

The lightning threat to mines – real or imagined?

Lightning over the Twin Shafts complex at South Deep (photo: Gold Fields).

While most observers would probably agree that lightning is not the biggest problem that the mining industry faces in terms of safety and possible disruption to operations, it is nevertheless a phenomenon which presents very distinct threats to virtually every African mine. This is the view of Ian McKechnie (left), MD and co-founder of Centurion-based Innopro, who notes in particular that the shift towards ever more sophisticated mechanisation, automation and communications systems at mines – a trend often referred to as ‘digital mining’ – has heightened their vulnerability to lightning damage and its knock-on effects.

Trying to source hard and fast facts on the impact of lightning on the mining industry is an almost impossible task – the statistics simply do not exist. Yet every now and then a news report surfaces which highlights the fact that mines do indeed need robust lightning protection systems in place. For example, in 2010 the (now defunct) Smokey Hills platinum mine in the Steelpoort area was struck by lightning, with the result that its processing plant was put out of commission for several days, resulting in a significant loss of production. This, in turn, impacted on the share price of the mine’s owner, Platinum Australia Limited.

Says McKechnie: “There is no question that lightning can have potentially damaging effects on mining operations and it is absolutely essential that mines take the issue of lightning safety and protection seriously. Many already do so, but there are others who either have no systems in place or, if they do, are relying on legacy techniques and technologies that are outdated and need replacing. Digital mining is also about increasing safety, and the degradation of systems due to lightning will obviously also impact that negatively.”

McKechnie speaks from a wealth of experience. A Past President (2007/8) of the South African Institute of Electrical Engineers

(SAIEE) and an Honorary Research Fellow at the University of the Witwatersrand (Wits), he is one of South Africa’s leading experts on lightning and has consulted extensively on lightning protection to organisations – including mining companies – both in South Africa and internationally. A graduate of the University of Cape Town, he has a BSc (Eng) degree in Electrical & Electronic Engineering and is a registered Professional Engineer.

He established Innopro as a specialist consulting engineering and forensic engineering company in 2001, in collaboration with Professor Ian Jandrell, who also enjoys an international reputation in the earthing and lightning protection field. While Jandrell is an active Director of Innopro, he is best known for his long association with Wits, where he is the current Dean of the Faculty of Engineering and the Built Environment. He was the 1994 SAIEE Engineer of the Year and in 2011 the recipient of the SAIEE President’s Award. He is also a member of the Scientific Committee of the International Conference on Lightning Protection (ICLP).

McKechnie also recently presented a paper, jointly authored with Jandrell, at ICLP 2014 in Shanghai (China), entitled *A systems*

engineering and strategic approach to holistic lightning safety and protection solutions. He notes that this is particularly pertinent to complex applications such as mining.

McKechnie makes the point that increased mining activity in more lightning intensive areas – a worldwide phenomenon but particularly in Africa – has increased the probability of lightning impacting on mining operations. “The African continent experiences some of the highest lightning activity in the world,” he says. “As we all know, South Africa’s highveld can deliver some spectacular lightning displays but – contrary to popular perception – it is by no means the worst area in Africa for lightning strikes. This distinction belongs to the north-eastern DRC where the lightning ground flash density per square kilometre per year is around 158 – whereas the equivalent figure for Johannesburg is 12 and the planetary average approximately 6,5. The north-eastern DRC – where at least one new large-scale gold mine has started up recently – is in fact the worst place in the world for lightning.”

He adds that the improved data collection over the past few years indicates that the lightning problem in South Africa is more severe than previously thought. “Data from the SA Weather Service Lightning Detection Network, which was commissioned in 2006, indicates that the ground flash density was significantly under-estimated in the past and indeed this is reflected in the 2012 edition of the Lightning Protection standard from the SABS (SANS 10313:2012). This new data, incidentally, correlates well with NASA data from imaging surveys.”

Elaborating on the risk profile of mines to lightning, McKechnie says modern open-pit operations tend to have tightly inter-connected systems in place (in terms of communications and control), can frequently extend over huge areas, thus exposing both personnel, equipment and infrastructure to lightning strikes, and can often include hazardous locations. In addition, certain operations such as blasting can be affected by lightning activity. Even in the case of underground mines, lightning presents risks. Again the geographic surface area covered by infrastructure, including processing plants, can be substantial while the presence of surface to underground interfaces can transmit the effects of lightning to underground work areas – particularly dangerous in the case of coal mines which in South Africa are typically not very deep and which may, in addition, be classed as ‘fiery’.

McKechnie points out that direct lightning

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strikes are only one of numerous potential ways in which lightning can cause injuries to personnel. “The reality is that one also has to consider step voltages, which are the biggest contributor to injuries emanating from lightning activity, touch voltages and side flashes,” he says. “Other potential injury mechanisms include – for example – the upward streamer mechanism and barotrauma as well as, obviously, secondary mechanisms including fire and explosion.”

Turning to the issue of how mines can protect themselves from the effects of lightning, McKechnie emphasises the need for a holistic approach: “People tend to fixate over earthing or surge protection, but these are just elements of what must be a much wider, structured and integrated approach incorporating both micro and macro strategies. The macro strategy should be about creating a mine-wide enabling environment compatible with the overall mine and site health and safety plan while the micro strategy will encompass the ‘nuts and bolts’ of lightning protection at an engineering level.

“The starting point, of course, must be a thorough assessment of the lightning risk at the mine, bearing in mind that lightning protection is a risk management – and not a risk elimination – process and that the level of protection achievable is, to some extent, dependent on the investment the mine owner is prepared to make above and beyond the statutory or required minimum. But the risk assessment must go beyond this and consider the broader risk profile such as engineering risks associated with potential solutions.”

On the micro strategy, McKechnie notes that the technologies, concepts and techniques contributing to efficient lightning protection systems – surge protection and equipotentialisation, for example – have shown great advances in recent years and that the effectiveness of protection achievable is far higher than, say, 20 years ago. He also points out that Innopro makes maximum use of what might be termed ‘natural’ components. “By this I mean that – where possible – we will use plant structures as part of the solution – for example, when we install earthing we’ll integrate foundation reinforcing where we can, an approach, of course, which is easiest to implement when a project is being developed,” he explains.

More often than not, Innopro tends to work on ‘brownfield’ as opposed to ‘greenfield’ installations but McKechnie does mention that the consultancy was called in a couple of years ago to provide – working as a sub-contractor to the electrical consultant – a comprehensive

lightning protection system for the general (but not plant) infrastructure at Kumba Iron Ore’s new Kolomela mine in the northern Cape. As he recalls, “It was very rewarding to be involved with a ‘greenfield’ project right from the outset and to work with a mine owner and project team who were so receptive and supportive to what we proposed and implemented.”

He stresses that once a system is in place, it needs to be maintained to ensure its continuing efficiency. “Basically, one needs a lifecycle approach,” he remarks. “The days of putting in a system and then forgetting about it are long gone. Upgrades, extensions or modifications will also often be needed in order to provide safety and protection as a mine evolves and its electronics and communications systems in particular grow ever more complex or extensive.”

To get its message on lightning safety and protection across to interested parties, Innopro frequently holds seminars, which are publicly offered but which can also be tailored to the needs of specific companies and organisations and held at their premises. In August this year, for example, it held its popular – and recently updated – one-day ‘Best Practices in Lightning Safety and Lightning Protection of Structures and Systems’ seminar in-house at the head office of a major mining company, attracting a good turnout and interaction with delegates. This particular seminar is validated for Continuing Professional Development (CPD) with the Engineering Council of South Africa (ECSA) by the South African Institute of Electrical Engineers.

Summing up his views on lightning safety and protection, McKechnie says it is a field which is often misunderstood, with inappropriate management, strategies, techniques and methodologies being applied as a result, often on a piecemeal basis. On the specific topic of mining, he re-emphasises that the industry has a higher risk profile than many other sectors of the economy in terms of its vulnerability to lightning and that mining industry executives and managers need to be aware of this and act accordingly. “The lightning risk to mines can be dramatically mitigated – generally, quite economically – if the right measures are taken and Innopro can assist with this. Specialist professional engineering consultants such as ourselves have the relevant qualifications, expertise and experience to assist our clients to effectively manage the risks associated with lightning,” he concludes. ■

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