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Lightning Procedure v2

WHS-PRO-035

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1 PURPOSE

The purpose of this document is to provide a procedure for personal safety during thunderstorms, outlining:

- The hazards of lightning
- How to determine if a site is at risk
- Safe locations during a thunderstorm
- Hazardous locations during a thunderstorm
- The effects of lightning strike
- Steps to be taken after a lightning strike to persons or plant

2 ANTICIPATING A THUNDERSTORM

Keep a constant lookout for thunderstorm clouds in the region. They can develop in as little as 15 minutes. If thunder is heard and intra-cloud or cloud to ground lightning can be seen, you are already in a higher risk situation.

Once thunder can be heard, keep estimating the distance to the lightning activity by using the 'Flash to Bang' reckoning method. This is a mental calculation that anyone can do simply by counting the delay between seeing a lightning flash to hearing the audible thunder associated with the flash.

The rule of thumb is that every 3 seconds of delay between a flash to thunder, equates to a distance of 1 kilometre, so where there is a 30 second flash-to-thunder time interval, the lightning activity is about 10 km away.

Data from lightning location systems show that you should seek a safe location whenever the Flash to Bang interval is less than 30 seconds.

3 THE 30/30 RULE

The "30–30 Rule" states that when you see lightning, count the time until you hear the associated thunder. If the time delay is 30 seconds or less, go immediately to a safe location as described below.

If you cannot see the lightning, just hearing the thunder means you are most likely to already be within striking range, and it is time to seek whatever appropriate shelter is available.

After the storm conditions have apparently dissipated or moved on, wait a further 30 minutes after hearing the last thunder before leaving the safe area location. Should thunder be heard within this period, the 30 minute period must be restarted from the last thunder clap heard.

The "30–30 Rule" is best suited for existing thunderstorms moving into the area. However, it cannot predict or protect against a first lightning strike. Thunderstorms can develop overhead where there will be no prior notice that a storm is incoming. Be alert to changes in sky conditions indicating thunderstorm development directly overhead.

When lightning threatens, go immediately to a safer location. Do not hesitate. The lightning casualty statistics outline that many persons have been struck just prior to reaching a safe location. Even a few extra minutes lead time can be lifesaving.

4 DETECTION AND WARNING TECHNOLOGIES

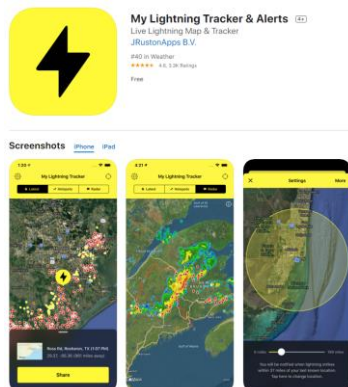
Lightning warning and detection systems fall into two categories:

- Those systems that warn of the conditions that precede a lightning discharge "A Lightning Warning System"; and
- Those that report on historic events, albeit only seconds old. "A Lightning Detector"

4.1 Lightning Warning Systems

Workers who have access to mobile phones such as the Site manager or Supervisor must have downloaded onto their phone or tablet the "My Lightning Tracker" App. Setting the radius in the app to 10km aligns with the 30/30 rule. This can be done by accessing the settings page under 'More' and setting the 'Lightning Time Interval' to 30 minutes.

If "My Lightning Tracker" sends an alert of lighting within the 10km radius, alert all persons in site to seek shelter. Additionally, the app will remove lightning strikes after 30 minutes, allowing users a quick reference tool to ensure the 30/30 rule is complied with.



Whenever storm conditions are forecast for site, the Site Manager or Supervisors are to monitor the "Bureau of Meteorology" (BOM) website for adverse weather conditions and severe weather forecasts and warnings within the area of the site. This will provide a guidance on expected storm activity in the region. There is a link on the MawCentral Intranet page.

4.2 Lightning Detectors

Work sites that have been identified as high risk, either by the type of work undertaken or products handled, such as shottfirsers, or due to high risk site locations shall be provided with lightning detectors.

Lightning detectors can detect cloud to ground lightning strikes within a variable distance from the unit, once detected the unit will immediately provide an alert to the user.

5 SAFE LOCATIONS WHEN THERE IS CHOICE

Do not remain outdoors. Seek shelter in one of the following locations:

- Within a dedicated safe area such as any area that is protected by a Lightning Protection System;
- Inside a metal-skinned car, or other vehicle, including heavy vehicles or mobile plant;
 - Vehicles and mobile plant have metal bodies that act like a faraday cage;
 - If you need to shelter inside the vehicle or mobile plant, keep your hands on your lap until lightning storm has passed, do not touch anything;
 - Keep all windows shut;
 - Park in a low-lying area, away from tall objects
- Inside a substantial metal-clad building that has normal headroom; or
- Inside a large building, keeping away from the windows and any appliances connected to outside electrical conductors.

6 HAZARDOUS LOCATIONS

Avoid these if possible:

- Explosives magazines, vehicles containing explosives and loaded blast patterns;
- Areas near flammable hydrocarbons and accelerants;
- Standing near a Lightning protection down-conductor, mast, or earthing system;
- Cement silos, overhead bins and catwalks;
- All areas of a crushing plant;
- Communications towers and tall metallic masts;
- Cranes and concrete pumps;
- Any use of fixed line telephones, especially corded headsets. (Cordless & mobile excluded);
- Metal hair clips, metal clips on helmets, keys in pockets etc.;
- Umbrellas;
- Small, unprotected buildings, sheds;
- Areas on tops of buildings;
- Open areas e.g. car parks;
- Open water sources;
- Areas near wire fences, overhead wires, pipelines and railroad tracks;
- Standing beneath isolated trees, or touching or standing near any tree;
- Riding/driving open roof machinery e.g. forklifts.
- Contact with metal objects and electrical appliances; and
- Hilltops and ridges and open pits.

7 HIGH RISK WORKGROUPS

There are specific activities within company operations that are at higher risk of lightning strike. These specific workgroups include, but are not limited to:

- Maintenance and Electrical workers who work with switchboards and copper conductors;
- Site Manager;
- Quarry Workers;
- Heavy Vehicle Drivers e.g. Tippers, Floats;
- Cement Tanker Delivery Drivers;
- Freight Delivery Drivers;
- Construction workers;
- Pump operators;
- Crane and Hiab operators;
- Explosives crews;
- Concrete delivery drivers;
- Concrete testers; and
- Drillers

8 WHAT TO DO IF YOU CANNOT REACH A SAFE LOCATION

If the thunderstorm is above you (flash-to-thunder time < 5 seconds) and you cannot reach a suggested safe location, follow the steps below to minimise the risk of being struck or affected by the indirect effects of lightning.

You should try to:

- Seek a depressed area; avoid high places;
- Keep away from large isolated trees; and
- If in a group, stand at least 3 metres apart.

If isolated in an exposed area and your hair stands on end, this is indicative that the e- fields at ground level are rising quickly and that lightning is about to strike, you should immediately assume a crouched position with your feet together, or sit with your feet tucked in close to your body.

9 COMMON LIGHTNING INJURIES

Lightning strike statistics show that there are 5-10 fatalities from lightning strikes and over 100 severe injuries in Australia each year. Being in contact with an object that is struck by lightning, or a person who has been struck by a side flash from a nearby object being struck such as a tree; has the same result as a direct strike.

If you are nearby to a lightning strike, rings of lightning impulse spread out from the strike area. These rings have differing voltages as they move away from the strike area. This is called 'step voltage'. If two parts of the body are in different voltage 'rings' energy may travel between the 'rings' by passing through one part of the body and exiting another. Injuries can include burns and paralysis but these are usually temporary.

A person who is in contact, or in close proximity to an electrical appliance, power or communication line may be exposed to an injury from surge propagation. Serious injury is not common but a number of deaths have resulted from fixed line telephone usage.

10 FIRST AID TREATMENT

Immediately enact the site emergency plan, ensure that emergency services are called, commence first aid, notify emergency services, ensure all other people are safe, and make required notifications.

There is no danger in touching a person who has been struck by lightning as no electric charge remains. First aid is required urgently and should be started without delay. Breathing and blood circulation can be restored using CPR. These procedures must be continued until breathing and circulation is restored, trained emergency services personnel arrive to take over, or until it can be medically confirmed that the patient has not survived.

Lightning victims are sometimes thrown violently against an object, or are hit by flying fragments so first aid may have to include treatment for traumatic injury.

11 LIGHTNING SAFETY FOR OUTDOOR WORKERS

Lightning safety awareness should be a priority at every outdoor facility and operation. Education is the single most important means to achieving this goal.

The number one rule is that workers need to always consider their own situational safety, and those who may find themselves exposed to the risk should always recognize and anticipate their exposure to a changing or high-risk situation, and where appropriate move to a lower-risk location.

The following steps are suggested:

- Regularly monitor weather conditions and local weather forecasts prior to scheduled activities;
- Suspension and resumption of work activities should be planned in advance;
- Understanding locations of shelters is essential. Evacuation sites include:
 - Fully enclosed metal vehicles including heavy vehicles and mobile plant with windows up;
 - Substantial buildings; and
 - Low ground.

12 LIGHTNING STRIKE LIGHT VEHICLE AND HEAVY VEHICLE OR MOBILE PLANT

12.1 Light Vehicles

Lightning strikes have the potential to cause damage to vehicles through several mechanisms including:

- Direct strike – where lightning directly hits the vehicle;
- Indirect damage – when another item is damaged by lightning and then falls or is thrown into or onto the vehicle; and
- Causing a vehicular accident when a lightning strike to or near the vehicle impacts on the driver's ability to safely operate the vehicle.

Reported impacts on vehicles include pitting, damage to electrical systems, stopping the motor when a running vehicle is directly hit and setting off air bags.

Light vehicles are protected with a faraday cage and it may be safer to shelter in a stationary vehicle during lightning activity if no other shelter is available. Ensure that have your hands on your lap at all times until the lightning storm passes.

Where an LV is struck by lightning it should be parked up in a safe area/compound for 24 hours as tyre explosion or a fire could occur). An exclusion zone of 300 metres is required. The tyres and auto electrics should then be checked by a competent person before returning the vehicle into service.

12.2 Heavy Vehicle and Mobile Plant – Safety Hazards Associated with Lightning Impact

Lightning strikes on heavy vehicles or mobile plant can have many of the same impacts as on light vehicles. Additionally, overheating of rubber as a result of lightning strikes on heavy vehicles or mobile plant may cause tyre explosions which could potentially result in accidents if the vehicle or plant is in operation.

When a rubber tyre becomes overheated, a chemical reaction in the rubber called pyrolysis can occur. Pyrolysis causes the rubber to deteriorate. At a certain point, this deterioration can create a very rapid pressure increase inside the tyre that can lead to a sudden and unexpected explosion.

Once this chemical reaction starts, it can continue on its own even after the heat source is removed. Pyrolysis can last seconds or hours. There are no visible signs when it's taking place until the explosion occurs, and this has been known to take up to 21.5 hours. Pyrolysis does not require oxygen, meaning nitrogen filled tyres are also at risk. Anyone standing near the explosion is at risk of serious injury or even death.

The heavy vehicle driver or Mobile Plant Operator should stay inside, keep their hands on their lap at all times until the lightning storm passes and only exit when safe to do so. Never get out of the Mobile Plant and walk away with your back facing the sidewalls of the tyres – if the tyres should blow they can travel out away from the mobile plant for hundreds of metres. Exit the heavy vehicle or Mobile Plant and walk away from the front or back.

If the heavy vehicle or mobile plant has been struck by lightning – it should be parked up in a safe area/compound for 24 hours as a tyre explosion or fire could occur. An exclusion zone of 500 metres is required. The tyres and auto electrics should then be checked by a competent person before returning the vehicle into service.

13 BUILDING STRIKE

Lightning passing through a building may branch and utilise more than one path to ground at a time. It can also jump from one conductive path to another as a side flash. The three main hazards to the building are:

- Fire danger: flammable materials can be ignited if electrical energy from lightning passes through or near to them (i.e. down pipes or wires);
- Power surge damage: electrical energy can damage wiring and attached electronic devices; and
- Shock wave damage: lightning can cause an explosive shock wave which can fracture solid materials, blow out plaster walls, shatter glass, create trenches in soil and crack foundations. This can result in shrapnel which can create secondary damage to the building or injury to inhabitants.

14 FIXED PLANT STRIKE

Lightning risks for fixed plant are similar to other buildings. Risks during lightning include:

- Direct strikes to personnel in open areas of the plant;
- Indirect strikes to personnel in contact or close proximity to metal structure;
- Damage to electrical components and electronic devices;
- Fire danger;
- Injury to personnel due to step voltage effects from standing on metallic or wet surfaces; and
- Shock wave damage.

15 UNSAFE SHELTER AREAS

Unsafe shelters include all outdoor metal objects, like power poles, fences and gates, high mast light poles, electrical equipment, silos, open cab machinery.

- AVOID solitary trees;
- AVOID water;
- AVOID open areas; and
- AVOID high ground.

16 SUMMARY

- If you feel your hair standing on end, and/or hear "crackling noises," you are in lightning's electric field. If caught outside during close lightning activity, immediately remove metal objects (including baseball cap, jewelry, belts, car keys etc.), place your feet together, duck your head, and crouch down low with hands on knees;
- Use the "My Lightning Tracker" App to detect lightning near to site. If not available use the 30/30 reckoning system.
- Lightning's remote distance is easy to calculate: If you hear thunder, the associated lightning is within visual range;
- Site personnel to retreat to a safe area if lightning is detected within 10km of site.
- Wait a minimum of 30 minutes from the last observed lightning or thunder before resuming activities. Be extra cautious during this phase as the storm may not be over;
- People who have been struck by lightning do not carry an electrical charge and are safe to handle. Apply first aid immediately if you are qualified to do so. Get emergency help promptly;
- If a rubber tyred vehicle is struck by lightning, put a 500m isolation zone in place for 24 hours. Before returning to service have tyres and electrical systems checked by qualified personnel.
- Be aware of your surroundings and the nearest safe area.

17 REFERENCES

- Occupational Health and Safety Act (VIC) 2004
- Occupational Health and Safety Regulation (VIC) 2017
- Work Health and Safety Act (NSW) 2011
- Work Health and Safety Regulations (NSW) 2017
- Work Health and Safety (Mines and Petroleum Sites) (NSW) Act 2013
- Work Health and Safety (Mines and Petroleum Sites) (NSW) Regulations 2022
- <https://www.australiawidefirstaid.com.au/lightning-strikes>

18 DOCUMENT HISTORY

Revision	Date	Amended By	Reason for Change
1	03/02/2022	Suzanne Gundry	Document created – adapted for use from document CON-PRO-1020 FOST – 001 v1
2	22/06/2023	Simon Taylor	Created general document, reformatted, took out Fosterville information and made appropriate for company wide use.