



THE BIGGER PICTURE

FLASH, BANG AND HOPEFULLY NOT WALLOP!

This month, we have an abbreviated version of an article by James Cobb of CA Event in which he documents his research into lightning and the risks it poses at outdoor events....

On June 27 2009, a lightning strike at an outdoor re-enactment of Roman history in Germany left 13 injured. A month later, on July 25, the first day of the *Virgin Festival* at Deer Lake Park in Canada was cut short due to lightning. According to reports, the organisers felt that the risks involved in a large crowd standing out in the open during a thunderstorm were too great.

During June 2009, thunderstorms raged around the *Glastonbury* site, but the festival continued. The same storms passed close to a Madness concert at Gatcombe where CA was responsible for site safety. A call to the stage supplier revealed that they had no documented risk assessment, policy or guidance relating to safety on stage or around their structures during a lightning strike.

A search through available publications shows there is very little if any guidance or standards applicable to outdoor events. We have collected together here any relevant published information we were able to find.

The key questions are whether a mass public outdoor gathering can be considered safe when thunderstorms are nearby, and whether employers are putting workers (outdoors, on stages, at FOH positions, etc) at unacceptable risk.

TO THE PHYSICS: WHAT IS LIGHTNING?

During thunderstorms, clouds build up an electrical charge. During a lightning strike, electrical current flows between differently charged areas. Strikes are classified as cloud to ground (CG) — the hazardous ones and inter cloud — only immediately risky for aircraft but can be the precursor to CG strikes

FLASH AND BANG

A lightning flash is always accompanied by the sound of thunder, but if the flash is sufficiently distant the thunder may be inaudible. Whilst the flash can be seen over many miles, the thunder is usually only audible within about 12 miles.

The light from the flash travels almost instantaneously, whilst sound travels at

approximately 330ms⁻¹. The time between flash and bang therefore tells us how distant the strike was — with roughly three seconds representing 1km (or roughly five seconds for a mile).

Within a storm cell, the lightning strikes can reach over quite some horizontal distance, and frequently stretch out towards the leading edge of the storm. The generally accepted 'safe' distance seems to be about six to eight miles. Lightning any closer than this means the next strike could hit your location. That means anything less than a 30 second gap between lightning and thunder means there is a risk of an immediate local strike.

This gives rise to the '30/30' rule — when outdoors you should seek safety when the lightning/thunder gap is less than 30 seconds. And you should stay there until 30 minutes after the last audible or visible strike to be sure lightning activity has passed.

This rule has been generally superseded by 'when thunder roars, go indoors'. The speed with which a storm cell could be moving means that by the time you've counted to 30, the storm could be overhead! So a better rule may be to seek shelter as soon as thunder is audible, which means the strike is likely to be no more than 12 miles away.

HAZARDS AND EFFECTS

Lightning can cause injury or death in a number of ways, by direct strike of a person out in the open, by a person being in contact with part of a structure that becomes a conductor, by high voltage arcing between conductors and people or by step voltage — a person standing on the ground within about 3m of a lightning strike can have such a large voltage across their two feet that a potentially fatal current can flow.

Exploding electrical equipment, property damage and subsequent collapse and crowd panic are all hazards that pose a risk in the event of lightning strikes.

CURRENT GUIDANCE

There is little available guidance that specifically



applies to UK outdoor events but it must be considered as part of any event risk assessment as it does pose a threat to people affected by your work.

ROSPA published guidance called 'Lightning At Leisure' in 2007. It encourages readers to think about the following:

- In case of an event, monitor the local weather from the day before activity to the end of play and the dispersal of crowds.
- Have an efficient method of warning people at risk, and evacuation if necessary.
- Define and list safe structures and locations. Safe structures can include a large/substantial building with plumbing and wiring that will conduct lightning to the ground such as a clubhouse, or fully enclosed metal vehicles including buses.
- Determine criteria for suspension and resumption of activity — for example, use the 30/30 rule.
- Ensure the dissemination of information — participants, officials, spectators, and staff must be aware of potential dangers and how to minimise the risk of injury.

The guidance is pretty clear that outdoor leisure activities should cease during local thunderstorms. However the requirement for spectators to move to a safe structure/location may be impossible for a large scale concert/festival on a greenfield site.

BS 62305

The IEC has recently published an updated standard for lightning protection to buildings and structures. This standard is in the process of being

accepted as a British Standard, which will replace the current lightning protection standards.

Although the standard applies essentially to buildings and lightning conductors, it contains a methodology for assessing lightning risk that is applicable to any scenario. The calculation model is a little too complex for the limited space here.

NLSI

In the US, the National Lightning Safety Institute publishes guidance. Their recommendations for outdoor workers are as follows:

Lightning safety awareness is a priority at all outdoor activities. No place outdoors is 100% safe from lightning. The important thing to remember is to "Anticipate a high-risk situation and move to a low-risk location".

A comprehensive lightning safety program consists of the following details:

- 1. Detection.** Lightning conditions are to be monitored continuously. In most cases, a combination of a lightning network subscription service, a professional-grade lightning warning system, and a high-quality hand-held detector is suggested. However, if thunder is heard, the danger is close enough to suspend operations and to seek refuge.
- 2. Notification.** Suspension and resumption of work activities are planned in advance:
- 3. Safe shelter.**
- 4. Re-assess the threat.** Wait until thunder is no longer heard before resuming activities. Be extra cautious during this storm phase, as the lightning danger still may be a significant hazard.
- 5. Resume normal outdoor activities.**
- 6. Policies & procedures. Education & training.** Again, the practicality of evacuating a large scale festival site to a safe shelter is probably impossible.

ESTIMATING RISK

On the one hand, the probability of being struck by lightning is put at a vanishingly small annual one in 18 million. This is even less likely than a set of six particular numbers winning the lottery at about one in 14 million. So lightning risks seem too small to worry about.

On the other hand guidance from ROSPA and NLSI is for all outdoor work and leisure activities to cease when lightning is nearby, with both workers and public seeking shelter. A numerical assessment of the risks involved is needed together with some benchmarks on what risk levels are considered tolerable.

We need to focus on two different groups of people — the public (who arguably make their own decision to be in an open field during a storm — and the hazard is an Act of God not a result of their chosen leisure activity) and workers (who will be treated differently both under UK law, and also from a moral perspective).

Further work is needed to more accurately estimate the risks of being on a stage during a thunderstorm. It may or may not be more dangerous than being out in the open.

For workers in the open the numerical risks are within the tolerable region, which means

measures must be in place to reduce the risk as low as is reasonably practicable. Certainly all guidance (both US and UK) is that workers must not be outdoors during thunderstorms, and must seek safety in a refuge.

These risks should be identified and controlled in the risk assessments for any outdoor event.

We would suggest that during build periods for any outdoor event site, some kind of monitoring is essential. Before lightning is within strike range (i.e. thunder is audible), procedures should be in place to stop outdoor work, evacuate hazardous locations (e.g. working at height, PA masts, and maybe stages), and move all employees to an identified safe place. Monitoring would need to continue to determine when it is safe to return to work.

The same should apply at all times which would include during shows, which could include show stop procedures being initiated; public safety will have to be considered too rather than considering employers in isolation.

SUITABLE CONTROL MEASURES FOR THE PUBLIC

For the public, the risks from lightning obviously do not arise from a work activity. Lightning is an Act of God, and it might be reasonable for an event organiser to ignore these risks to the public — lightning is completely beyond their control, and an audience make their own decision to be outdoors during lightning or not.

However, it would appear the *Virgin Festival* in Canada was cancelled on the first day for just these reasons, which indicates a contrary view. And all the advice for the public undertaking leisure activities such as golf or fishing is for them to seek refuge and not be outdoors during a thunderstorm, which again would suggest the risk is not acceptable.

We also need to remember that we've only looked at the risk of strikes to a person in the open. Despite all advice being to the contrary, the public will often seek shelter during a storm under trees, and many of them maybe located dangerously close to FOH towers or PA masts, that places them at greater risk. Under an isolated 25m high tree, your risk of a lightning strike increases from 10⁻⁵ to about 2 x 10⁻³, which is well into the completely intolerable risk level.

Unlike many sporting events, it would not be possible to move the audience for an outdoor concert to safety within the site (which requires being inside a 'proper' building or a vehicle). The only option would be to evacuate the site and for the attendees to return home as happened in Canada.



As another option, the audience could be informed of the hazards, and in particular briefed not to stand under or near high structures. This would at least mean risks are probably tolerable if not broadly acceptable.

There appears to be no simple rule or consensus as to how to treat the audience at an outdoor event if a thunderstorm is approaching.

LIGHTNING DETECTION

Critical to controlling the risks associated with lightning is the detection of nearby lightning so that appropriate action can be taken. Three methods are recommended by the NLSI — online services, static detectors, and handheld detectors. More information is available in the full article.

The full text of this article will be available from www.caevent.co.uk and in the members' section of the PSA website. The research is still a work in progress, and we would ask anyone with knowledge or experience of this area to get in touch with James Cobb at james@caevent.co.uk.

The PSA and TPI magazine would like to thank James for sharing his study.



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