Get in the Game
2018-2020

Sports Field Lighting

This fact sheet has been developed to assist in the installation of affordable and effective sports field lighting and to provide background to assist in discussions with consultants. It covers key issues to be considered in the planning and ongoing maintenance of a new sports field lighting projects:

- Scoping of project
- Planning and Approvals
- Design Considerations including Power supply, Types of lighting and Pole heights and location.
- Cost of Ownership
- Maintenance

Scoping of Project

A starting point in the development of any infrastructure project is to ask:

1. what exactly do we want to achieve and over what timeframes?
2. do we have the expertise to deliver the project and what impact will it have on our current operations?
3. how much will it cost to plan, deliver, maintain and run when completed and can we afford it over the long term?

Before deciding to install sports field lighting, it is important to undertake a Return on Investment analysis. This must consider the potential increased use, venue flexibility, additional income v's initial capital cost, increased risks, safety of participants as well as increased energy, maintenance and management costs.

Installation of sports field lighting will require the services of professionals; such as lighting designers, electrical and structural engineers. We also recommend engaging a professional project manager to coordinate the delivery of the project, The Project Manager will be responsible for coordinating consultants, planning requirements, Council and building certifiers as well as engaging contractors, project tendering, certification of payments, commissioning and project certification. Other factors to be considered are:

- Levels of lighting required to suit your sport/s
- The varying and conflicting requirements of individual sports in a multi-sports facility.
- Developing performance requirements into acceptable design solutions and specifications.
- Consideration of other environmental lighting that will be required for support areas.
- Related systems such as electrical supply, wiring and illumination controls.

Planning and Approvals

Local Governments (Councils) control the planning requirements around the operation and construction of sports field lighting. These can vary but the same basic principles will apply in every installation.

Local planning schemes together with zoning controls are used to determine approval on your site. Generally, both Development approval (DA) and Building approval (BA) will be required. It is important not to confuse DA with BA. Building approval relates to the method of construction to ensure it complies with relevant standards whilst DA is advice that a particular use or development may proceed on a specific parcel of land. Typically, new sports lighting will require DA whilst upgrade to existing lighting may not. DA does not remove the need to obtain BA. For further information on DA and BA, please refer to the SRS fact sheet.

In many instances, DA and associated community consultation will be required prior to a sports field lighting project receiving approval. In addition, BA will be required for any installation where the height of poles exceeds local conditions and controls. Challenges include:

- **Ground Conditions** Poor or contaminated soil conditions will require special consideration. Many sport and recreation venues are established on land fill sites, flood plains or areas with other unsuitable soil conditions. These factors complicate foundations, excavating and trenching and make construction more expensive.
- **Flood Inundation Overlays** and the need to factor in types of equipment installed and the mounting heights of these (e.g. electrical safety such as height of control gear).
- **Light spill** – a well-designed outdoor sports lighting installation must limit and control spill light to limit impacts to residential properties and other critical infrastructure (roads and rail lines) in close proximity. Spill light therefore needs to be minimized and must be carefully considered in the planning process. Refer to AS 4282 for further detail.
- **Potential impact of aviation:** Venues within 6 kilometres of an airport must advise the Airport Operator and it is likely that limitations will be placed on luminaire intensities and/or pole heights potentially acting as obstructions. When constructing near an airport it is a mandatory requirement that both the Obstacle Limitation Surface (OLS (pole heights etc) and spill light patterns are determined to ensure compliance with constructed obstacles as well as glare into aircraft.

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- **Cyclone and earthquake** design needs to take into consideration the wind loading for cyclonic conditions and also earthquakes if applicable to the project area.
- **Ecological consideration** needs to be given to the limitations placed on artificial lighting where venues exist close to significant habitat areas.

Design Considerations

Power supply - Site power supply requirements are frequently neglected until very late in the project development phase. This could have a major impact on delivery timeframes and project costs, if not considered early in the project cycle. It is therefore essential that contact is made with your local electricity distributor (in QLD that is either Energex or Ergon) as early as possible to arrange for the new or upgraded power supply to the facility if required.

In order to determine the appropriate supply of power to the new installation consideration must be given to the maximum lux levels required for play as well as possible future requirements. If the project is not initially installing to the highest levels e.g. if illuminating a rugby field to 50/100 lux but plan on increasing the levels to 200 lux in future, then all calculations and installations for power supply, cabling, equipment and poles should be based on 200 lux e.g. a Rugby field illuminated to 100 lux would typically require 12 x 2Kw luminaires, 200 lux would typically require 20 luminaires.

Power requirements will vary depending on the illumination level used. Most “High Intensity Discharge” (HID) lamps have a higher demand during start up and this needs to be considered when determining the sizing of the electrical supply and associated cable reticulation. This may require the installation of Programmable Logic Controllers (PLC’s) to sequence switching between luminaire banks and poles and thereby reduce start up demand current and reduce overhead infrastructure costs.

Types of lighting - There are a variety of different lamp types used for sports field lighting. Currently the most widely used being HID Metal Halide or High-Pressure Sodium. Solid State Lighting (SSL) such as Light Emitting Diode (LED) is becoming popular, due to its reduced maintenance and running costs. However, LED remains significantly more expensive initially than an equivalent lumen output HID Luminaire. The characteristics of each lamp type differ and selection is usually based on the colour of the light emitted, energy consumption and life expectancy.

Pole height and location - Guidelines for Pole Heights and Locations are provided in the Australian Standard (AS2560) series of documents. This specifies a minimum of 5 metres clearance from the edge of the playing area (PA) (i.e. line marked boundary) for pole positions.

Geotechnical (soil testing) analysis should be undertaken at each light pole location to ensure the correct foundation design for the height and wind loading of the pole. Many pole manufacturers also provide the footing design and corresponding reinforcement cages required for successful installation. To undertake an appropriate design, pole manufactures will require:

- number of and details of the luminaires to be installed,
- required wind load rating; and
- results of the geotechnical analysis.

Levels of illumination - The level of illumination required for a particular sport should be checked with the State Sporting Organisation or against the Australian Standards 2560 series.

Volume of the field of play - When installing lighting, there is more to consider than just the playing surface. Where a sport involves the use of the height above the playing area (PA) e.g. athletics throwing events, baseball, cricket or rugby then consideration of the volume of the PA is important. In terms of lighting engineering this requires consideration of lighting in both horizontal and vertical planes. As well as the area of the pitch or court perimeter line, additional safety or run off zones (Total Area) will also need to be lit. Consideration must be given to the lighting levels both on the surfaces of and in the volume above each of these zones.

Even illumination - The full volume of the field of play must be illuminated evenly to create equal playing conditions for all players and a consistent level of visibility including for spectators. This calls for suitable brightness and contrast over the playing area, sufficient light at all points, correct distribution of light and the adequate control of glare.

Glare - The complete elimination of glare in sport is difficult to achieve due to the ever-changing directions of view of participants. Nevertheless, measures should be taken to minimise glare that may affect the visual performance of participants. Where possible, luminaires should be located in positions which reduce the need for players to look towards them during a game. Unfortunately, because of their high light output and efficiency, HID and to an even greater degree LED lamps will cause glare. The locations of luminaires relative to directions of view should therefore be considered carefully.

Cost of Ownership

The initial purchase cost of a sports lighting installation may seem high, but the on-going costs associated with running the system are also significant. The on-going cost of ownership is made up of energy costs, maintenance costs and the need for a sinking fund for future replacement. When design proposals and alternative systems are being assessed, the ongoing costs including energy and maintenance, together with the initial capital need to be included as part of any realistic cost benefit analysis. It is essential when choosing lighting levels, they are matched to the requirements or the particular sport; higher lux, means higher ongoing costs.

Maintenance factor - The light output of an installation, irrespective of regular maintenance, will diminish as lamps age. When designing lighting, the as-new performance of the system must be high enough to ensure that lighting levels are still adequate when all degrading factors have taken effect. The ‘maintenance or depreciation factor’, is the amount that the performance of the lamp will fall (lamp lumen depreciation), compared to its performance after 100 hours of use (design level). This is combined with other depreciation factors such as the Luminaire Maintenance Factor (LMF allows for dirt (lens and reflector)) and these collectively provide the Maintained Illuminance level.

These factors should be included in any design calculations to establish the minimum initial illuminance values required to achieve the recommended maintained illuminance level.

There are two components in the maintenance factor; loss of light due to deterioration of the luminaire (lens and reflector); and loss of light due to lamp depreciation.

In the case of HID luminaires, if the specified illuminance on a football field is 200 Lux and the maintenance factor is 0.8, the average illuminance when the lights are new should be no less than 250 Lux. 'New' normally means after no more than 100 hours use. LED's have a much longer lifecycle, typically with hours of 30,000 or higher, while HID is typically 3,000 to 8,000 hours.

Energy costs - The careful selection of lamp types and luminaires at design stage is the first step to ensuring good energy efficiency. Step 2 is to ensure that the switching and control (or ability to dim in the case of some LED's (not all LED's are dimmable)) system allows you to control the lighting by switching or diming so you are only using the right level at the right time in the right location. Energy and maintenance costs of wasted light should not be underestimated and it is important that the system allows a number of different combinations. In addition agreement needs to be reached with the electricity retailer for the most appropriate and cost effective electricity tariff.

Maintenance

All lighting should operate under a cyclic maintenance program. An effective cleaning and maintenance schedule will ensure the installation continues to operate at maximum efficiency throughout its life cycle. An effective maintenance program should include:

- Replacement of HID lamps in accordance with a 'Lighting Design Maintenance Plan based on the manufacturers' specifications. This should give information relating to lamp light output depreciation, bulk lamp replacement intervals and the number of hours a lamp should operate before being replaced.
- Cleaning of luminaires at intervals appropriate for the frequency of use and the ambient pollution levels.
- Recording all maintenance to show the development of problems or faults before they become significant issues.

Access to lamps should only be undertaken by an appropriately qualified electrical/lighting maintenance company with the required access equipment.

Lamp replacement - The failure of an individual lamp may not require immediate replacement, particularly in installations were scaffolds and / or raised platforms are needed to do so. However, even a single lamp failure can create a dark area in the illuminated volume. On a field or court where there are often relatively few lights or low lux levels (there may be only 4 lights on a netball court), failure of a single lamp can cause lighting levels and uniformity to fall below acceptable levels.

All lamps (particularly HID) start to deteriorate in their effectiveness from the moment they are first switched on. Ideally they should be replaced at the end of their design performance life, which is usually well before the end of their ultimate life.

To maintain lighting uniformity, lamps should be replaced as a complete set per court, field or pitch. However, where there are different switching levels in regular use, the 'high' and 'low' level lamps could be on different replacement cycles. For example, lamps used for the 100 lux level will need to be replaced more frequently than those used for the illumination of the 200 lux level. This issue is not a factor in dimmable LED lamps as all luminaires are switched at all times and are dimmed to achieve required lux levels.

Cleaning - Apart from replacing HID lamps, the glass (includes LED luminaires) and reflector of each fitting needs to be kept clean as well. Outdoor sports luminaires have a sealed front glass which may be opened to clean the reflector and replace the lamp; in some cases lamps are replaced from the back of the luminaire. The condition of the seals should be checked whenever a lamp is replaced or the luminaire is cleaned. Luminaires should be cleaned more frequently (annually) than lamps will need to be changed and it would be financially beneficial to arrange for luminaire cleaning to coincide with lamp changing. Most lighting contractors will clean the luminaires as a matter of course when re-lamping.

Luminaire aiming - When a new system is installed each luminaire is aimed at a particular point on the playing surface, in accordance with the lighting design and associated calculation grid (see attachment 1 as example). After a period of time or a severe weather event, the luminaire may be shifted by vibration or high winds and will need to be adjusted back to the design parameters.

Sinking fund - Life cycle costs - A typical sports lighting system is likely to have a life expectancy of 20 - 25 years. Individual components will however have shorter lifespans and ongoing, adequate budget must be allocated to cover these costs. Lamps have a life expectancy related to actual hours of use, but the life expectancy of other components will depend on a range of factors such as wear and tear, switching frequency, environmental conditions, misuse and the level of maintenance. Contributions to the sinking fund must therefore be regular and realistic.

Acknowledgements, Resources and Reference documents

1. OLS - 'Obstacle Limitation Surfaces (OLS) are a series of surfaces that set the height limits of object around an aerodrome. Objects that project through the OLS become obstacles.' (CASA 1999)
2. Australian Standard AS 2560 Series including Sports Lighting, General Principals and Sport specific versions
3. Australian Standard AS 4282 – Control of the Obtrusive Effects of Outdoor Lighting
4. European Standard EN 12193 :2007 Light and Lighting – Sports Lighting
5. Peter Jones, Lighting Design Manager - Zumtobel Group
6. Civil Aviation Authority MOS139 – Manual of Operating Standards Part 139 – Aerodromes
7. Department of Sport & Recreation Western Australia, Sports Dimensions Guide
8. Sport England - Design Guidance Note, Artificial Sports Lighting Updated guidance for 2012
9. Cricket Australia – Community Cricket Facility guidelines – September 2015
10. Community Sporting Facility Lighting Guide for Australian Rules football, Football (Soccer) and Netball. Dept of Planning and Community Development, Victoria.