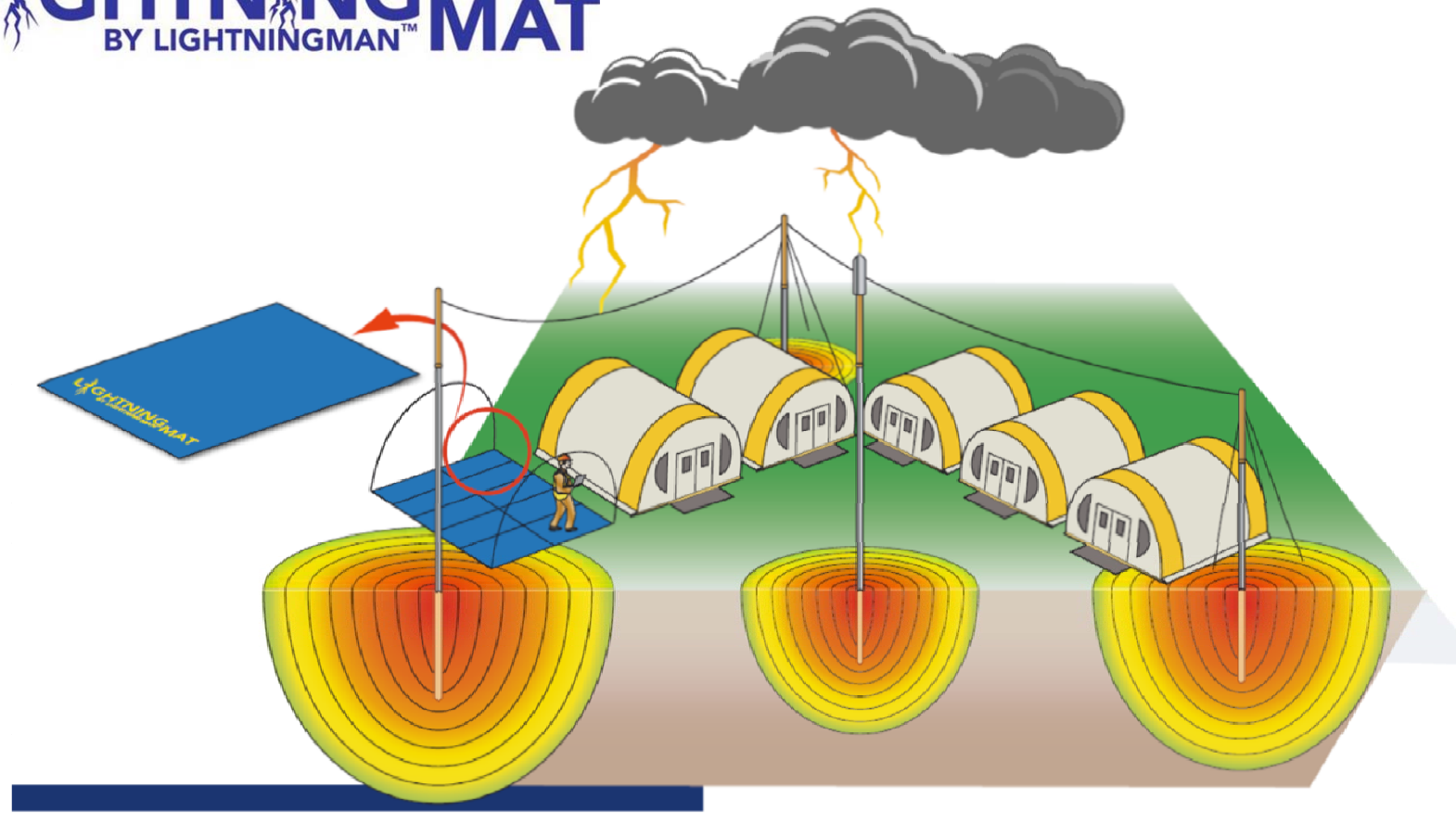


LIGHTNING BY LIGHTNINGMAN™ MAT



Presented by

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Significant Lightning Incidents - Mining and Resources

- Fatality (2) WA (1968) Explosives pre-detonation
- Fatality (63) South Africa (1987) Harmony Gold
- Fatality WA (2000) WMC Resources
- Fatality (2) Indonesia (2005) Exploration
- Fatality (12) USA (2006) ICC
- Fatality (4) South America (2006) Anglo American
- Fatality (+ 8 injuries) Peru (2007) Newmont
- Fatality Dominican Rep (2008) Barrick
- Fatality Laos (2008) Oz Minerals
- Fatality (+ 3 injuries) Laos (2008) Pan Australia
- Fatality Peru (2015) MMG
- Injury WA (2000) WMC Resources
- Injury WA (2010) BHP Billiton
- Injury (2) WA (2011) Rio Tinto
- Injury WA (2012) St Barbara
- Injury (2) WA (2014) McConnell Dowell
- Injury WA (2017) AngloGold Ashanti

LIGHTNING RISK MECHANISMS



There are several primary mechanisms by which lightning can injure or kill humans.

Direct Strike

Where an actual lightning attachment has occurred.

Contact /Touch Potential

Where persons are in direct bodily contact with differential voltages.

Side Flash

Where lightning current flashes off some object, over to some adjacent object.

Step Potential

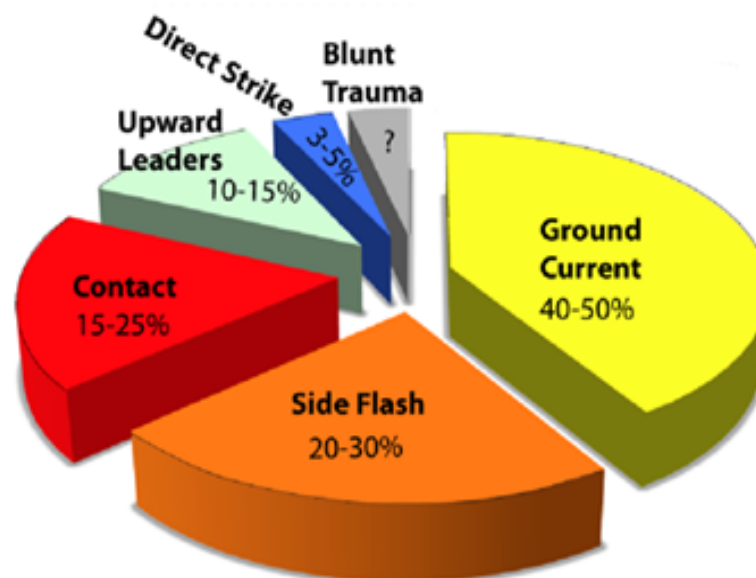
Where differential voltage gradients exist across a person's two footed stance.

Upward Streamer

Where non-intercepting upward streamers are launched from the person.

Blunt/Burns Trauma

Where lightning causes explosion or other debris to be blown off.



Earth Potential Rise (EPR)



Wherever high voltage of lightning current is injected into the earth mass, the local ground becomes highly electrified resulting in a dangerous Earth Potential Rise (EPR) which can cause serious injury /death to persons over large areas.

EPR Controls are mandated for use in all high voltage electrical switchyard and substations so as to protect electrical workers from the dangerous voltage differentials they may be exposed to during their activities.

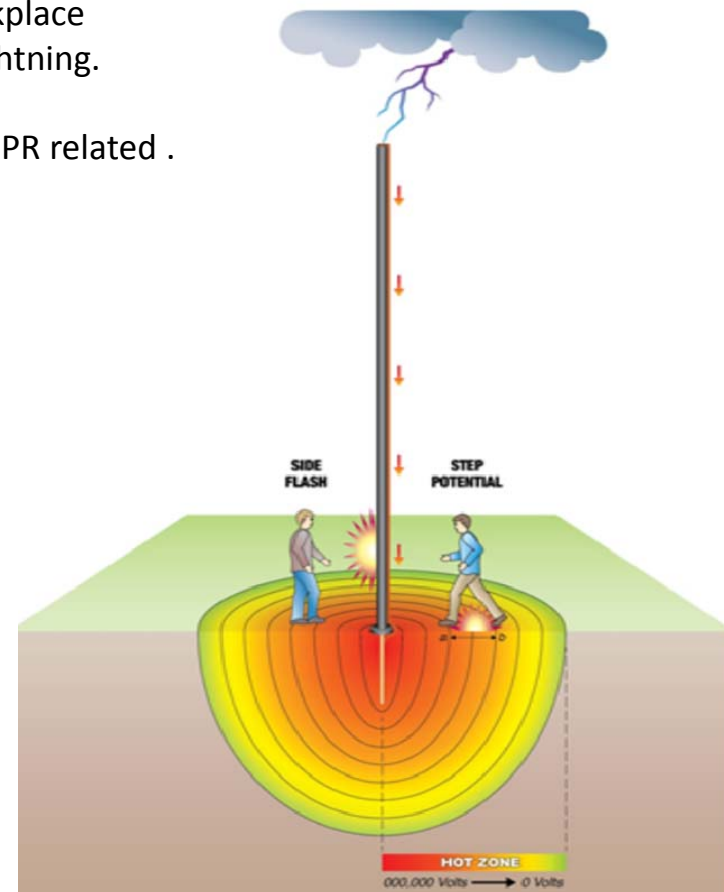
No similar controls are required for any other higher risk workplace activities, that can present similar EPR risks posed through lightning.

Over 55-75 % of all lightning fatality and injury statistics are EPR related .

Direct strike accounts for only 3-5% of the statistics.

Such higher risk workgroups will include:

- Remote Construction
- Exploration teams
- Geologists / Survey teams
- Tented camp accommodations
- Communications technicians
- Electrical workers,
- Linesmen/powerline construction
- Drilling crew
- Railway Maintenance crew
- Pipeline Maintenance crew



EPR STATISTICS



Year	Deaths	Injuries	Est. EPR Injuries	Probability
2008	27	305	229	7.6×10^{-7}
2009	34	256	192	6.4×10^{-7}
2010	28	241	181	6.0×10^{-7}
2011	26	248	186	6.2×10^{-7}
2012	28	212	159	5.3×10^{-7}
2013	23	235	176	5.9×10^{-7}
2014	20	144	108	3.6×10^{-7}

Table 1: Lightning injury data for the USA from 2007 to the present. Probability value is based on a total population of 300 million. (2014) has only partial data.

Mills et al (2009) had also published the mean lightning death and injury data rates for Canada for the period 1986 to 2005. This data is shown in Table 2.

Deaths	Injuries	Est. EPR Injuries	Probability
53	277	208	5.9×10^{-6}

Table 2: Mean annual lightning injury data for Canada from 1986 to 2005. The probability value is based on a total population of 35 million.

LightningMat EPR Safety Mat

Introducing the Lightningman™ LightningMat EPR Safety Mat

The **LightningMat EPR Safety Mat** offers unique and innovative new approach to EPR Risk Mitigation.

The **LightningMat EPR Safety Mat** works by redistributing the surface voltage profile associated with EPR, and reducing dangerous potential gradients across the mat structure.

Any persons situated upon the **LightningMat EPR Safety Mat** during an EPR event, should be equipotential with the mat, such that they will not be exposed to significantly differing voltage gradients that result from EPR .

The **LightningMat EPR Safety Mat** will therefore prove invaluable to those groups working exposed to the elements, and who may have a limited access to appropriate safe shelter.

Additionally, those working with/ or in close proximity to long conductive elements, such as Rail Lines, Pipelines, and Power/Signal lines, will also benefit from the protection offered by the LightningMat.

Whilst the **LightningMat EPR Safety Mat** can be used without an electrical bond to nearby touchable objects (since it redistributes the surface voltage profile), enhanced performance and voltage reduction is achieved, wherever an electrical bond is used.

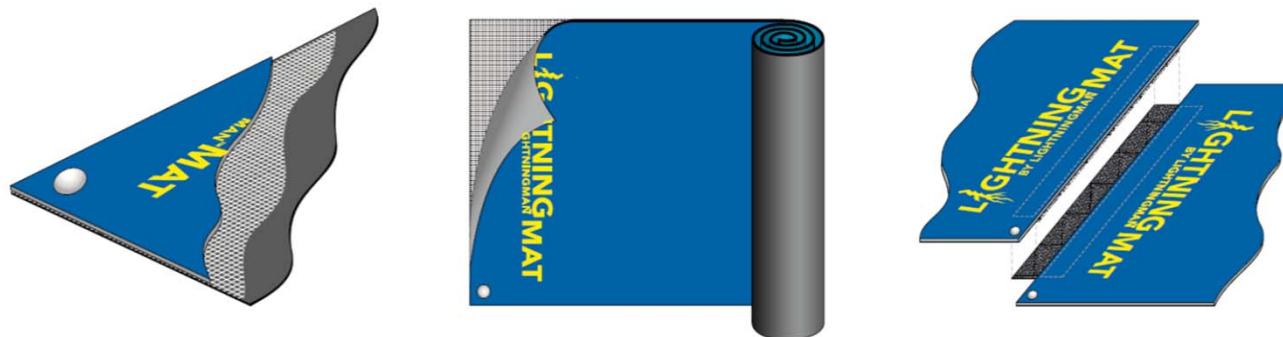
The flexibility and light weight of the **LightningMat EPR Safety Mat** offers simple field application, and an ease in portability.



The **LightningMat EPR Safety Mat** provides a simple means for mitigating the EPR hazard via its unique three-layer design (Figure 1).

All of the layers are highly flexible, hence enable the mat to be rolled and unrolled as required |

An additional product option is available that enables mats to be joined electrically, to create longer mats as required





LightningMat is an innovative and highly portable EPR risk mitigation control.

It has been developed primarily for ease of portability, and to provide a cost effective and simple means for mitigating EPR hazards to remote personnel via a unique three (3) layer flexible mat design, comprising of:

- A central, electrically-conductive mesh layer that rapidly equalizes electrical potential developed across the mat.
- An upper insulating layer that insulates personnel /and assets from the electrically conductive central layer.
- A lower electrically-conductive layer that protects the central layer, and provides electrical continuity to the central layer.



Figure 1: LightningMat EPR Safety Mat cross sectional view



TESTING

The following testing has been carried out: *(All reports are available upon request)*

- CDEGS computer modelling.
- Compliance to IEC 61111:2009 –Electrical Insulating Matting.
- Verification of the function of the LightningMat EPR Safety Mat via a full-scale current injection testing in the field. (Lightning Protection International)
- Independent review and validation of the testing methodology applied to EPR safety mat. (Power Quality Research Centre - University of Wollongong, Australia.)

REFERENCES

- Lightning Protection International. EPR Safety Mat- Statistics on Lightning & Power-related Injuries 2014
- Cawley, J.C. & Homce, G.T, 2008, "Trends in Electrical Injury in the U.S., 1992–2002", IEEE Trans. Indust. Appl., Vol. 44, No. 4, pp. 962-972.
- Cooper, M.A., Holle, R.L. & Andrews, C., 2008, "Distribution of lightning injury mechanisms", Proc. 20th ILDC / 2nd ILMC, Tucson, AZ, USA.
- Pointer, S. & Harrison, J., 2007, "Electrical injury and death", NISU Briefing, No. 9, Flinders University & Australian Government.
- WA Government, 2012, "Electrical Incident Safety Report Western Australia 2010-11", Department of Commerce (Energy Safety), Report DP0281/2012.