Managing lightning **risks** in hazardous locations

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Lightning risks related to hazardous locations need to be managed coherently, holistically and effectively through a structured engineering approach.

Hazardous locations present particular challenges with respect to lightning safety and protection. These challenges relate to both direct and indirect human safety as well as to the risks posed to plant and equipment and to the consequential effects of damage. Compounding these challenges and risks is the fact that many of the applications and environments where these hazardous locations are situated are complex in nature.

As a result, the effective management of lightning risks related to hazardous locations is particularly important, and this emphasises the need to manage them coherently, holistically and effectively through a structured engineering approach.

Some pertinent issues

Some of the pertinent issues that need to be addressed in designing and implementing effective and comprehensive lightning safety and protection solutions include the following:

- Ensuring appropriate techniques and solutions are implemented in a systematic, structured and holistic manner. This includes avoiding 'blind adherence' to legacy techniques
- Following a holistic approach and not focusing only on specific aspects (for example, on just the external lightning protection system (ELPS) or just on surge protective devices (SPDs) etc)
- Ensuring proper maintenance throughout the solution life cycle (and the various support actions required to facilitate this)
- Ensuring adequate management visibility and insight, to ensure a proper appreciation of the risks and measures and hence to ensure that the necessary technical, operational and financial support is available
- Ensuring coordination across operational and technical departments, including proper change management

A comprehensive approach is considered essential in order to effectively manage the risks.

Hazardous location risks

Hazardous locations present particular risks related to lightning. These include:

- Personal injury
- Fire and explosion
- Structural and plant damage
- Equipment damage

All of these also imply the risk of potential economic loss, both direct and indirect in nature. They also imply, in particular, a necessary emphasis on safety-related consequences and issues. Lightning safety is, and must be, a primary objective in addition to the protection of equipment and plant.

Different aspects of lightning safety and protection are of course also typically interrelated, in that, for example, infrastructure and system protection contribute to safety (directly and indirectly). Specific safety plans, measures and precautions are also critical to achieving a lightning safety solution.

Engineering approach

It is well understood that a properly designed lightning safety and lightning protection system (LPS) can limit damage and loss of life or injury. Whilst a standards-based technical approach has been found to be effective and to result in enhanced protection against the effects of lightning, a proper engineering approach to lightning protection is often not evident [3].

In South Africa, the applicable lighting protection standards were

ELPS – External Lightning Protection System
ILEP – Integrated Lightning Engineering Plan
LPS – Lightning Protection System
SPD – Surge Protective Devices

Abbreviations

updated in 2011, with the release of Edition 2 (a technical revision) of the IEC62305 suite of documents as SANS62305:2011 [1]. SANS 10313 [2] was also subsequently updated at the end of 2012, as SANS 10313:2012.

Examples of some pertinent implications arising from the SABS62035:2011 updates include:

- Extensions and changes to the risk management section (Part 2)
- Updates to Part 3, Annex D, with improved information for the lightning protection system in the case of structures with a risk of explosion (ie including those containing hazardous locations)
- Revision to the consideration of minimum thickness of metal sheets/pipes for air termination systems, with respect to assumptions related to the prevention of potential 'hot-spot' problems

However, whilst the current standards provide a comprehensive and useful technical reference guide for engineering professionals trained in the process of engineering analysis and design, it is important to understand that effective lightning safety and protection solutions are not about a 'cook book' approach simply using technical standards as 'recipe books'. It is about an engineering approach where these standards play an important technical role, but are applied within a structured, systematic and integrated engineering framework, taking account of a dynamic plant or application environment. This is particularly important in the case of complex applications, such as those involving industrial plants and hazardous locations.

Lightning exposure risk and management

Lightning exposure risks in South Africa are significant across large areas where industry, including mining, with hazardous locations, is located. The recent new edition of SANS10313:2012 [2] also contains an updated table of lightning ground flash density figures which show significantly increased exposure risk for many of these areas. This has significant implications for industry, not least in respect of established industry and existing lightning safety and protection solutions, and their adequacy going forward.

In addition to ensuring that lightning safety and protection solutions are adequate, ensuring the initial and ongoing integrity of these plans and measures is obviously also critical in mitigating the risks. Ensuring appropriate 'behaviour' (operationally and technically) is obviously also key. A conservative engineering approach would be prudent and recommended.

It goes without saying (or does it?) that a holistic and structured approach to lightning risk management must be supported with sound, comprehensive, appropriate and available (where and when it is needed) documentation.

Objectives and considerations

There are two distinct but interrelated objectives of a lightning safety and protection solution. These are to address:

- Human ('living being') safety
- Protection of infrastructure, including electrical and electronic systems

Complex applications are typically characterised by:

- A diverse and complex range of systems, technologies, and interfaces
- These may also include additional factors and particular potential risks, such as the presence of hazardous locations and particular application characteristics (such as location, operations, etc) that impact on the lightning risks
- A diverse, and often separated, engineering, operational and maintenance environment
- Engineering management and coordination challenges across the facility and through the life cycle

As already alluded to, it is clear that effective lightning safety and

protection in complex applications and environments requires a broad perspective and a holistic and structured engineering approach.

Some pertinent engineering considerations include ensuring a clear understanding of the application environment, the objectives and the driving factors. These include:

- Lightning related risks and assessment
- Other project, engineering and life cycle risks and objectives, and their assessment and consideration
- Technologies and systems involved, and associated constraints and issues
- Interfaces (technical, operational, maintenance and management)

The integration of the lightning protection solution into the application environment, including all facility plans and operations, is also a key factor.

It goes without saying (or does it?) that such a holistic and structured approach must be supported with sound, comprehensive, appropriate and available (where and when it is needed) documentation.

A life cycle approach is also critical, as has already been alluded to, to ensure the ongoing integrity and effectiveness of the lightning protection solution. Supporting this is an ongoing requirement for change management and for ensuring continuous awareness and coordination across the application environment.

Such a structured engineering approach for lightning protection solutions is illustrated by the Integrated Lightning Engineering Plan (ILEP) as shown in *Figure 1*, which provides a core mechanism and engineering management framework to ensure a holistic and systematic approach to achieve effective lightning safety and protection at a facility. Proposed by McKechnie and Jandrell [4], this engineering approach and model is particularly appropriate to complex applications including those which contain hazardous locations.

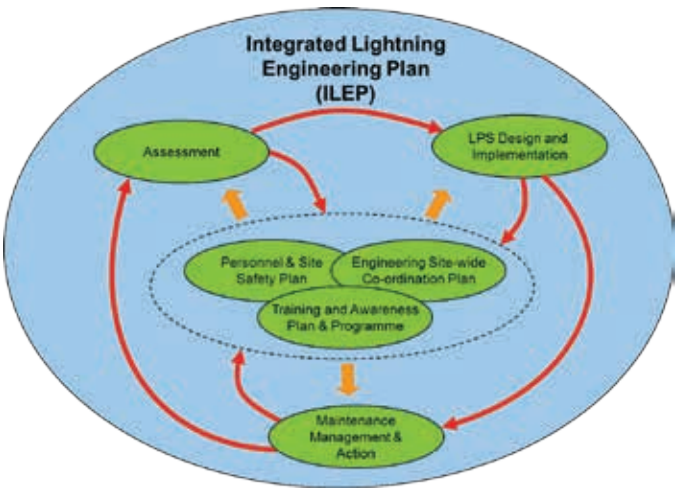

Figure 1: Integrated Lightning Engineering Plan (ILEP).

Conclusion

The risks and hazards due to lightning can generally be well managed in the industrial plant environment.

take note

- Effective management of lightning risks related to hazardous locations is important.
- Different aspects of lightning safety and protection are interrelated.
- A properly designed lightning safety and lightning protection system can limit damage and loss of life or injury.

Effective lightning safety and protection solutions are achieved through a comprehensive and systematic engineering approach that requires an appropriate engineering management framework and the application of appropriately skilled resources and expertise. An overarching and coordinating engineering management framework (and Integrated Lightning Engineering Plan – ILEP) is strongly recommended as a 'living' framework in a dynamic environment. This is particularly important in complex environments, including those involving hazardous locations.

References

[1] SANS (IEC) 62305:2011 suite: 'Protection against lightning'. South African Bureau of Standards, Private Bag X191, Pretoria, 2001.

[2] SANS 10313:2012: 'South African National Standard: Protection against lightning – Physical damage to structures and life hazard'.

[3] McKechnie IS, Jandrell IR. 'Further Southern African experiences with the application of the IEC lightning protection standards based on their application at four major installations'. Proceedings of the 27th International Conference on Lightning Protection (ICLP 2004), Avignon, France, September 2004.

[4] McKechnie IS, Jandrell IR. 'The Integrated Lightning Engineering Plan as an overarching and coordinating framework for an effective and holistic lightning protection solution'. Proceedings of the 30th International Conference on Lightning Protection (ICLP 2004), Cagliari, Sardinia (Italy), September 2010.

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