Lightning Protection Risk Assessment & Design Services

Liberty Consulting Services (LCS) engineers have many years’ experience in the lightning protection industry and have a proven history of working with different industries to provide solutions for lightning protection systems. With our detailed knowledge, considerable experience and understanding of all relevant codes and standards in this field, LCS will carry out risk assessments to calculate the probability of loss. Using a systematic approach, LCS will make recommendations for cost-effective protection solutions to reduce the risk of loss below an acceptable level. LCS uses SESShield-3D to produce 3D software design outputs showing protected and unprotected areas.

Increasing need for Lightning Protection System (LPS)

Recent trends of higher lightning activity, and ever increasing sensitivity of electrical and electronic equipment often results in damage to equipment and interruption to services across many industries.

In order to protect against this threat, an understanding of the statistical nature of lightning activity is required. We can determine how often a facility could expect a direct strike, or experience effects from lightning induced earth potential rise (EPR) due to nearby strikes from statistical ground flash density data provided in Standards.

However these estimates are average values expected over a long period of time. Since lightning has a highly random nature, over shorter periods of time there may be more or less lightning events than indicated by historical data.

More than 100 published lightning protection standards are used in countries around the world, and in Australia AS1768 is the applicable Standard. LCS Lightning Protection Engineers have a good working knowledge of this and other Standards and Codes.

Relevant Lightning Protection Standards & Codes

- AS/NZS 1768 Lightning protection
- AS/NZS 60479.4 Effects of current on human beings and livestock - Part 4: Effects of lightning strokes
- IEC 62305 series 1 to 5 Protection against lightning (including Part 2: Risk Management)
- IEC 61643 11 & 21 Surge protection devices connected to low voltage power systems
- BS EN 50164 series 1 to 7 Lightning protection components
- IEEE Std 998 IEEE Guide for Direct Lightning Stroke Shielding of Substations
It is important to note that design methods in most Standards rely on 50 year old research (electro-geometric model and rolling sphere method – RSM), with more modern techniques slowly being adopted.

Risk management and assessment tools

Fundamentally, the results of any risk analysis are given by the formula, Risk = N x P x L, where N = number of events or frequency; P = probability of damage; and L = quantitative assessment of damage. This risk result is then compared with acceptable, tolerable societal risk factors. However it should be understood that no LPS is 100% effective, because it involves statistical probabilities and risk management.

AS1768 states that its risk calculation tool provides only an estimate of lightning risk, and that this calculator is a simplified tool for the more common structure types. Facilities may or may not fall into the category of “more common structure types” hence a qualified professional approach is often required to assess risk at a particular site.

LCS uses the AS1768 risk assessment tool in combination with more in depth study of facility layouts, in order to identify other hazards that could be overlooked by the sole use of the risk calculator.

IEC62305 adopts the 3 times height (3H) rule and LCS provides simple calculations based on ground flash density (GFD), which will predict how often a facility can expect a direct strike. This analysis clarifies the absolute risk of a lightning strike, and enables the client to make a more informed decision on the required LPS methods and equipment.

Lightning protection system design procedures

The RSM recommended in AS1768 was developed in the 1960-70s. The striking distance formula and protection radius upon which the RSM is based are shown below. The striking distance formula is the same for all structures and all points on structures. This is not sophisticated, but is easy to implement.

AS1768 describes 4 statistical protection levels (PL). For example, a 99% protection level means 1% of smaller strikes (< 2.9 kA) may bypass the LPS designed to PL I.

<table>
<thead>
<tr>
<th>Protection Level</th>
<th>RSM Radius “a” - m</th>
<th>Lightning Current kA</th>
<th>% Strikes</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>20</td>
<td>2.9</td>
<td>99%</td>
</tr>
<tr>
<td>II</td>
<td>30</td>
<td>5.4</td>
<td>97%</td>
</tr>
<tr>
<td>III</td>
<td>45</td>
<td>10.1</td>
<td>91%</td>
</tr>
<tr>
<td>IV</td>
<td>60</td>
<td>15.7</td>
<td>84%</td>
</tr>
</tbody>
</table>

AS1768 recommends to first place air terminals on the most vulnerable parts, i.e. corners or protruding features (refer AS1768 4.3 over-riding design rules), then apply the RSM to determine locations of additional air terminals around edges (use a larger Rolling Sphere for flat surfaces - 2 times radius).

More modern design methods are being adopted by Standards. Research has shown for sometime that leader propagation is important in the lightning attachment process. The striking distance is a function of height of the structure, as well as the charge of the down-leader (the RSM is based on charge only). Shape & location of the attachment point are also important.

New models have been developed (using leader propagation techniques), with some into practical engineering methods (refer IEEE Std 998). LCS uses SESShield-3D which provides software model outputs for conventional (RSM & Mesh) and more modern designs, including the Collection Volume Method, and the Eriksson Electro Geometric Model.