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**Tunnel Lighting Controller**

**Software Detailed Design**

Document Number: 1975-TLC-SDD

Revision: 5.0

Date: January 15th 2015

Approved by:

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# Version History

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| --- | --- | --- |
| Version | Revised by | Description |
| 1.0 | Jane Wilson | Original |
| 2.0 | Jane Wilson | Correction of typo errors |
| 3.0 | Jane Wilson | Addition of lamp siren & sign handling |
| 4.2 | Jane Wilson | Significant updates made for functional safety compliance |
| 5.0 | Jane Wilson | Changes made for updated requirement volume |

# Introduction

* 1. **Purpose**

The purpose of this document is to provide a complete description of software detailed design for a tunnel lighting system application software. As defined in BS5489-2:2003, the levels of the lighting inside a road tunnel needs to be varied depending on the brightness of the prevailing conditions on entry to and exit from that tunnel, to ensure that drives have good visibility into the tunnel as far as their safe stopping distance.

* 1. **Scope**

**The scope of this document is intended to be at the software detailed design level to describe the expected behaviour, constraints, and performance parameters of the Tunnel Lighting System software and all of its components**

# Referenced Documents

1. IP66 specifications

# Requirements

## Cell management

LLR\_0010: Instantiate Cell

A Cell shall be instantiation with zero types of lamps, zero maximum lumens, zero minimum lumens, zero for the cell ID, and zero for the cell size

Links: HLR\_0360

LLR\_0020: Initialise Cell

A Cell shall be initialised by initialising both the cell parameters as well as the lamps within the cell

Links: HLR\_0360

LLR\_0030: Set Emergency output level

For emergency lighting, only the smallest lamp per luminaire shall be set to its defined emergency demand level to minimize power demands on emergency supplies

Links: HLR\_0220

LLR\_0040: Set PoweredOutputLevel

Powered output settings shall be computed and assigned, such that lamps used shall be at a consistent setting for any given size of a lamp

Links: HLR\_0360, HLR\_0090

LLR\_0050: Calculate cell output

The Cell output shall be calculated as the number of lumens demanded per meter multiplied by the cell spacing

Links: HLR\_0360

LLR\_0060: Get Lamp Model Duo

A Duo lamp model shall be applied if a lamp must be fitted by an exit sign and a siren

Links: HLR\_0160

LLR\_0070: Get Lamp Model Guide

A Guide lamp model shall be applied if a lamp must be fitted with an exit sign

Links: HLR\_0160

LLR\_0080: Get Lamp Model Announcer

An Announcer lamp model shall be applied if a lamp must be fitted with a siren

Links: HLR\_0160

LLR\_0090: Get Lamp Model LightSolo

A LightSolo lamp model shall be applied if a lamp is not fitted with a siren or an exit sign

Links: HLR\_0160

## Input data initialisation

LLR\_0100: Get Data and Read Content

Get Data shall parse the tunnel lighting system initialisation data using a provided initialisation file

Links: HLR\_0100, HLR\_0200, HLR\_0215

LLR\_0110: Get Data and Read Content

Get Data shall initialise system data using a, provided initialisation file.

Links: HLR\_0100, HLR\_0200

## Lamp management

LLR\_0120: Initialise Lamp

Lamps shall be instantiated by default as the brightest setting, be assigned a lamp type, a unique lamp identifier, and a model identifier

Links: HLR\_0231

LLR\_0130: Set Lumens Output

When power is sent to a lamp, the number of lumens shall be outputted to the display

Links: HLR\_0100

LLR\_0140: Get Maximum Lumens

When queried, a lamp object shall be provide the maximum lumens it can support

Links: HLR\_0160

LLR\_0150: Get Minimum Lumens

When queried, a lamp object shall be provide the minimum lumens it can support

Links: HLR\_0160

LLR\_0160: Send Power to Lamp

When power is sent to a lamp with a power setting greater than zero, the power setting and the lamp identifier shall be outputted to the display

Links: HLR\_0100, HLR\_0160, HLR\_0180, HLR\_0190, HLR\_0230

## Lamp attributes

LLR\_0170: Initialise Lamp Attributes

A lamp model shall be initiliased by a provided height, width, and model

Links: HLR\_0170

LLR\_0180: Lamp Dimensions

A lamp model shall provide its dimensions, height, width and area, when queried

Links: HLR\_0170

LLR\_0190: Lamp Dimensions

A lamp model shall provide its dimensions, height, width and area, when queried

Links: HLR\_0170

LLR\_0200: Lamp Dimensions

A lamp model shall provide its dimensions, height, width and area, when queried

Links: HLR\_0170

LLR\_0210: Lamp Drain

A lamp model shall calculate and provide its current drain when on emergency battery backup based on the surface area of the lamp

Links: HLR\_0232

## Lamp types

LLR\_0220: Lamp Type Instantiation

The LampType class shall default to no output until initialized

Links: HLR\_0180, HLR\_0190

LLR\_0230: Lamp Type Initialisation

The lamp type class shall be initialized with its maximum power consumption as well as the maximum and minimum output percentages

Links: HLR\_0180, HLR\_0190

LLR\_0240: Lamp Type Get Maximum Lumens

The lamp type class shall provide its maximum output in Lumen units

Links: HLR\_0180, HLR\_0190, HLR\_0232, HLR\_0233, HLR\_0234, HLR\_0235, HLR\_0236

LLR\_0250: Lamp Type Get Minimum Lumens

The lamp type class shall provide its minimum output in Lumen units

Links: HLR\_0180, HLR\_190, HLR\_0232, HLR\_0233, HLR\_0234, HLR\_0235, HLR\_0236

LLR\_0260: Lamp Type Get Power Required

The lamp type class shall provide the power it consumes for a specified amount of light in lumen units

Links: HLR\_0180, HLR\_0190, HLR\_0232, HLR\_0233, HLR\_0234, HLR\_0235, HLR\_0236

## Tunnel lighting system executive

LLR\_0270: Initialise lighting system

The Tunnel lighting system software shall be initialised by an initialisation file that describes Tunnel width and zone data

Links: HLR\_0010, HLR\_0120, HLR\_0200, HLR\_0215

LLR\_0280: Photometer input interface

Photometer inputs shall be read in either via hardware or display input with input ranges between

Links: HLR\_0020, HLR\_0237

LLR\_0282: Input options photometer input out of bounds

If Photometer range values entered are less than

Links: HLR\_0030, HLR\_0237

LLR\_0284: Input options exit

The software shall offer the user an input option to exit the application from the user input display using the letter 'q' for quit

Links: HLR\_0040

LLR\_0286: Input options days since cleaning nominal

The software shall allow the user to set the number of days since cleaning between 0 and 182 days

Links: HLR\_0050

LLR\_0287: Input options days since cleaning out of bounds

If a number of days since cleaning is entered less than zero or greater 182, the software shall prompt for input again

Links: HLR\_0030

LLR\_0288: Input options power failure

The software shall allow the user to invoke the power failure state

Links: HLR\_0070

LLR\_0289: Input options power failure

The software shall allow the user to invoke the nominal power state

Links: HLR\_0070

LLR\_0290: Days since cleaning input interface

Number of days since cleaning shall be read in via the display input

Links: HLR\_0100, HLR\_0115

## Mounting area

LLR\_0310: Mounting Area Instantiation

The MountArea class shall be initialized with the ceiling area available for mounting lamps specified by the length and breadth

Links: HLR\_0350

LLR\_0320: Mounting Area Number of Lamps

The MountArea class shall provide the number of lamps which will fit within its mounting area

Links: HLR\_0350

## System data

LLR\_0330: System Data Instantiation

System data shall be instantiated only once as this data will be global for the system

Links: HLR\_0340

LLR\_0340: System Data Initialisation

All system data tied to the tunnel lighting system as a whole shall be managed to provide data needed for system level data acquisition and decision making

Links: HLR\_0340

LLR\_0350: Calculate and get soiling factor

Based on days between cleaning system data shall calculate and return soiling factor as a percentage of efficiency

Links: HLR\_0110

LLR\_0360: System Data Query Get Lamp Power Required

For each lamp type power required shall be returned upon query

Links: HLR\_0210

LLR\_0370: System Data Query Get Lamp Maximum Lumens

For each lamp type maximum lamp lumens shall be returned upon query

Links: HLR\_0210

LLR\_0380: System Data Query Get Lamp Minimum Lumens

For each lamp type minimum lamp lumens shall be returned upon query

Links: HLR\_0210

LLR\_0390: System Data Query Get Lamp Emergency Lumens

Emergency lamp lumens shall be returned upon query

Links: HLR\_0210

LLR\_0400: System Data Set Days since Cleaning

Days since cleaning shall be set when needed

Links: HLR\_0110, HLR\_0115

LLR\_0410: System Data Query Set Days between Cleaning

Days between cleaning shall be returned upon query

Links: HLR\_0110

LLR\_0420: System Data Query Get Exit Sign Spacing

Exit sign spacing shall be returned upon query

Links: HLR\_0210

LLR\_0430: System Data Query Get Siren Spacing

Siren spacing shall be returned upon query

Links: HLR\_0210

## Adjust Lighting

LLR\_0440: Initialise Tunnel

The Tunnel lighting system data shall be initialised such that all zones and their data is populated upon start up

Links: HLR\_0010, HLR\_0200

LLR\_0450: Adjust Tunnel Lighting

Depending on a power failure condition, lighting shall be adjusted according to powered lighting or emergency lighting

Links: HLR\_0125

LLR\_0460: Adjust Powered Lighting

Given the photometer input in mAmps and powered conditions, the lighting output demands shall be adjusted across all zones

Links: HLR\_0125, HLR\_0237

LLR\_0470: Adjust Emergency Lighting

Given the photometer input in mAmps and emergency conditions, the lighting output demands shall be adjusted across all zones to emergency levels

Links: HLR\_0125, HLR\_0237

## Zone Management

LLR\_0480: Zone default intensity

The zone class shall set the default intensity to the brightest level for all the lamps in a luminaire.

Links: HLR\_0130, HLR\_0150

LLR\_0490: Initialise zone

The zone class shall be configurable with the specified values

Links: HLR\_0120

LLR\_0500: Zone Calculate output coefficients

The zone class shall determine the formula coefficients needed to determine the outputs in units of lumens/meter for a specific demand percentage

Links: HLR\_0130, HLR\_0140

LLR\_0510: Zone soiling power compensation

The zone class shall increase the power to the lamps to compensate for lumen output reductions due to lamp soiling

Links: HLR\_0130, HLR\_0140

LLR\_0520: Zone assign powered cells

The zone class shall assign the cell output in lumen units taking into account the distance of the cell from the beginning of the zone

Links: HLR\_0130, HLR\_0140

LLR\_0530: Zone assign emergency cell output

The zone class shall assign the emergency cell output levels to conserve emergency power supplies

Links: HLR\_0210