A guide to the design of road lighting
A GUIDE TO THE DESIGN OF ROAD LIGHTING – LD001

AMENDMENT RECORD

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Manager, Technical Services
/ / 2015

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1 INTRODUCTION

This Design Standard specifies the requirements for undertaking the design and documentation of road lighting systems and associated electrical infrastructure on DPTI roads. It does not cover the design of the lighting of public transport interchanges, railway stations and railway infrastructure.


2 DESIGN DEVELOPMENT – GENERAL INFORMATION

The design must comply with:

a) Electricity Act 1996 (SA);

b) Electricity (General) Regulations 2012 (SA);

c) SA Power Networks: Service Rules and Regulations;

d) AS/NZS 1158: Lighting - Roads and Public Spaces;

e) AS/NZS 3000: Electrical Installations;

f) AS/NZS 3008.1: “Electrical Installation - Cable Selection”;

g) Austroads Publication: Guide to Road Design Part 6B: Roadside Environment;

h) CASA (Civil Aviation Safety Authority) Airport Lighting exclusion zones.

i) OTR (Office of the Technical Regulator) Building near & Working near requirements.


k) DPTI LD 002 “A Guide to Conduit Design for Road Lighting”

l) Clearances specified by the Office of the Technical Regulator (OTR): Building Safely Near Powerlines, available from:


For unmetered supplies refer to Australian Energy Market Operator (AEMO) approved load tables refer:

For information on DPTI Standard Road Lighting drawings refer -

All lighting design must be approved by DPTI before the commencement of construction.

3 RESPONSIBILITIES

3.1 Designer’s Responsibilities
The person/organisation undertaking the design (“Designer”) shall:

a) Liaise with relevant DPTI staff;
b) Source asset numbers from DPTI;
c) Arrange SAPN Bracket Checks where required;
d) Arrange Service Points where required; and

3.2 DPTI Internal Responsibilities
Projects Technical Services is responsible for:

a) Providing lighting design advice & direction to Project Managers & external Designers that have been engaged to perform Lighting Designs;
b) Design review & sign off for the compliance of the design with AS/NZS1158 & DPTI Standards & Guidelines; and
c) Nominating the road category e.g. V, P, or TU

Road and Marine Electrical Assets Management is responsible for:

a) Providing lighting asset management advice;
b) Liaising with SAPN for tariff amendments and requests;
c) Supplying asset number allocations for luminaires & switchboards; and
d) Control of Standards & Specifications

Electrical Assets Maintenance is responsible for:

a) Providing Lighting advice regarding compliance, constructability & maintenance of the installation; and
b) Assisting contractors & designers with site investigations when required.

4 DRAWINGS

Drawings and other documentation must comply with the requirements specified in http://www.dpti.sa.gov.au/standards, specifically DP001, DP002, DP013.

This Design Standard references Instructional Drawings (Sheets 104, 105 and 107) which are attached as an appendix to this document.

For example, Refer Sh105 4a refers to Sheet 105, instructional note 4a (i.e. Comment: a) shown below:
Lighting drawings must substantially follow the layout shown in the Instructional Drawings in the appendix. However DPTI may permit departures in the documentation & drawings, for example:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Resolution</th>
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<tbody>
<tr>
<td>Drawing tables, Lighting Details, Legends may not all fit on appropriate sheets</td>
<td>If required these tables can be put onto a separate sheet</td>
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<tr>
<td>Conduit runs where multiple different infrastructure (e.g. ITS TS RL ELECT) is being fed</td>
<td>CST Common Services Trench with a cross-section or proposed services layout can be shown</td>
</tr>
<tr>
<td>Where SAPN is being designed as part of the DPTI project</td>
<td>May apply SAPN adaptation of drawings on a DPTI titleblock as per example sheet 107</td>
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5 LIGHTING OPERATIONAL PERFORMANCE

5.1 Design Technical Requirements

Unless otherwise specified, the lighting design must:

a) light DPTI infrastructure to the appropriate technical parameters in AS/NZ 1158;

b) minimise the “whole of life” costs to DPTI (i.e. take into account the cost of construction, maintenance, repairs & energy consumption);

c) be appropriate for the site specific circumstances; and

d) take into account Work Health and Safety requirements for construction and ongoing maintenance.

Unless otherwise specified, existing network service provider poles (e.g. SAPN poles) must be used, subject to bracket checks for suitability of proposed mounting height and outreach.

Stobie poles which are no longer used for power distribution shall not be used for provision of new road lighting.

Wherever practicable, the design must avoid:

a) placement of poles directly under powerlines;

b) confusing lighting layouts;

c) interference with other structures (e.g. verandas);

d) property crossovers (e.g. driveways);

e) obscuring traffic signals;

f) the placement of lighting poles in corner islands;

g) placing poles within 8.5m of petrol pumps; and

h) placing poles within close proximity to the turning path of heavy vehicles.
The design must ensure that road lighting poles, bases, luminaires, conduits, pits and associated components comply with the following parts of the DPTI Master Specification:

a) Part R50 "Supply of Lighting Components"
b) Part R51 "Supply of Luminaires"
c) Part R52 "Installation of Lighting"
d) Part R53 "Supply and Installation of Conduits and Pits".

The above parts are available from the following website:

5.2 Drawing Examples

a) Refer Sh104/105 4a: Circuit Designators specify the circuit number feeding the light pole. A single circuit number is used for single phase installations (e.g. 1,2,3,4..) whereas a R W or B with the circuit designator number after it indicates three phase installations (e.g.R1, R2, W1, W2,B1, B2,etc). (note: Stobie pole luminaires are directly connected, so no circuit numbers are required). Where a combination Lighting & Signal pole is fed from a Signal Controller, the circuit designator should specify 'SC'.

b) Refer Sh104 4b: Where a Stobie mounted switchboard is used, a switchboard symbol shall be shown adjacent to the service point and an earth pit shall be shown between 3 and 5 metres from the base of the pole.

c) Refer Sh105 4c: Ground mounted switchboards shall have the door opening to the non-road side.

d) Refer Sh104 4d: SA Power Networks is responsible for providing bracket check information. This is then stored by DPTI, and a Knet reference number is shown on the Lighting Details table. (e.g 1234567)

e) Refer 104 4e: Shows a luminaire mounted on a SAPN pole, indicating height & outreach details in metres.

f) Refer Sh104/105 4f Clearance to reticulated overhead & underground AC supplies must be as specified by the Office of the Technical Regulator requirements. Notwithstanding the minimum clearance from any signal or light pole installed for DPTI must be 6.4m, unless an exemption is granted.

g) Refer Sh105 4g: Luminaire numbering needs to make logical sense. Left to right, top to bottom. At intersections number Luminaire Light poles clockwise from north. Where

h) Refer Sh105 4h: It is recommended to consult with Planning & Design or Electrical Asset Services before using different types of Luminaires & Poles. (e.g. LED) Refer Part 251 for specific requirements.

i) Refer Sh105 4i: Delete the unused items in the legend so as to minimize sheet clutter.

j) Refer Sh105 4k: To aid in installation & for reference (if known), indicate both aerial & underground cabling as Low Voltage(LV) or High Voltage(HV). (These should also include any swing & sag calculations if required).The drawing should also include cross-sections of the Swing & Sag determinations to any DPTI infrastructure.

k) Refer Sh105 4l: Common Services Trenches (CST) can be shared with other utilities (e.g. SAPN, Gas Telstra) and may include cross section profile of trench if deemed to be useful.

l) Refer Sh105 4m: Location of a S.P. should (for ease of locating on a drawing) include a street, landmark reference or chainage.
m) Refer Sh105 4o, 4q: If design information is unable to fit on a drawing, indicate which drawing and sheet the information resides on. e.g. Notes, A Signal Controller fed off a Type Road Lighting sw/bd (not as 4o though), a luminaire on a different sheet.

n) Refer Sh105 4r: Removal crosses should be shown on any equipment to be removed & or replaced. e.g. SAPN Luminaire, SAPN overhead cables, etc.

o) Refer Sh105/104 4s: Where known existing(E) and proposed(P) changes to installation should be shown.

p) Refer Sh107 4t: Where a DPTI project & design includes SAPN amendments, specific SAPN notes can be added to a DPTI drawing.

6 LIGHTING CONDUITS
Refer to LD 002 “A Guide to Conduit Design for Road Lighting”.

6.1 Drawings Examples – Conduits

a) Refer Sh104/105 1a: Where Road Lighting conduits cross a road a 3 pit is required either side of the road crossing & 2 x 80RL conduits are required as a minimum where the road crossing occurs. For unkerbed roads it is recommended to use a lockable 3 pit.

b) Refer Sh104 1b, Sh105 1a & c: Typical road lighting runs use a 1x80RL conduit.

c) Road Lighting conduits should be designated Number:x50RL or Number:x80RL. Note: always use 80mm² conduits for road crossings & 3 phase supplies.

d) Refer Sh107 1d: Where a DPTI project & design includes SAPN amendments SAPN specific standards may be applied.

7 LIGHTING PITS LOCATION & TYPE
Refer to LD 002 “A Guide to Conduit Design for Road Lighting”.

7.1 Drawing Examples

a) Refer Sh104 2a Typically P3 pits are used in Road Lighting designs. (It is recommended the pit blocks are sourced from the DPTI FTP website.)

b) Refer Sh104 2b Spacings between pits should be as per D30.

c) Refer Sh104 2c: Where a Stobie Pole switchboard is used it will require an earth stake pit to be placed within 4m from the switchboard stobie pole.

d) Refer Sh105 2d: Where a Combination Lighting/ Traffic Signals pole is used a ‘4 pit’ needs to be installed adjacent/behind the pole. The exception to this is where a Combination pole is within 2-3m from a ‘D’ or ‘S’ pit.

8 LIGHTING POLES

8.1 Technical Requirements

a) DPTI Lighting Pole Luminaire upcast angle must be 0° Refer S-4055 Sh49, whereas SAPN Luminaire upcast angle must be 5° unless otherwise specified.
b) Allowable mounting heights on Stobie poles may vary from 7m up to 12m. The lighting design shall incorporate SAPN’s determination of allowable mounting height.

c) Poles and luminaires should be aligned linearly where possible (differing kerb styles may need special consideration). Pole outreaches should be aligned perpendicular to the centre line alignment of the road.

d) Designers must consider the relative risks to motorists and pedestrians for the specific design, when selecting impact absorbing or slip base poles. Impact absorbing poles should be used in urban areas where there is the likelihood of high pedestrian activity (as defined in AS/NZS 1158), such as in shopping precincts, schools, public transport interchanges and parking areas, and within 30 m of bus stops.

e) Slip base poles should be used on roadways where there are low pedestrian numbers or no pedestrian facilities but must be used where the road speed is greater than 60km/h.

f) Combination traffic signal/road lighting poles, that can include mast arms, must be used at traffic signal sites to minimise the number of poles around an intersection.

g) Unless approved otherwise, poles must be 10.5m or 12.0m high with single, dual or 4 way outreaches of 3.0m or 4.5m.

h) At roundabouts with a centre island diameter greater than 8m, a 4 way outreach or a 15m high mast pole may be considered if technical parameters of AS/NZS 1158 are satisfied.

i) Where it is proposed to use light poles and outreaches that are not currently approved for use by DPTI, details of maintenance requirements, crash testing compliance and the process of purchasing replacement poles must be provided.

j) Provision of details of proposed light poles shall constitute a HOLD POINT. The Principal is under no obligation to accept unapproved light poles or outreaches.

k) Pole setback and placement must be in accordance with AS/NZS1158.

l) Poles must be located so that the level of lighting is not compromised by any existing or proposed trees or structures.

m) New pole locations must not conflict with other services or property crossovers and must be located to avoid conflict with traffic signal line-of-sight requirements. In the event of service conflicts, the Contractor is required to review the DPTI Standard Lighting drawings for details of possible alternative pole footing designs. Where practicable, road lighting poles must be installed at the boundary between two adjoining properties. Clearances from hazardous areas must be in accordance with AS/NZS 2430.3.2 or OTR requirements.

n) Road lighting poles may only be installed in centre medians where the median has a minimum width of 2.0m.

o) Road lighting poles must not be located in front of traffic and pedestrian barriers. Where poles are installed behind non rigid barriers, allowances must be made for the deflection of the barrier on impact.

p) In instances where road lighting is in the vicinity of airports the height and placement of light poles must comply with CASA requirements.

8.2 Drawing Examples
a) Refer Sh 105:2d: Where road lighting occurs at signalised Intersections designers must use Combination Traffic Signal/Road Lighting Poles so as to minimise road furniture at the intersection. (Feeding the pit is a 1x80RL/TS conduit).

b) Refer Sh 104 3a: Pole setbacks should be as per AS/NZS1158, & set back correctly according to the relevant speed zones. A typical example for a 60Km/H Rd will be 0.7m minimum, whereas from the tangent point around corners this increases to 1.0m. Refer to AS1758 for roads with higher speeds or discuss with DPTI. DPTI recommends where road lighting poles can be setback further (e.g. back of footpath) they are.

c) Refer Sh 105:3c: For signalised intersections Combination Lighting & Signal Poles should generally be considered in the Primary signal Pole location.

d) Refer Sh 105:3d: Lighting details table should provide reference to a ‘3D string’ for pole location & orientation. Typical poles orientation should be aligned with the centre line of the road (not the kerb).

e) Refer Sh 105:3e: DPTI Norwood Electrical Assets allocates Luminaire numbers & switchboards numbers for installations & adjusts ongoing tariffs requirements for DPTI.

9 ELECTRICAL REQUIREMENTS

General requirements

This section relates to the general electrical requirements associated with road lighting.

9.1 Technical Requirements

b) Electrical dimensioning needs to be considered for all circuits & sub circuits including any sub-mains feeds associated with the design. This should include any other circuits that maybe not be included in the design scope but fed off the common distribution point. It should include Voltage drop (V Drop) & Impedance Calculations (Z loop) luminaire(s) on traffic signal combination poles are to be wired exclusively from an Extension Housing (‘Top Box’ - pictured) which is then fed from the SC distribution. This is not applicable to pedestrian & koala crossings, where the luminaire(s) may be fed from a dedicated circuit breaker within the SC.

c) Unless otherwise specified, the typical maximum demand calculation for a traffic signal controller intersection is deemed to be 5 Amps (based on a standard 4 way intersection design). Luminaire(s) fed from a controller cabinet (i.e. luminaires on combo poles) will increase the load accordingly.

d) When a signal controller is fed from a switchboard incorporating a PE cell for lighting control, the signal controller shall not be fed from the PE cell controlled circuit.

9.2 Distribution

Electrical feeds to DPTI Lighting distribution equipment shall be by one of the following methods:-

a) SAPN stobie pole dedicated service fuse on the pole (either 32A or 63A HRC fuse). Designated SP:?

SAPN Underground/‘Green Top/fibreglass/plastic’ distribution pillar dedicated service fuse (either 32A or 63A HRC fuse) or can be ‘Direct connect’. Designated SP:xx.
b) A Stobie mounted Road Lighting Type ‘A’ switchboard

c) A Ground mounted Road Lighting Type ‘A’ switchboard with P3 pit. (pictured).

d) Combination Lighting/Signal poles should be fed off a Signal Controller via the ‘Top Box’ as per 9.2 c).

e) Signal Controllers can also be fed off the type A Road Lighting switchboard & can still be fed via a UPS (Uninterruptible Power Supply) & isolation fuse-pit feeding the controller where required.

9.3 Clearance to Electrical Cables

a) Clearances of new lighting poles to overhead and underground electrical cables (including Transport related distribution cables) should aim to comply with the OTR & DPTI requirements. In the event that the design fails to comply wse minimum clearances, the Designer must obtain the written approval of the OTR & DPTI to use non complying clearances prior to proceeding with the Final Design. Consideration should be given to swing and sag calculations where required, and safe work installations using cranes (if required). (NOTE: at present DPTI requires a working clearance of >3m refer Working Safely near Overhead Powerlines- Cranes- Spotter Required.)

b) It is also recommended that the designer familiarise themselves with the Office of the Technical Regulators documents ‘Working Safely near Overhead Powerlines’ & ‘Building Safely near Powerlines’. The Contractor must provide a copy of any OTR approval(s) and calculations with the Final Design drawings.

9.4 Cable Selection

a) Electric distribution cable must be hed multi-strand copper core with V-90 thermoplastic insulation. Distribution cables with conductor cross sectional areas between 4.0 mm² and 16mm² are acceptable and should be selected to comply with AS3000 & 3008 requirements for distribution circuits.

b) Consumer main and sub-main supply cable must be sheathed multi-strand copper core with V-90 thermoplastic or X-90 XLPE insulation. Supply cable conductor cross sectional area must be a minimum of 16 mm² and must comply with AS/NZS3000 & 3008 requirements for distribution circuits.

9.5 Switchboards

a) Unmetered road lighting switchboard enclosures may be either Ground mounted or Stobie pole mounted. Metered road lighting switchboards will be ground mounted. (Refer to: http://www.dpti.sa.gov.au/standards, Drawing 4055, Sheet 43-45, 54)

b) For new installations, Type B Circuit Breakers must be used for distribution sub-circuits.

c) Unless otherwise approved, Ground mounted switchboard enclosures must be located not less than 5 m from the edge of seal of any carriageway, and where possible, beyond the clear zone for the respective road sections as outlined in Austroads Road Design guidelines. If it is proposed to install a ground mounted switchboard within a clear zone, the Designer must obtain DPTI prior approval and be able to demonstrate on the design drawings the protection measures.

d) Dual purpose switchboards located at signalised intersections may be used to supply the Traffic Signal Controllers (through an isolation pit) & the Road Lighting distribution.

e) Road Lighting luminaires installed on combined traffic signal poles must be supplied and controlled from a Traffic Signal Controller ‘Top Box’ distribution. Where one does not currently exist, a Top Box cabinet must be retro-fitted to the existing traffic signal controller.
f) For upgraded Lighting installations, DPTI requires that ‘Green top/fibreglass/plastic’ Electrical Distribution Pillars need to be upgraded to a DPTI Type A switchboard.

g) Any equipment not on AEMO load tables must be connected via a metered supply. (Refer to: http://www.dpti.sa.gov.au/standards, Drawing 4055, Sheet 54)

9.6 Power Supply
The Designer must determine the power supply points and reticulation in conjunction with SA Power Networks and obtain its written confirmation of the approval of the supply point.

DPTI pits supplying Consumer Mains to a DPTI distribution switchboard must be equipped with lockable lids.

9.7 Drawing Examples
a) Refer Sh105 4n: All individual circuits loading added together should be equal to the total current designed loading. (phase load & balancing for 3 phase distribution should be ‘relatively close’).

b) Refer Sh105 4p: Because of the way the circuits are wired in 3 phase installations Vdrop & Zloop calculations need to be performed as a single phase calculation.

10 LIGHT MONITORING AND CONTROL SYSTEM

10.1 General Requirements
a) Where a lighting control system is to be adopted, which includes the management of light output based on traffic numbers, the lighting category may be reduced to the appropriate lighting category as determined in accordance with the specified references.

b) The lighting control system must allow the management of the light output, to enable dimming road lights to match different times of night and traffic numbers and provide light management in luminaire groups based on site specific conditions.

c) The light monitoring system must incorporate a system diagnostics with features including:

1) lamp failure;
2) failed to operate;
3) reduced power;
4) shutdown including thermal and aged lamp shutdown,
5) communications failure;
6) load monitoring to give consumption in kilowatt hours;
7) ability to adjust light output to maintained design levels; and
8) separate data address for each luminaire.

Details of light monitoring and Control systems including integration with DPTI traffic management centre shall constitute a HOLD POINT.

11 LAMPS & LUMINAIRES

11.1 General Requirements
a) Unless specified otherwise, Sodium (HPS), Limited Metal Halide (MH) and Light Emitting Diodes (LED) must be used with a strong preference for LED’s.
b) The preferred mounting heights for road lighting luminaires are either 10.5m or 12m, in accordance with AS/NZS1158 1.2 Table 8.1.

c) Mounting heights for luminaires other than HPS must be such that point horizontal illuminance levels do not exceed 40 lux (except at zebra crossings). Notwithstanding this, DPTI preference is 10.5m or 12m unless otherwise agreed.

d) Unless constrained by overhead cables or specified otherwise, mounting heights for other Luminaires types and ratings, will require prior approval.

e) For luminaires on DPTI poles the preferred upcast is 0 degrees from horizontal, however 5 degrees is permitted provided the requirements for verge surround illuminance are met. Luminaires on DNSP brackets are mounted at 5 degrees upcast.

f) Design for luminaires on DNSP poles should apply the relevant DNSP maintenance factor (typically 0.68 for SAPN Designs).

g) Design for luminaires on DPTI poles should apply a maintenance factor of 0.7 for HPS or 0.8 for LED.

h) In instances where road lighting is in the vicinity of Airports (refer to CASA document reference) the use of full cut off fittings (e.g. aeroscreens) is required.

11.2 Drawings Examples

a) ReferSh105 4h: DPTI have historically used REXEL Lighting Optispan luminaire with high-pressure sodium vapour lamps on a typical arterial road.

b) ReferSh105 4h: SAPN prefer to use Sylvania ‘Roadster’ luminaire or as specified by SAPN Corporation. The luminaire Illuminance requirements should match those used by DPTI

c) ReferSh105 4q: Lamps located on other drawing sheets (than where the circuit details reside) need to be identified on the Circuit Details table.

d) ReferSh105 4r: Lamps Poles and DNSP transmission wires/paths removal should be shown to be removed with crosses.

12 TUNNEL & UNDERPASS LIGHTING

a) Tunnel & underpass lighting must comply with AS/NZS1158 part 5.

b) The Designer must also consider the specification of TU sub-category & reasons for the determination.

13 RECORDS

The Designer must prepare and provide the following records:

**Drawings**

The design drawings in accordance with DPTI Design Presentation Standards, in particular “DP001 – General requirements” and “DP013 Lighting”.

Update of any existing lighting and conduit drawings.

If feature lighting is part of the lighting system then details of lighting types and mountings must be included in the Detailed Design drawings.

**Reports**

A report detailing
compliance with AS/NZS1158
  o Providing all calculations, including details of the program used to prepare the calculations
  o The Maintenance Factor used in the design.
  o power system, volt drop and fault loop impedance calculations
  o For checking purposes, pole spacing calculations are required for straight road sections
  o Isolux contour drawing or straight road spacing calculations with the relevant illuminance level shown

DPTI Lighting & Signals Presentation & Technical check list.

Implementation Records
Copy of any OTR clearance approval.
SA Power Networks “Bracket Check”.
SA Power Networks supply point availability.

14 APPENDIX: ROAD LIGHTING INSTRUCTIONAL DRAWINGS:
These instructional drawings are attached to show practical application of design considerations as specified above.
The drawings show most (not all) typical installations that can apply to Road Lighting drawings & designs. All items on these instructional drawings DO NOT NEED to be actually shown on a Road Lighting drawing.
In the legend only items relevant to the design need to be shown on that sheet.

AMENDMENT 1:
Drawing below show 1x50mm conduit where it does not cross the road or use 3 phase. This is now incorrect. All conduits for electrical shall be a minimum of 80mm.
The numbering system for Luminaires has now changed so as to provide a unique number to the pole & luminaire which in fact is the asset number. This number should be requested at the design stage to the asset Management group. David Richardson 8343 2334.