from the scheduled maintenance works list for the new MOM contract for New Territories West region commencing in October 2015 to allow greater flexibility in the timing of ordering the replacement works in future. In Audit's view, the HyD still needs to review the service lives of all types of lamps currently in use with a view to determining the most cost-effective replacement cycles.

#### Prolonged use of temporary overhead cables

2.35 According to the MOM contracts, when the power supply to a series of lights is faulted and cannot be repaired within a short time, the contractors shall arrange restoration of the lighting service by installing temporary overhead cables. The contractor shall remove all temporary overhead cables as soon as practicable by laying permanent cables.

2.36 Audit examination of the HyD's records revealed that there was prolonged use of temporary overhead cables in 245 locations as summarised in Table 5. These temporary overhead cables could pose safety concerns because according to the Code of Practice for the Electricity (Wiring) Regulations issued by the EMSD, the cables should have a minimum vertical clearance of 5.2 metres above ground. However, according to the PLIS records, many lampposts have a height of 5 metres only. A case in point is the New Territories West region where

**Note 17:** In September 2015, the HyD informed Audit that the replacement cycles of the lamps concerned had been reviewed and discussed at internal meetings where supplier information on the service lives of lamps and the complaint figures on unlit lamps were taken into consideration.

temporary overhead cables in 44 (25%) of 174 locations were spanning between lampposts of 5 metres in height as at 30 April 2015. An example of prolonged use of an overhead cable with vertical clearance not complying with the Code of Practice requirement is shown in Photograph 2.

#### Table 5

# Prolonged use of temporary overhead cables (30 April 2015)

Region	Number of locations with temporary overhead cables	Number of locations with prolonged use of temporary overhead cables
Kowloon and New Territories East	150	133 (89%) with cables installed from October 2005 to September 2010
New Territories West	174	103 (59%) with cables installed prior to October 2011
Hong Kong Island and Lamma Island	35	9 (26%) with cables in use for over 2 years
Overall	359	245 (68%)

Source: Audit analysis of HyD records

#### Photograph 2

#### A temporary overhead cable installed before October 2011



Source: Photograph taken by Audit at 5:58 pm on 17 September 2015

Remarks: According to HyD records, the overhead cable was installed before October 2011. The cable connecting two 5-metre lampposts did not comply with the EMSD's Code of Practice requirement on the minimum vertical clearance of 5.2 metres above ground.

# Audit recommendations

- 2.37 Audit has *recommended* that the Director of Highways should:
  - (a) step up monitoring of the contractors' scheduled maintenance works to ensure that they are carried out in accordance with the stipulated frequencies;
  - (b) consider incorporating suitable provisions in future MOM contracts for making deductions from the monthly lump-sum fees for the non-performance of maintenance works;

- (c) follow up outstanding maintenance works with contractors concerned for completed MOM contracts and where appropriate, seek legal advice on the possible actions to be taken;
- (d) review the service lives of all types of lamps currently in use with a view to determining the most cost-effective replacement cycles and keep proper records of the review results; and
- (e) require contractors concerned to expedite action on completing the outstanding scheduled maintenance works and the replacement of temporary overhead cables by permanent ones.

# **Response from the Government**

2.38 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the timely completion of scheduled maintenance works is subject to external constraints such as inclement weather and unforeseen obstructions. Under the contract provisions, when encountering such problems, contractors are required to submit revised programmes for the outstanding works for the HyD's agreement (see para. 2.30). The HyD has been monitoring and will continue to closely monitor the contractors' performance on scheduled maintenance works. For works which cannot be fully completed because of external constraints, the HyD will consider incorporating suitable provisions in future contracts; and
- (b) in contrast with the corrective repairs of numerous scattered individual faulty lamps after they reach the end of their service lives, group lamp replacement is a cost-effective preventive measure widely adopted overseas. Such an arrangement can also reduce the disruption in providing road lighting to the public. The HyD also considers that continuous review on replacement cycles of lamps is necessary with a view to saving costs. In this connection, the HyD has been collecting data of lamp failure for statistical analysis.

# Management of the Public Lighting Information System

2.39 As mentioned in paragraph 2.29, the MOM contractors are required to update information in the PLIS based on records of completed maintenance works. Besides, they have to conduct annual inspections to verify the PLIS data. Deductions from contract payments will be made if the HyD identifies inaccuracy in specified PLIS data (e.g. lampost locations).

### Discrepancies in lamppost locations

2.40 The MOM contractors are required to ensure that the locations of all lampposts recorded in the PLIS shall be consistent with a set of electronic base maps of the Lands Department (Lands D). They should report to the HyD any discrepancies over 3 metres found in the lamppost locations as recorded in the PLIS and the base maps. Based on the contractors' regular updates on lamppost locations, the HyD will inform the Lands D to update its maps, including the GeoInfo Map which is available to the general public for searching locations of buildings and public facilities (including lamppost locations) in Hong Kong.

2.41 In a review of lamppost locations as at 31 December 2014, the HyD found that 12,751 (10% of the total 131,152) lampposts recorded in the PLIS had deviated for more than 3 metres from the locations recorded in the GeoInfo Map (see details in Appendix E).

2.42 As at August 2015, the HyD was still in the process of verifying and rectifying the discrepancies. Audit considers that the HyD needs to set a target completion date for verifying/rectifying the discrepancies found between the PLIS and the GeoInfo Map.

### Incomplete records in PLIS

2.43 Audit examination of the PLIS records revealed cases of incomplete records:

- (a) Gantry sign and roadside directional sign lighting. Regarding the 1,617 records of gantry sign and roadside directional sign lighting kept in the PLIS as at 30 April 2015, Audit found that 98% had one or more of the required data missing (see details in Appendix F);
- (b) Lighting cable drawpits. For the 7,600 records of drawpits (see Photograph 1(d) in para. 1.2 for an example) kept in the PLIS, as at July 2015, the required data found missing included number of spare cable ducts (4,586 or 60%) and number of ducts with cables (4,626 or 61%); and
- (c) *Fault history.* According to the MOM contracts, the contractors should maintain the fault history (including the nature of fault) of all types of road lighting equipment in the PLIS. Audit found that only the fault history for cables was maintained in the PLIS but not for other types of lighting equipment (e.g. lamppost). Audit examination of the cable fault records (Note 18) also revealed that for one region, there was no record of cable faults after December 2013.

2.44 The large number of records in the PLIS found with inaccurate and incomplete data (see paras. 2.40 to 2.43) is unsatisfactory as the PLIS may no longer be able to support accurate analysis of systemic maintenance issues. It also raises the question on the adequacies of the HyD's monitoring of the contractors' annual inspections and maintenance of PLIS records. In this connection, Audit found that in the 6-month period from August 2014 to January 2015, only 6% (instead of the laid-down 10% — see para. 2.28) of the completed works in Hong Kong Island and Lamma Island region were selected for inspection in 5 of the 6 months. Audit examination of the HyD's inspection records of completed maintenance works for gantry sign and roadside directional sign lighting also revealed that the HyD had failed to identify cases of missing required data in the PLIS as mentioned in paragraph 2.43(a) which should be subject to contract payment deductions (see para. 2.39). The HyD needs to take prompt actions to rectify the problems.

**Note 18:** As at June 2015, the numbers of cable fault records for Hong Kong Island and Lamma Island region, Kowloon and New Territories East region, and New Territories West region were 1,695, 2,222 and 3,898 respectively.

- 2.45 In September 2015, upon Audit's enquiry, the HyD said that:
  - (a) the existing PLIS had been developed for over 10 years. Owing to limited resources, there had been no technical support for system maintenance or upgrading; and
  - (b) there were deficiencies in the PLIS. For example, there was no interface with the contractors' database. Due to changed circumstances, some data fields had become less important for daily road lighting operation and maintenance works.

In Audit's view, the HyD should carry out a review of the PLIS with a view to improving the system performance for better supporting road lighting maintenance works.

# Audit recommendations

- 2.46 Audit has *recommended* that the Director of Highways should:
  - (a) set a target completion date for verifying/rectifying the discrepancies found in the lamppost locations between the PLIS and the GeoInfo Map;
  - (b) require the contractors concerned to:
    - (i) take prompt actions to rectify the problems of inaccurate and incomplete records in the PLIS; and
    - (ii) account for the failure to detect such problems in their annual inspections of lampposts, and gantry sign and roadside directional sign lighting;
  - (c) take regulatory actions against any non-compliance with the contract requirements on proper maintenance of the PLIS records;

- (d) remind relevant staff to carry out inspections on the contractors' completed works as laid down in the MOM contracts; and
- (e) conduct a review of the PLIS with a view to improving the system performance for better supporting road lighting maintenance works.

# **Response from the Government**

2.47 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) from road lighting maintenance point of view, the lamppost positional accuracy does not affect the maintenance works. Notwithstanding this, the HyD still wishes to enhance the data accuracy as an action of continuous improvement. The HyD is using the Mobile Mapping System Technology for capturing and verifying lamppost positions. The HyD has commenced to rectify the discrepancies for Hong Kong Island and anticipates that the rectification work can be completed by the end of the first quarter of 2016. Rectification of all the discrepancies is expected to be completed by the end of the third quarter of 2018;
- (b) the HyD will continue to ensure that the contractors update PLIS records in accordance with contract requirements and to ensure the accuracy of the data provided;
- (c) the HyD has already revised the inspection criteria on contractor's maintenance works in the new MOM contract based on the inventory and available resources. A payment deduction mechanism has been adopted with reference to the inspection results with a view to enhancing the quality of the maintenance works; and
- (d) the HyD has started a review of the PLIS in 2014 and is seeking funding from the Office of the Government Chief Information Officer for its upgrading. Through the upgrading, the PLIS and the associated database will be enhanced and revamped to improve the efficiency of the system in handling the large amount of data with high accuracy.

# PART 3: OPERATION AND MAINTENANCE OF SPECIAL LIGHTING

3.1 This PART examines the following issues relating to the operation and maintenance of special lighting under the SLA between the HyD and the EMSTF:

- (a) availability of the special lighting system (paras. 3.4 to 3.11);
- (b) attendance to fault calls (paras. 3.12 to 3.18); and
- (c) scheduled maintenance works (paras. 3.19 and 3.20).

#### Subcontracting arrangements under SLA

3.2 In 2014-15, the HyD paid SLA charges totalling \$49 million to the EMSTF. As mentioned in paragraph 1.10(a), the maintenance of general special lighting installations under the SLA is undertaken by an outsourced contractor (Subcontractor A). The EMSTF's roles are arranging and managing the outsourced contract. Similarly, for some of the other special lighting installations (viz. the high bay lighting at public transport interchanges and some of the high mast lighting), the EMSTF has subcontracted the maintenance works to two other subcontractors (Subcontractors B and C). The three subcontracts together cover 58,997 (74%) of the 79,225 special lights as at April 2015 under the SLA. Maintenance of the remaining 26% special lighting installations is handled by the EMSTF in-house staff (see Table 6). The scope of work under the subcontracts includes patrol service on the lighting operation, fault call attendance and scheduled maintenance works (e.g. group replacement of lamps). The EMSTF issues works orders to the subcontractors for carrying out these maintenance works and pays for their services on a re-measurement basis.

#### Table 6

#### Distribution of maintenance responsibilities for special lighting (April 2015)

Maintenance agent	Number of lighting points (%)		
Subcontractor A for maintaining general special lighting in 1,049 locations (Note 1)	49,109 (62%)		
Subcontractor B for maintaining high bay lighting at 77 public transport interchanges	8,492 (10%)		
Subcontractor C for maintaining high mast lighting in 19 locations (Note 2)	1,396 (2%)		
Subtotal	58,997 (74%)		
EMSTF in-house staff for maintaining the remainder of other special lighting in 108 locations (Note 3)	20,228 (26%)		
Total	79,225 (100%)		

Source: EMSTF records

- *Note 1: These comprised 460 footbridges, 399 subways, 93 ferry concourses/walkways and 97 tram shelters.*
- *Note 2: Patrolling of high mast lighting in the Kowloon areas is carried out by EMSTF in-house staff.*
- *Note 3:* Special lighting points directly maintained by EMSTF staff included those in underpasses and noise enclosures.

3.3 The EMSTF has laid down guidelines for its staff to conduct spot checks on the subcontractors' works. The percentage of check varies for different types of works (e.g. 5% check on patrol service and 100% check on group replacement of lamps). The subcontractors have to submit reports on their completed works to the EMSTF on a regular basis. Based on these reports and those compiled by its in-house maintenance staff, the EMSTF provides monthly performance reports to the HyD.

# Availability of the special lighting system

3.4 Similar to the MOM contracts for road lighting, the HyD has laid down the following operational requirements in the SLA to ensure a high service level of special lighting:

- (a) the target average equipment availability shall be 99.5% on a monthly basis; and
- (b) patrol service on the lighting operation shall be conducted once bi-weekly.

# Equipment availability requirement not reflected in general special lighting subcontract

3.5 Under the general special lighting subcontract, Subcontractor A is responsible for providing patrol service on the lighting operation and carrying out repair works (Note 19). However, Audit noted that the 99.5% equipment availability requirement stipulated in the SLA had not been incorporated in the general special lighting subcontract. The omission is unsatisfactory as the attainment of an overall 99.5% equipment availability depends to a large extent on Subcontractor A's maintenance works (which covers 62% of the total special lighting points — see Table 6 in para. 3.2). There is a need to make Subcontractor A aware of and contractually responsible for meeting the equipment availability requirement for lighting installations under its purview.

**Note 19:** For the high bay and high mast lighting subcontracts, Subcontractors B and C may be required to carry out repair works upon the issue of works orders by the EMSTF.

### Inadequacies in the basis of calculating equipment availability

3.6 Unlike the MOM contracts, the SLA has not stipulated the method for calculating the equipment availability of the special lighting system. According to the HyD and the EMSTF, the following formula had been used to calculate the monthly equipment availability figures:

100 x number of faulty lights referred by100% -the 1823 Call Centre and subsequently confirmedTotal number of lighting points inspected during regular patrols

3.7 Audit noted that there were inadequacies in using the number of faulty lights in the above formula as it only represented those faulty lights which had become the subject of public complaints. The monthly equipment availability of special lighting so determined might not fully reflect the overall lighting operation, particularly in areas less frequented by the public. For example, in 2014-15, the 1823 Call Centre received complaints about 1,542 faulty special lights while the EMSTF and its subcontractors reported a total of 39,470 faulty special lights in that year (Note 20). Given that the SLA has required regular patrols for all special lighting installations which are subject to the EMSTF's spot checks, it would appear more appropriate to use the number of faulty lights as identified by such patrols for calculating the equipment availability of special lighting.

3.8 In response to Audit's enquiry, the EMSTF and the HyD agreed in June 2015 to adopt the number of faulty lights identified by regular patrols for calculating the monthly equipment availability. According to the EMSTF, using the revised methodology, the monthly equipment availability figures for 2014-15 would fall below the SLA requirement of 99.5% (i.e. ranging from 98.7% to 99.4%) instead of those reported by the EMSTF using the formula mentioned in paragraph 3.6 (ranging from 99.8% to 100% — see Appendix G for details).

**Note 20:** The number of faulty lights excluded those found in underpasses/noise enclosures as such information was not available (see para. 3.17).

# Special lighting points omitted from regular patrol service

3.9 According to the SLA, the patrol service on lighting operations shall cover the special lighting points listed in the SLA and any subsequent additions during the agreement period. In 2014, the HyD developed a computerised Special Lighting Information System for managing information of its special lighting points. In checking the HyD's computer records of special lighting points against those listed in the 2015 SLA, Audit found that 4 footbridges/subways (involving 329 special lighting points) were not listed in the SLA. By checking the special lighting points listed in the SLA to the three subcontracts and the patrol reports, Audit also found that 18 footbridges/walkways (involving 1,558 special lighting points) were missing in the subcontract and hence the patrol routes. In other words, a total of 22 footbridges/subways/walkways (involving 1,887 special lighting points) were omitted from the regular patrol service.

3.10 In August 2015, Audit carried out site inspections of 3 of these 22 footbridges/subways/walkways omitted from the regular patrol service and found that 2 had a total of 28 unlit lights (see Photographs 3 and 4 for examples). Audit considers that the HyD and the EMSTF need to tighten control to ensure that all special lighting points are listed in the SLA/subcontract and covered in the regular patrol service.

#### Photograph 3

#### A footbridge in Admiralty not covered by regular patrol service



Source: Photograph taken by Audit at 7:25 pm on 7 August 2015

*Legend:* → 7 *unlit lights* 

Remarks: There were 16 more unlit lights on the other side of the footbridge not captured in this photograph.

#### Photograph 4

A footbridge in San Po Kong not covered by regular patrol service

Source: Photograph taken by Audit at 7:12 pm on 27 August 2015

*Legend:*  $\rightarrow$  2 unlit lights

*Remarks:* There were 3 more unlit lights on the other sections of the footbridge not captured in this photograph.

#### Reduced patrol frequency in SLA not yet implemented

3.11 In the previous SLA (April 2013 to March 2015), the HyD required the EMSTF to provide patrol service for lighting operation on a weekly basis. Since the commencement of the current SLA in April 2015, the HyD has required the EMSTF to reduce the frequency of the patrol service from weekly to bi-weekly having regard to the past low failure rates of special lighting installations. However, the EMSTF had not made corresponding adjustments to the patrol frequency of the three ongoing subcontracts which was based on the previous SLA's requirement (Note 21). As a result, the subcontractors had continued to provide the patrol service on a weekly basis from April 2015 and additional cost was incurred for patrol service that was superfluous to the HyD's requirement (Note 22).

# Attendance to fault calls

3.12 According to the SLA, the EMSTF has to respond to any complaints and reports on faulty lights, and complete the repair works within the specified time limits as shown in Table 7.

- Note 21: In September 2015, the EMSTF informed Audit that works orders for carrying out patrols based on previous SLA requirement had been issued to the subcontractors on 31 March, and 8 and 20 May 2015, before the current SLA was officially signed on 28 May 2015. However, Audit noted that the reduced patrol frequency requirement had been incorporated in the draft SLA for discussion between the HyD and the EMSTF in November 2014. Moreover, the EMSTF continued to issue a works order based on the old requirement to Subcontractor B in July 2015.
- Note 22: Additional service cost of about \$0.05 million a month was borne by the HyD as under the SLA, it reimbursed the EMSTF the contract payments of the general special lighting subcontract plus 16% management fees (see para. 1.11). Additional service cost of about \$0.04 million a month under the other two subcontracts was borne by the EMSTF.

#### Table 7

Nature of fault	<b>Response time</b> (arrival time on site)	Fault rectification time	Compliance level (Note 1)
Major (Note 2)	Within 2 hours	Minor repair (Note 3): Within 3 hours Others: Within 24 hours	98.5%
Minor	Within 24 hours	Within 72 hours	98.5%

#### Fault call response time requirements

Source: HyD records

- *Note 1: The compliance level was revised from 98% to 98.5% for SLAs commencing in April 2013 and afterwards.*
- Note 2: Major fault is defined as power failure or total tripping of the main circuit breaker of subways, footbridges, ferry concourses/walkways, underpasses, high bay and high mast lighting covered under the SLA. All other faults are classified as minor faults.
- *Note 3: Minor repair refers to minor adjustment or replacement of minor components (including faulty photo-electric controllers leading to abnormal operating time of special lighting installations).*

# Lower service standards on fault call attendance in SLA than MOM contracts

3.13 Under the MOM contracts for road lighting, the contractors have to arrive on site within two hours upon receipt of an urgent fault call and complete minor repairs within three hours. The completion time for more complicated repairs to urgent faults would be less than 12 hours, and repairs to non-urgent faults would be less than 24 hours (see Table 2 in para. 2.16). The SLA used different terminologies from the MOM contracts (see Table 7 in para. 3.12) to represent fault cases accorded with different priorities (i.e. major faults instead of urgent faults to stand for priority cases, and minor faults instead of non-urgent faults to stand for non-priority cases). In essence, the service standards in the SLA were lower than those of the MOM contracts, as follows:

- (a) *Priority cases.* While the response time of two hours for major faults under the SLA was the same as that for urgent fault calls under the MOM contracts, the fault rectification time limit of within 24 hours was longer than the within 12 hours allowed in the MOM contracts when more complicated repair was involved; and
- (b) *Non-priority cases.* For minor faults in the SLA, the response time was within 24 hours and fault rectification time was within 72 hours which were longer than within 12 hours and 24 hours respectively for non-urgent faults in the MOM contracts.

3.14 In September 2015, the HyD informed Audit that the main reason for adopting lower service standards in the SLA was that most of the special lighting facilities were for pedestrians (i.e. those under the general special lighting subcontract — see Note 1 to Table 6 in para. 3.2) with less concern in traffic safety. For special lighting in underpasses and noise enclosures which usually involved more complicated electrical systems than road lighting, it would take a longer time for rectifying complicated faults. However, Audit noted that the target equipment availability for the SLA had not been met in 2014-15 (see para. 3.8) and lamp failure in pedestrian-related facilities was a contributing factor. For public safety, Audit considers that there is a need to closely monitor the situation and consider aligning the fault attendance service standards for general special lighting in the SLA with those in the MOM contracts where warranted by circumstances.

# Service standard on fault call attendance not duly reflected in general special lighting subcontract

3.15 Under the general special lighting subcontract, Subcontractor A shall handle emergency fault calls and public complaints, and carry out repair works in accordance with the specified service standard. However, Audit noted that the service standard on fault call attendance laid down in the SLA in April 2013 was not duly reflected in the general special lighting subcontract. For the subcontract commencing in May 2013, the compliance level was still set at 98% instead of the

98.5% (Note 23) required in the April 2013 SLA (see Note 1 to Table 7 in para. 3.12). According to the EMSTF, although the compliance level was set at 98%, it has been managing Subcontractor A to meet the SLA requirement of 98.5%. Notwithstanding this, there is a need for the EMSTF to incorporate the SLA's service standard on fault call attendance to ensure its enforceability on the subcontractor.

3.16 In a scrutiny of the EMSTF/Subcontractor A's fault attendance reports for January 2015, Audit found that the detailed response times and rectification times were not always recorded by Subcontractor A (i.e. only the dates were provided). As timeliness of the fault rectification works is a key performance indicator, the EMSTF needs to remind Subcontractor A to record all key dates/times in the fault attendance reports.

# Rectification of faults identified during regular patrols

3.17 While the SLA requires the conduct of regular patrols of special lighting installations, no time limit has been imposed on the rectification of any faulty lights found during the patrols (the MOM contracts have stipulated time limits in this regard — see para. 2.2(b)). Audit sample checked the subcontractors' patrol reports and found that there were delays in rectifying the faulty lights so identified:

(a) *General special lighting subcontract.* According to Subcontractor A's patrol reports from May 2013 to June 2015, some 325 lights in 13 locations had been repeatedly reported to be faulty (see Photographs 5 and 6 for examples) but repair works had remained outstanding as at June 2015 (see Appendix H for details). In September 2015, the EMSTF informed Audit that for most of the delay cases, the repair works would require replacement of underground cables or removal of obstructions; and

**Note 23:** According to the EMSTF, the tender specifications for the May 2013 subcontract was issued in January 2013 based on the then prevailing SLA requirement. However, Audit noted that the EMSTF had not made subsequent amendment to the standard in the subcontract to tie in with the April 2013 SLA requirement.

(b) High bay and high mast lighting subcontracts. According to patrol reports submitted by Subcontractors B and C from April 2014 to March 2015, 25 high bay lights in 9 public transport interchanges and 18 high mast lights in 5 locations had been repeatedly reported to be faulty but repair works had remained outstanding as at March 2015 (Note 24).

Regular patrols of special lighting in underpasses/noise enclosures are carried out by the EMSTF staff. According to the EMSTF, the replacement of faulty lights in these places would involve road closure. To minimise the disruption to traffic, the SLA allowed a lamp failure rate of 10% at these locations but in practice, the EMSTF would arrange rectification works before 10% of the lights were found to be faulty. Audit noted from the EMSTF's patrol report for March 2015 that faulty lights in underpasses and noise enclosures were found but the number was not recorded. Without the faulty light information, there is a risk that the rectification works might not be conducted in a timely manner.

**Note 24:** According to the EMSTF, for about half of the faulty lights, there were access difficulties or their repair works required removal of obstructions.

#### Photograph 5

Faulty lights in Central not yet rectified since identification in May 2013

Source: Photograph taken by Audit at 9:43 pm on 19 August 2015

*Legend:*  $\longrightarrow$  2 unlit lights

#### Photograph 6

Faulty lights of a footbridge at Salisbury Road not yet rectified since identification in March 2014



Source: Photograph taken by Audit at 9:41 pm on 19 August 2015

Legend:  $\longrightarrow$  3 unlit lights

3.18 Delays in rectifying faulty lights could increase safety risks to pedestrians and other road users. There is a need to expedite action in this regard, especially in light of the consistently unmet target equipment availability in 2014-15 (see para. 3.8).

# Scheduled maintenance works

3.19 Under the SLA, the EMSTF has to arrange scheduled maintenance works for the special lighting installations, including periodic group replacement of lamps and cleaning of lanterns. For those installations under the subcontractors' purview, the EMSTF would issue works orders for them to carry out the scheduled maintenance works.

# Scheduled maintenance works not carried out in accordance with the stipulated frequencies

3.20 Audit examination of the completed works reports of the EMSTF and subcontractors for the previous SLA period (i.e. April 2013 to March 2015) revealed that periodic group replacement of lamps and cleaning of lanterns were not carried out in accordance with the stipulated frequencies in the SLA (see Table 8 for details). The situation is unsatisfactory as the scheduled maintenance works are important to keep the special lighting installations working properly.

#### Table 8

#### Types and number of maintenance works not complying with the stipulated frequencies (April 2013 to March 2015)

			Number of locations not			
Type of	Stipulated frequency	Total	maintained in accordance with			
scheduled		number of	stipulated frequencies			
maintenance		locations	throughout	occasionally		
WOLKS			2 years	(Note)		
			(%)	(%)		
(A) Cleaning of lan	tterns:	200	54	207		
Subway		389	54	297		
Deathridee		42.4	(13.9%)	(70.5%)		
Footbridge		434	96	248		
<b></b>		02	(22.1%)	(57.1%)		
Ferry concourse/	Once every 12 months	93	38	53		
Walkway		05	(40.9%)	(37.0%)		
I ram snelter		95	$\begin{pmatrix} 0 \\ (6, 207) \end{pmatrix}$	89 (02.7 <i>1</i> %)		
High most		21	(0.5%)	(93.7%)		
High mast		21	0	13 (61.007)		
High how		70	(38.1%)	(01.9%)		
nigii bay		70		(0.0%)		
Undernass/noise	Once every 6 months	100	(0.0%)	(9.0%)		
enclosure		100	(72 0%)	(28.0%)		
(R) Group replaces	(P) Crown replacement of lamps:					
Subway	Once every 12 months	389	55	296		
Subway	Chee every 12 months	507	(14.1%)	(76.1%)		
Footbridge		434	96	0		
1 000011480			(22.1%)	(0.0%)		
Ferry concourse/		93	38	0		
walkway	Once every 18 months		(40.9%)	(0.0%)		
Tram shelter		95	6	0		
			(6.3%)	(0.0%)		
High mast	Once every 36 months	21	0	0		
			(0.0%)	(0.0%)		
High bay	Once every 18 months for white	78	11	0		
	light source lamps / Once every		(14.1%)	(0.0%)		
	36 months for high pressure					
	sodium lamps					
Underpass/noise	Once every 12 months for	100	44	22		
enclosure	fluorescent lamps / Once every		(44.0%)	(22.0%)		
	36 months for high pressure					
	sodium lamps					

Source: Audit analysis of EMSTF records

*Note:* For example, according to the stipulated frequency, lanterns in subways should be cleaned twice during the 2-year period but the lanterns in 297 subways were only cleaned once.

# Audit recommendations

3.21 Audit has *recommended* that the Director of Electrical and Mechanical Services should:

- (a) incorporate the target equipment availability requirement and fault attendance service standard of the SLA in the general special lighting subcontract;
- (b) in conjunction with the Director of Highways:
  - (i) closely monitor the achievement of the target equipment availability requirement of the SLA and step up maintenance efforts if there is any indication that the target is not met;
  - (ii) immediately incorporate the omitted footbridges/subways/walkways (mentioned in paragraph 3.9) in the SLA/subcontract for providing the regular patrol service, rectify any faulty lights thereat and tighten control to prevent similar omission in future; and
  - (iii) tighten control to ensure that any revised service requirements of a new SLA are promptly reflected in the subcontracts;
- (c) remind Subcontractor A to record all key dates/times in fault attendance reports;
- (d) keep proper records of faulty lights found in underpasses/noise enclosures;
- (e) speed up rectification of faulty lights found during regular patrols; and
- (f) tighten control to ensure that the group replacement of lamps and cleaning of lanterns are carried out in accordance with the stipulated frequencies in the SLA.

3.22 Audit has also *recommended* that the Director of Highways should closely monitor the equipment availability for general special lighting and consider aligning the fault attendance service standards for general special lighting in the SLA with those used in the MOM contracts for road lighting where warranted by circumstances.

# **Response from the Government**

3.23 The Director of Electrical and Mechanical Services agrees with the audit recommendations. He has said that the following improvement measures have been/will be taken:

- (a) the EMSTF has put in place various measures to cope with the revised methodology for calculating the monthly equipment availability. The SLA requirement of 99.5% equipment availability had been met from June to September 2015;
- (b) the target equipment availability requirement and the fault attendance service standard as laid down in the SLA have been incorporated in the draft tender specifications of the upcoming general special lighting subcontract;
- (c) the 22 footbridges/subways/walkways omitted from the database and hence the regular patrol service have been added to the SLA/subcontract. The associated faulty lights have already been rectified. Besides timely updating, the EMSTF will tighten its control to prevent similar recurrences by performing a data matching among the records of the HyD, the EMSTF, and the subcontractors on a quarterly basis;
- (d) Subcontractor A was reminded in August 2015 to record all key dates/times in the fault attendance reports and it has complied with the requirement since September 2015. Besides, a mobile reporting technology that automatically logs all key dates/times will also be used in all subcontracts;
- (e) video/photo recording has been used during patrolling of underpasses/noise enclosures to assist the counting and keeping of proper records of identified faulty lights;

- (f) Subcontractor A has been reminded to speed up rectification of faulty lights found during regular patrols. Complicated cases involving special arrangements (such as road closure) would be brought up in time at monthly meetings between the HyD and the EMSTF if the fault remains unresolved for over one month; and
- (g) based on the EMSTF's operation experience and with the HyD's agreement, the group lamp replacement frequencies specified in the 2015 SLA had been extended by six months for most types of lamps. To ensure that group replacement of lamps and cleaning of lanterns are carried out in accordance with the stipulated frequencies in the SLA, a mobile reporting technology will be used for keeping track of the scheduled maintenance activities of all subcontractors, and the EMSTF's computerised contractor reporting system will be enhanced to ensure subcontractors' adherence to the maintenance programme.

3.24 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the HyD understands that the target equipment availability figures are affected by complicated cases. The EMSTF has agreed to bring up all these cases at monthly meetings to alert the HyD;
- (b) after the setting up of the Special Lighting Information System in 2014, the HyD has commenced to cross-check data with the EMSTF's database to ensure data accuracy. The omitted locations found by Audit (see para. 3.9) have been included for regular patrol service;
- (c) the HyD will discuss the renewal of the SLA with the EMSTF at an earlier stage so that the EMSTF can promptly incorporate any new requirements in its subcontracts; and
- (d) the HyD will closely monitor the equipment availability for general special lighting and consider aligning the fault attendance service standards for general special lighting in the SLA with those used in the MOM contracts for road lighting where warranted by circumstances.

# **PART 4: INSTALLATION OF PUBLIC LIGHTS**

4.1 This PART examines the HyD's work on installation of public lights, focusing on the following areas:

- (a) installation of road lights (paras. 4.2 to 4.7); and
- (b) installation of village lights (paras. 4.8 to 4.20).

# **Installation of road lights**

4.2 As mentioned in paragraph 1.6, lighting installation works are mainly carried out under the PLP approved by the PLVC annually (Note 25). At the end of each year, the HyD provides the PLVC with a situation report of the installation works completed in the year and the outstanding works to be carried out. According to the situation report of March 2015, while 2,805 road lights had been installed in 2014-15, 2,919 new road lights (1,182 under road projects and 1,737 on existing roads) approved under the PLPs for 2014-15 and before had not been installed as at 31 March 2015. As lighting installation works under road projects have to tie in with the respective project implementation which is beyond the scope of this audit, this PART focuses on installation of new lights on existing roads.

### Inadequacies in monitoring long outstanding works

4.3 In early July 2015, Audit requested the Lighting Division to provide a breakdown of the 1,737 outstanding road lights mentioned in the situation report by year of approval for analysis. The HyD provided Audit with the requested information in mid-August 2015 as it was not the HyD's practice to use ageing analyses for monitoring outstanding installation works. The HyD also informed Audit that the 1,737 outstanding road lights figure stated in the March 2015 situation report was inaccurate as detailed in Table 9.

**Note 25:** According to the HyD, the approved lighting installations are subject to further investigations of feasibility.

#### Table 9

	Number of outstanding road lights provided by HyD in August 2015				
PLP year	Breakdown of the March 2015 situation report (a)	Amended figures (b)	Discrepancy (c) = (a) - (b)		
2010-11	33	28 71	5		
2011-12	74	43 5 71	31		
2012-13	320	321	-1		
2013-14	341	328 5 649	13		
2014-15	969	814	155		
Total	1,737	1,534	203		

#### Discrepancy of outstanding road light figures in the March 2015 situation report

Source: Audit analysis of HyD records

4.4 As shown in Table 9, as at March 2015, of the 1,534 approved road lights pending installation, 71 (5%) had been outstanding for more than three years after PLVC approval. In response to Audit's enquiries on these 71 outstanding road lights, in September 2015, the HyD said that:

(a) *Case 1.* In accordance with the HyD's proposed lighting improvement, installation of 23 new road lights and upgrading of 5 existing road lights in Ap Lei Chau were approved in 2010-11. The lighting condition of the subject area was subsequently improved after the upgrading of 5 existing road lights in 2011 and installation of a road light under another project in 2012. The installation of the 23 new road lights was no longer required as measurements conducted in March 2014 and August 2015 had confirmed the adequacy of the lighting level;
(b) *Case 2.* In response to a request from the Hong Kong Police Force (HKPF), for safety and security reasons, installation of 2 new road lights in a rear lane in Western District (see Photograph 7) was approved in 2010-11. Installation works were found not feasible in 2012 due to obstructions by underground utilities. The HKPF was informed of the result in August 2015;

#### Photograph 7

#### Approved lighting installation in a rear lane subsequently found not feasible



Source: Photograph taken by Audit at 7:00 pm on 22 August 2015

(c) Cases 3 to 7. In response to complaints lodged by the public and requests from the HKPF, installation of 16 road lights in Aberdeen, Happy Valley and Tuen Mun was approved in 2010-11 and 2011-12. After the HyD's reviews of the five cases, 12 road lights were not required as the lighting levels were found adequate and installation of two other lights was found not feasible. As a result, only two lights would be installed; and

(d) *Cases 8 and 9.* Upgrading of 30 road lights in various districts was approved in 2011-12 for energy saving purposes. The upgrading works of 17 road lights had been completed by June 2015. The upgrading of the other 13 road lights was found technically not feasible after the HyD's review in September 2015.

4.5 It is unsatisfactory that the 71 approved road lights to enhance the safety of road users/achieve energy saving were only dealt with after a lapse of over 3 years, i.e. completed works (17 in number), confirmed unnecessary/not feasible (52 in number) and followed-up action taken (2 in number). To prevent recurrence of similar problem, the HyD needs to step up monitoring of the progress of approved installation works by providing the PLVC with accurate situation reports and ageing analyses of the outstanding cases. Meanwhile, the HyD also needs to expedite action on the 649 road lights that had remained outstanding for over one year as at March 2015 (see Table 9 in para. 4.3).

# Audit recommendations

- 4.6 Audit has *recommended* that the Director of Highways should:
  - (a) step up monitoring of the progress of lighting installation works by providing the PLVC with accurate situation reports and ageing analyses of outstanding cases; and
  - (b) expedite action on the 649 road lights that had remained outstanding for over one year (see Table 9 in para. 4.3).

## **Response from the Government**

4.7 The Director of Highways agrees with the audit recommendations. He has said that the HyD has been monitoring the progress of lighting installation works, and will continue to review and enhance the monitoring as appropriate with a view to expediting action on the 649 road lights that had been outstanding for over one year.

# Installation of village lights

4.8 Apart from road lighting, the HyD is also responsible for providing village lighting in the New Territories and on outlying islands (see para. 1.6). Having regard to the manpower resources and available funding, the HyD sets an annual quota for the number of village lights to be installed under the PLP. The Lighting Division plans, designs and monitors the installation works.

4.9 According to the Village Lighting Procedure agreed between the HyD and the HAD, the HAD is responsible for coordinating applications for village lighting and according priorities to these applications. According to the HAD, if the total number of initial applications received by its District Offices exceeds the annual quota, the HAD Headquarters will distribute the quota on a pro-rata basis among the applicant districts. Upon receipt of the district quota, the District Offices will prioritise the lighting requests mainly based on the date of application (Note 26). Site meetings will be arranged with relevant parties to agree on the locations of lights and cables to be installed. Subsequently, the applications will be submitted to the PLVC for approving the installation works. A flowchart for village lighting installation is at Appendix I. Audit examination of village lighting installation works revealed room for improvement as set out in paragraphs 4.10 to 4.17.

### Unmet demand for village lighting

4.10 From 2005-06 to 2015-16, the annual quotas of village lighting installation varied from 400 to 2,000 which turned out to be insufficient to meet the village lighting applications received by the District Offices. According to the HyD's database, the number of lights installed during the period (up to August 2015) was 7,205, averaging 655 per year. In 2007-08, there was a waiting list of about 3,000 village lights, mostly in Yuen Long, North District and Tai Po. District Councillors and rural leaders expressed their concerns on the slow progress. At a conference on village lights held in July 2007, some Members of the

**Note 26:** According to the HAD's guidelines, individual District Office staff also take into consideration other relevant factors (such as views of rural committees and villagers and residents, utilisation of access roads and availability of lighting facilities in the vicinity) in according priorities to lighting proposals.

Legislative Council (LegCo) requested the Government to clear the backlog of waitlisted applications in one go. The HyD implemented an accelerated programme to clear the backlog of waitlisted applications from 2008-09 to 2010-11 through redeployment of internal resources.

4.11 In 2012, the HAD informed the HyD that the number of village lighting applications waitlisted for inclusion in the PLP had built up again and requested the HyD to consider increasing the installation quota. However, in the recent four years 2012-13 to 2015-16, the annual quota had remained at 400. With an unmet demand averaging 684 village lights each year from July 2012 to June 2015, the number of waitlisted village lights for inclusion in the PLP had increased to 2,693 as at June 2015 (see Appendix J for an ageing analysis).

4.12 Even assuming no new applications, if the annual installation quota remains at 400, it may take more than 6 years to clear the backlog of 2,693 waitlisted village lights. The long waiting time for providing village lighting could increase safety risks to villagers. The HyD needs to take measures to meet the demand for village lighting in good time.

### Slow progress in installing village lights

4.13 From 2005-06 to 2015-16, the PLVC approved the installation of 9,075 village lights. According to the HyD's database, as at August 2015, 7,205 (79%) of the approved lights had been installed and 1,870 (21%) were outstanding. Ageing analysis of 1,750 outstanding village lights (Note 27) showed that 822 (47%) had remained outstanding for over three years.

#### Audit examination

4.14 Audit sample checked 45 outstanding village light cases as at August 2015 and found that there were inadequacies in the HAD's and the HyD's follow-up actions in 21 (47%) cases:

**Note 27:** Of the 1,870 outstanding village lights, 120 were replacement cases (see para. 4.17 and Note 29). They were excluded from the ageing analysis as the dates of their replacement were not recorded in the HyD's database.

- (a) *Cancelled/completed cases.* In 5 (11% of 45) cases, the installation works had been completed or cancelled. Apparently, the HyD's records of outstanding works had not been kept up-to-date;
- (b) Long time taken by the HAD in following up approved cases. In 12 (27%) cases, the HAD took a long time to take follow-up actions. For example, in one case of approved village lights in 2009-10, the HAD only arranged a site meeting (see Appendix I) in December 2014 (after a lapse of five years) despite the HyD's reminder in May 2013 and a public enquiry in October 2014. In another approved case involving 13 village lights in 2009-10, a site meeting was conducted in August 2009 at which the installation locations for 4 lights were confirmed but those for the remaining 9 village lights had yet to be identified. The HAD only followed up the case again in April 2014 (after a lapse of more than four years); and
- (c) **Delay in taking follow-up action by the HyD.** In 4 (9%) cases, there were delays in taking follow-up actions by the HyD. In three of the four cases, as a result of the delays, a restart of the installation process from the site meeting stage was necessary. For example, in one case, after resolving local objections in 2008, the HyD requested the Lands D to post on site a one-month notice of the installation works. There was no record to show that the HyD had followed up with the Lands D on the outcome. In April 2014 (after more than five years), upon the HAD's enquiry, the HyD resumed action. However, due to the long lapse of time, another site meeting had to be conducted in November 2014.

4.15 In response to Audit's enquiry, in October 2015, the HAD said that after a review in conjunction with the HyD, the number of outstanding village lights had decreased from 1,750 in August 2015 to 1,461 in October 2015 due to the following:

(a) 263 village lights involving unresolved local objections were identified for deletion from the PLP and should not be regarded as outstanding. Their quotas would be subject to re-prioritisation (see para. 4.17); and

(b) the status of 26 village lights installed before August 2015 was recently updated in the HyD's database.

The status of the 1,461 outstanding lights is shown in Appendix K.

4.16 It is unsatisfactory that 553 (38%) of the 1,461 approved village lights had remained outstanding for over three years after inclusion in the PLP (see Appendix K). Of the 1,461 outstanding lights, 302 (21%) were pending arrangement of site meetings after inclusion in the PLP. This was not in accordance with the Village Lighting Procedure, which has stipulated that site meetings should be held (see Appendix I) before seeking approval from the PLVC (Note 28). The delays in providing village lighting may increase safety risks to villagers. To clear the backlog, the HyD and the HAD need to consider arranging another accelerated programme similar to that carried out from 2008-09 to 2010-11. There is also a need to step up monitoring of the progress of the approved installation works to ensure no delays in setting up site meetings and taking follow-up actions. Besides, the HyD needs to keep up-to-date the status information of approved village lighting installation works in its database.

#### **Re-prioritisation of approved works items**

4.17 The re-prioritisation of approved works items in October 2015 (see para. 4.15(a)) was the second such initiative since 2013. At a PLVC meeting held in March 2013, the HyD expressed concern on the delays of installation works due to unresolved local objections and sought the HAD's advice on whether such cases could be deleted from the PLP. However, the HAD considered that such cases should be kept in the PLP. In October 2013, the HyD requested the HAD to review cases involving unresolved local objections and cases pending site meeting without known reasons (involving 962 village lights at that time). After a review, the HAD

**Note 28:** According to the HAD, it took time to set up site meetings that suited the schedule of all stakeholders, reach consensus on lighting locations and cable routes through repeated negotiations, and make arrangement for installation works by the HyD.

and the HyD agreed in June 2014 that 215 outstanding village lights (Note 29) should be replaced by other more urgent applications in the waiting list. Similarly, after a review in October 2015, the HAD considered that the quotas for 263 lights could be re-prioritised (see para. 4.15(a)). While such re-prioritisation of the approved installation cases is conducive to better utilisation of resources in providing village lighting, there is a need to keep the PLVC informed of the changes.

# Audit recommendations

- 4.18 Audit has *recommended* that the Director of Highways should:
  - (a) take measures to meet the demand for village lighting in good time;
  - (b) consider implementing another accelerated installation programme to clear the backlog of approved village lighting works in one go;
  - (c) in collaboration with the Director of Home Affairs, step up monitoring of the progress of the approved village lighting installation works to ensure that there is no delay in setting up site meetings and taking follow-up actions;
  - (d) keep up-to-date the status information of approved village lighting installation works in the HyD's database; and
  - (e) in consultation with the Director of Home Affairs, keep the PLVC informed of any re-prioritisation of the approved installation works items.

Note 29: Of the 215 lights, 95 had been installed and 120 were outstanding as at August 2015.

# **Response from the Government**

4.19 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the installation of village lights is carried out based on the available resources and the increasing number of village lights has incurred large amount of recurrent expenditure. Based on the current resources, the HyD cannot meet the demand for village lighting. The HyD will discuss with the HAD to bid for additional resources to clear the backlog as well as for the associated recurrent consequences; and
- (b) the database on village lighting installation is being modified to comprehensively monitor the different steps of village lighting installation works. The HyD will keep the PLVC informed of any changes of the approved PLP items and seek endorsement from the PLVC accordingly.

4.20 The Director of Home Affairs agrees with the audit recommendations. She has said that:

- (a) the HAD welcomes the issues highlighted in this Audit Report with a view to meeting the demand for village lighting in good time; and
- (b) the HAD will work closely with the HyD to step up monitoring of the progress of the approved lighting installation works to ensure setting up site meetings and taking follow-up actions as early as possible.

# PART 5: IMPLEMENTATION OF ENERGY SAVING MEASURES

5.1 This PART examines the HyD's implementation of energy saving measures for the public lighting system.

#### **Energy saving measures**

5.2 Over the years, the HyD has made efforts to reduce energy consumption of the public lighting system. For example, the high pressure sodium lamps widely adopted in the road lighting system have attained an energy saving of about 30% as compared to the electricity consumption of road lighting equipment used in the past (see para. 1.12). From 2010-11 to 2014-15, while the number of public lights increased by 6% from 223,300 to 235,600, the electricity consumption decreased by 3% from 136.3 million kilowatt-hours (kWh) to 132.6 million kWh (see Figure 3).

#### Figure 3





Source: HyD records

5.3 In March 2014, the HyD reported to the LegCo Panel on Transport the implementation of the following energy saving measures:

- (a) **Dimmable electronic ballasts** (Note 30) for road lights. There were about 20,000 road lights operated with light bulbs of wattage higher than necessary (Note 31) due to unavailability of light bulbs of appropriate wattages. Starting from 2006, the HyD had progressively installed dimmable electronic ballasts to reduce the luminosity of these lamps to save energy. The HyD anticipated that, with the installation of electronic ballasts for all these lamps, by the end of 2014, an annual saving of about 20% in electricity consumption could be achieved;
- (b) *CDM lamps.* Given their better colour rendering (Note 32), energy saving could be achieved if CDM lamps with wattage lower than high pressure sodium lamps were used on subsidiary roads. The HyD had installed about 2,650 CDM lamps and was planning to install more in different districts and on different types of subsidiary roads to test their performance and acceptance by the public; and
- (c) *LED lights.* Given their better colour rendering, LED lights with wattage lower than high pressure sodium lamps could be used to enhance energy saving (see Note 33). The HyD had selected certified LED lights for

- **Note 30:** A ballast is a device that regulates the electrical current to a lamp and the voltage to start a lamp.
- **Note 31:** The wattage of a light bulb increased with discrete steps. When the luminosity required at a road section fell between two successive wattage steps, the HyD used a light bulb of higher wattage to ensure sufficient lighting, resulting in higher-than-necessary wattage in some lamps.
- **Note 32:** *Better colour rendering means that an object appears richer in colour and less loss in colour fidelity when illuminated by a light source with wider spectrum.*
- **Note 33:** *LED lights are solid state semiconductor devices that convert electrical energy into visible light. They are environmentally friendly as they produce higher lighting level per watt and their service lives can be 3 to 6 times longer than compact fluorescent lamps.*

trial use to observe their actual performance (Note 34). However, the cost-effectiveness of LED lights was low (Note 35) and the time was not yet ripe to adopt LED road lighting.

5.4 In January 2015, the Chief Executive of the Hong Kong Special Administrative Region announced in his Policy Address that the Government was setting a new target of achieving a 5% saving in electricity consumption for government buildings. To support the Government's energy saving initiative, the HyD needs to step up its efforts to implement energy saving measures for the public lighting system. Against this background, Audit has reviewed the progress of the HyD in implementing energy saving measures and the results are shown in paragraphs 5.5 to 5.10.

### Use of electronic ballasts

5.5 There are two types of electronic ballasts (i.e. dimmable and non-dimmable) that can save energy. As mentioned in paragraph 5.3(a), dimmable electronic ballasts can be used for light bulbs of higher wattage than necessary to reduce their luminosity. Non-dimmable electronic ballasts can be used to replace electromagnetic ballasts that have been used on non-high-speed roads (Note 36) to reduce energy loss. As at September 2015, 17,965 dimmable electronic ballasts had been installed.

5.6 *Non-compliance with requirement of installing non-dimmable electronic ballasts.* In August 2008, the Lighting Division of the HyD issued an instruction for its staff (Divisional Instruction) specifying that:

- **Note 34:** Up to August 2015, the HyD had installed for trial use 157 LED lights on roads and 672 LED light tubes at footbridges.
- Note 35: According to the HyD, the unit price of medium power LED light in 2014 of about \$14,000 was 10 times higher than that of a high pressure sodium light. If an LED light was used for replacing a high pressure sodium lamp, the electricity cost saving was only about \$200 per annum. The cost-effectiveness was lower than that of the high pressure sodium lamps and CDM lamps.
- **Note 36:** According to the HyD, there were limitations in the application of electronic ballasts to certain environmental conditions or types of road lights.

- (a) failed electromagnetic ballasts on non-high-speed roads should be replaced by non-dimmable electronic ballasts; and
- (b) non-dimmable electronic ballasts should be used for new installations on non-high-speed roads.

As at August 2015, for non-high-speed roads, 3,577 road lights were provided with non-dimmable electronic ballasts while 106,481 were using electromagnetic ballasts. Audit reviewed 735 non-high-speed roads with 3,841 ballasts installed/replaced between 2009-10 and 2014-15 (i.e. after the issue of the 2008 Divisional Instruction) and found that only 792 (21%) were non-dimmable electronic ballasts (Note 37). The remaining 3,049 (79%) were still electromagnetic ballasts, not in compliance with the requirement of the 2008 Divisional Instruction. Audit noted that as at May 2015, the HyD had not incorporated the Divisional Instruction requirement in one of the three MOM contracts (i.e. the contract for New Territories West region — Note 38). The HyD needs to incorporate its Divisional Instruction requirement in MOM contracts in future and take measures to ensure its compliance.

### Use of CDM lamps

5.7 According to the HyD, the use of a CDM lamp instead of a high pressure sodium lamp can achieve an energy saving of 30%. In June 2013, the Lighting Division issued a Divisional Instruction requiring the replacement of high pressure sodium lamps by CDM lamps on subsidiary roads. As there was no requirement in the MOM contracts for replacing high pressure sodium lamps with CDM lamps on subsidiary roads, works orders had to be issued to instruct the contractors to make such a replacement on a case-by-case basis. However, Audit noted that the HyD had not always done so.

- **Note 37:** According to the HyD, the cost of a non-dimmable electronic ballast ranged from \$312 to \$561.
- **Note 38:** In October 2015, the HyD informed Audit that the requirement had been incorporated in the New Territories West MOM contract commencing in October 2015.

5.8 In response to Audit's enquiry in September 2015, the HyD said that as the LED lighting technology grew rapidly in the last two years, the HyD slowed down the replacement of CDM lamps to see whether it could choose LED lights as a new lighting source. In view of the changed circumstances, the HyD needs to review the 2013 Divisional Instruction requirement on the use of CDM lamps on subsidiary roads and continue to monitor the latest development of LED lights for consideration of their wider application in the public lighting system.

#### Progress in implementing other energy saving measures

5.9 The HyD has made ongoing efforts in conducting researches and trial uses of other energy saving devices. After confirming their cost-effectiveness, the HyD's current practice is to use the energy saving devices for new lighting installations and replace damaged devices in existing installations. The progress in implementing these energy saving measures is summarised below:

- (a) Use of non-illuminated retro-reflective traffic bollards (NRTBs) to replace ITBs. Since 2006, the HyD had put on trial use of NRTBs (see Photograph 8) to replace ITBs (see Photograph 1(c) in para. 1.2). An evaluation in January 2015 confirmed that replacing ITBs by NRTBs could achieve energy and cost savings (Note 39). According to the HyD, to avoid unnecessary disposal of existing ITBs, NRTBs would be used for new installations and replacing damaged ITBs at suitable locations (Note 40). As at April 2015, of the 10,820 traffic bollards installed, 9,900 (91%) were ITBs and 920 (9%) were NRTBs;
- Note 39: An ITB is illuminated by an internal light source for its body to be seen conspicuously at night time. It is susceptible to traffic collisions resulting in high damage rate and high maintenance cost. An NRTB is installed with a retro-reflective sign plate to render its legibility at night. Its design incorporates a spring assembly to return the sign plate to its upright position after collisions so as to reduce the repair cost. As an NRTB does not require electricity to operate, there would be an energy saving of approximately \$120 per annum for each ITB replaced.
- **Note 40:** These included slip road junctions, refuge islands, and rear sides of refuge islands at T-road junctions and cross-road junctions. NRTBs were not suitable for locations where drivers could not see the signage at a reasonable stopping distance.

#### Photograph 8



#### A non-illuminated retro-reflective traffic bollard

Source: Photograph taken by Audit at 8:00 am on 4 September 2015

(b) Replacement of T8 fluorescent tubes by T5 fluorescent tubes at footbridges and subways. According to the EMSD, the use of T5 fluorescent tubes to replace T8 fluorescent tubes could achieve an energy saving of 20% to 30%. Since 2010-11, the HyD had proposed works in the PLPs for replacing deteriorating T8 fluorescent tubes with T5 fluorescent tubes for footbridges and subways. As at April 2015, of the 38,385 fluorescent tubes installed at footbridges and subways, 31,518 (82%) were T8 fluorescent tubes and 6,867 (18%) were T5 fluorescent tubes; and

(c) Implementation of energy saving improvement works at footbridges. In August 2011, after a review of the lighting levels of footbridges, the HyD's Consultant recommended energy saving optimisation schemes for 318 footbridges. In September 2011, the Lighting Division issued a Divisional Instruction specifying the need for lowering a lighting class (Note 41) for most of the new footbridges and footbridges requiring light reinstallation. Up to August 2015 (about 4 years later), the HyD had implemented energy saving measures for 135 (42%) of the 318 footbridges (Note 42).

5.10 *Need to review the pace of adopting energy saving devices.* According to the HyD's practice, the HyD will adopt energy saving devices for new installations and replacing failed or damaged devices (see para. 5.9). While this practice can avoid unnecessary disposal of existing devices, it takes a longer time to realise the benefits of the energy saving devices. For example, only 18% of the T8 fluorescent tubes were replaced by T5 fluorescent tubes after a lapse of 5 years (see para. 5.9(b) and item (B) of Table 8 in para. 3.20). The HyD needs to consider conducting a review of the cost-effectiveness of speeding up the use of energy saving devices in the public lighting system, especially when the existing devices are approaching the end of their service lives.

### Audit recommendations

- 5.11 Audit has *recommended* that the Director of Highways should:
  - (a) take measures to ensure that the MOM contractors comply with the 2008 Divisional Instruction requirement on replacing electromagnetic ballasts by non-dimmable electronic ones;
- **Note 41:** According to the Instruction, there are four lighting classes for covered footbridges, ranging from 30 lux to 100 lux, and the lighting level requirements for some footbridges are revised to attain energy saving. For example, for covered footbridges in urban or new town areas with relatively open structural form, the minimum illuminance required has been reduced from 60-80 lux to 60 lux.
- **Note 42:** These included installation of dimmable electronic ballasts, replacement of T8 fluorescent tubes by T5 fluorescent tubes and LED tubes, and reducing the number of lamps at footbridges.

- (b) review the 2013 Divisional Instruction on the use of CDM lamps on subsidiary roads and continue to monitor the latest development of LED lights for consideration of their wider application in the public lighting system; and
- (c) consider conducting a review of the cost-effectiveness of speeding up the use of energy saving devices, especially when the existing devices are approaching the end of their service lives.

# **Response from the Government**

5.12 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the HyD will continue to keep abreast of the latest technology and market development of LED lights for consideration of their wider application in the public lighting system; and
- (b) to avoid creating unnecessary waste and to ensure the quality and safety of new products, the HyD has been conducting a cost-and-benefit analysis and a series of trials before implementing an energy saving measure. Capital cost, maintenance cost and electricity saving will be considered in the analysis. The HyD will keep abreast of the latest technology and market trends and review the cost and benefit of energy saving measures from time to time.

## Highways Department: Organisation chart (extract) (30 June 2015)



Source: HyD records

Month July 2014	Routes no out of a tota	t inspected l of 27 routes	Lighting points not inspected out of a total of 46,576 lighting points		
	(Number)	(%)	(Number)	(%)	
July 2014	4	14.8%	7,901	17.0%	
August 2014	0	_	0	_	
September 2014	2	7.4%	4,177	9.0%	
October 2014	2	7.4%	4,485	9.6%	
November 2014	5	18.5%	9,153	19.7%	
December 2014	3	11.1%	7,087	15.2%	
January 2015	0	_	0	_	
February 2015	2	7.4%	4,851	10.4%	
March 2015	1	3.7%	3,006	6.5%	
April 2015	6	22.2%	11,812	25.4%	
May 2015	4	14.8%	5,519	11.8%	
June 2015	4	14.8%	6,616	14.2%	

# HyD's night inspections for New Territories West region (July 2014 to June 2015)

Appendix C (paras. 2.31 and 2.32 refer)

# Ageing analysis of lighting columns without annual inspection (30 April 2015)

Years without annual inspection	Number of lighting columns			
Over 1 year to less than 2 years	7,577 (82%)			
2 years to less than 3 years	786 (8%)			
3 years to less than 4 years	201			
4 years to less than 5 years	172 > 941 (10%)			
5 years or more	568			
Total	9,304 (100%)			

# Ageing analysis of lanterns without bi-annual cleaning (30 April 2015)

Years without bi-annual cleaning	Number of lanterns
Over 0.5 year to less than 1 year	8,907 (87%)
1 year to less than 2 years	792 (8%)
2 years to less than 3 years	295
3 years to less than 4 years	88
4 years to less than 5 years	11 561 (5%)
5 years or more	167
Total	10,260 (100%)

## Ageing analysis of low wattage high pressure sodium lamps not replaced within the stipulated cycle (30 April 2015)

Service time in excess of the 2-year replacement cycle	Number of lamps
Over 2 years to less than 3 years	671 (8%)
3 years to less than 4 years	4,566 (57%)
4 years to less than 5 years	360 (5%)
5 years or more	2,360 (30%)
Total	7,957 (100%)

## Ageing analysis of fluorescent lamps not replaced within the stipulated cycle (30 April 2015)

Service time in excess of the 16-month replacement cycle	Number of lamps
Over 16 months to less than 3 years	10 (7%)
3 years to less than 4 years	30 (22%)
4 years to less than 5 years	17 (13%)
5 years or more	79 (58%)
Total	136 (100%)

# Analysis of discrepancies in lamppost locations (31 December 2014)

Discrepancy between the lamppost locations recorded in the PLIS and the GeoInfo Map	Number of lampposts		
Over 3 metres but no more than 10 metres	10,102 (79%)		
Over 10 metres but no more than 20 metres	1,260 (10%)		
Over 20 metres but no more than 100 metres	583 (5%)		
Over 100 metres but no more than 1,000 metres	122 (1%)		
Over 1,000 metres	684 (5%)		
Total	12,751 (100%)		

Appendix F (para. 2.43(a) refers)

## PLIS records of gantry sign and roadside directional sign lighting found with missing data (30 April 2015)

<b>Required data found missing</b>	Number of incomplete records (% of total 1,617 records) (Note)		
Location	46 (3%)		
Number of lamps	147 (9%)		
Mounting height	463 (29%)		
Transport Department Reference number	518 (32%)		
Utility number	1,529 (95%)		

Source: Audit analysis of HyD records

*Note:* Of the 1,617 records, 1,580 (98%) were found with one or more of the required data missing.

Appendix G (para. 3.8 refers)

Month	Monthly equipment availability using the original formula	Monthly equipment availability using the revised methodology (Note 1)
Apr 2014	99.9%	98.9%
May 2014	99.9%	98.7%
Jun 2014	99.8%	98.8%
Jul 2014	99.8%	99.0%
Aug 2014	99.9%	99.0%
Sep 2014	99.9%	99.0%
Oct 2014	99.9%	99.2%
Nov 2014	99.9%	99.3%
Dec 2014	100.0%	99.3%
Jan 2015	100.0% Note 2	99.3%
Feb 2015	100.0%	99.4%
Mar 2015	100.0%	99.3%

## Monthly equipment availability of special lighting (April 2014 to March 2015)

Source: EMSTF and HyD records

- *Note 1:* The number of faulty lights used for calculating the availability excluded those found in underpasses/noise enclosures as such information was not available (see para. 3.17).
- *Note 2:* The figures were rounded up to 100% as the reported numbers of faulty lamps for these months were not significant.

# Faulty lights identified by Subcontractor A pending rectification (June 2015)

Item No.	Location	No. of faulty lights reported but not yet rectified as at June 2015	Explanations provided by EMSTF in September 2015 for not carrying out the rectification works
1	Tram shelter at junction of Ice House Street and Des Voeux Road Central	9 (since Jan 2014)	Repair works were obstructed by advertisement signs requiring temporary relocation by the tram company.
2	Walkway at junction of Chater Road and Ice House Street	70 (since May 2013)	
3	Walkway near Pedder Street	16 (since May 2013)	
4	Walkway near Chater Road	70 (since May 2013)	Repair works would require replacement of underground cables.
5	Walkway near Ice House Street	12 (since Mar 2014)	
6	Walkway near Connaught Road Central	90 (since May 2013)	
7	Tram shelter at junction of Foo Ming Street and Percival Street	9 (since Apr 2014)	Repair works were completed in July 2015.
8	Footbridge across Salisbury Road, Tsim Sha Tsui East Footbridge No. 2	>10 (since Mar 2014)	The footbridge had recently been renovated by the contractor of the Works Division of the HyD and it was still under the defects liability period. (However, there was no evidence that the HyD's contractor had been informed to take follow-up action.)

## Appendix H (Cont'd) (para. 3.17(a) refers)

Item No.	Location	No. of faulty lights reported but not yet rectified as at June 2015	Explanations provided by EMSTF in September 2015 for not carrying out the rectification works	
9	Footbridge across Salisbury Road, Tsim Sha Tsui East	>10 (since Dec 2013)	Same as item 8.	
10	Subway across Prince Edward Road, San Po Kong	>10 (since Apr 2014)	Repair works would require replacement of underground cable.	
11	Tram shelter at junction of Jubilee Street and Des Voeux Road Central	9 (since Jan 2014)	Repair works were obstructed by advertisement signs requiring temporary relocation by the tram company.	
12	Footbridge across Fleming Road	2 (since May 2013)	There were obstructions by other works in progress.	
13	Footbridge near Pak Wo Road	8 (since May 2013)	There were obstructions by other works in progress.	
	Total	> 325		

Source: Audit analysis of EMSTF records

**Appendix I** (paras. 4.9, 4.14(b) and 4.16 refer)





Source: Audit analysis of HyD records

*Note:* While the Public Lighting Ordinance empowers the Director of Highways to install lighting on both public and private roads, the present procedure is to post a notice on site to inform land owners and residents who will be affected by the installation works so that they may raise objections for the Government's consideration.

#### Appendix J (para. 4.11 refers)

## Ageing analysis of village lights on the waiting list (30 June 2015)

	No. of wa				
District	before 30.6.2012	between 1.7.2012 and 30.6.2013	between 1.7.2013 and 30.6.2014	between 1.7.2014 and 30.6.2015	Total no. of waitlisted lights as at 30.6.2015
	(a)	<b>(b</b> )	(c)	( <b>d</b> )	(e)=(a)+(b)+(c)+(d)
Yuen Long	246	238	195	243	922
North District	156	141	153	133	583
Tai Po	0	74	173	146	393
Islands	59	74	56	34	223
Sai Kung	71	36	57	37	201
Tuen Mun	43	63	36	40	182
Tsuen Wan	37	20	16	17	90
Sha Tin	30	11	19	17	77
Kwai Tsing	0	2	8	8	18
Eastern	0	0	2	2	4
Total	642	659	715	677	2,693 (Note)

#### Source: HAD records

*Note:* Apart from these 2,693 lights requested by the HAD, there were 9 lights requested by other parties and 59 installed lights due for replacement. Taken together, the total number of waitlisted village lights was 2,761 as at 30 June 2015.

Appendix K (paras. 4.15 and 4.16 refer)

# Status of outstanding village lighting installation works (12 October 2015)

	Status of village lights per HyD and HAD records							
Year	Pending site meeting	Under design and action by HyD	Under liaison by HAD	Under objection / site constraints	Under action by Lands D	Works in progress	Idle (Note 1)	Total
2005-06	0	0	0	1	2	0	0	3
2006-07	0	12	1	2	0	1	0	16
2007-08	0	3	4	4	1	0	1	13
2008-09	0	2	40	37	0	14	3	96
2009-10	12	7	3	140	16	12	16	206
2010-11	8	8	12	52	19	7	1	107
2011-12	31	0	35	34	4	4	4	112
2012-13	9	1	22	24	9	14	0	79
2013-14	6	1	31	28	6	39	0	111
2014-15	42	2	38	13	39	124	0	258
2015-16	194	34	170	43	15	4	0	460
Total	302	70	356	378	111	219	25	1,461 (Note 2)

Source: HyD and HAD records

Note 1: This represented village lights that were without follow-up action taken by the HAD.

*Note 2:* The 1,461 outstanding village lights were related to 510 approved applications.

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# Appendix L

# Acronyms and abbreviations

Audit	Audit Commission
CDM	Ceramic Discharge Metal Halide
EMSD	Electrical and Mechanical Services Department
EMSTF	Electrical and Mechanical Services Trading Fund
HAD	Home Affairs Department
HKPF	Hong Kong Police Force
HyD	Highways Department
ITB	Illuminated traffic bollard
kWh	Kilowatt-hours
Lands D	Lands Department
LED	Light Emitting Diode
LegCo	Legislative Council
MOM contract	Management-operation-maintenance contract
NRTB	Non-illuminated retro-reflective traffic bollard
PLCMS	Public Lighting Control and Monitoring System
PLIS	Public Lighting Information System
PLP	Public Lighting Programme
PLVC	Public Lighting Vetting Committee
SLA	Service Level Agreement