

RISK MANAGEMENT

CONSTRUCTION INDUSTRY



Electrical breakdown: an avoidable but potentially deadly threat

A breakdown of electrical equipment can not only pose a threat to the safety of staff, but it can be an extremely expensive problem for businesses. It can result in catastrophic fires, a costly bill to replace machinery, and damaging publicity for the company. However, Yuen Cher Ng, Senior Risk Consultant at Allied World, argues that risk managers can avoid these problems if they follow some basic safety rules.

A serious and costly hazard for any business

When electrical equipment fails, businesses not only have to repair or replace the machinery, but they suffer serious losses in revenue when operations are down – and this drop in profit can outstrip the cost of repair. Catastrophic fires associated with plant failures can cause injury or death to staff and lead to the authorities launching expensive and time-consuming inquiries.

Electrical systems are ever-present in buildings and interconnected through networks of circuit breakers and cables, so the potential for loss is high. A shorting at any point in the system can impact the entire system at the same time. Similarly, an incipient fire in an electrical cabinet can continue to burn and spread to a wider area through burning cables.

The scope of the threat: electrical equipment in commercial and industrial facilities

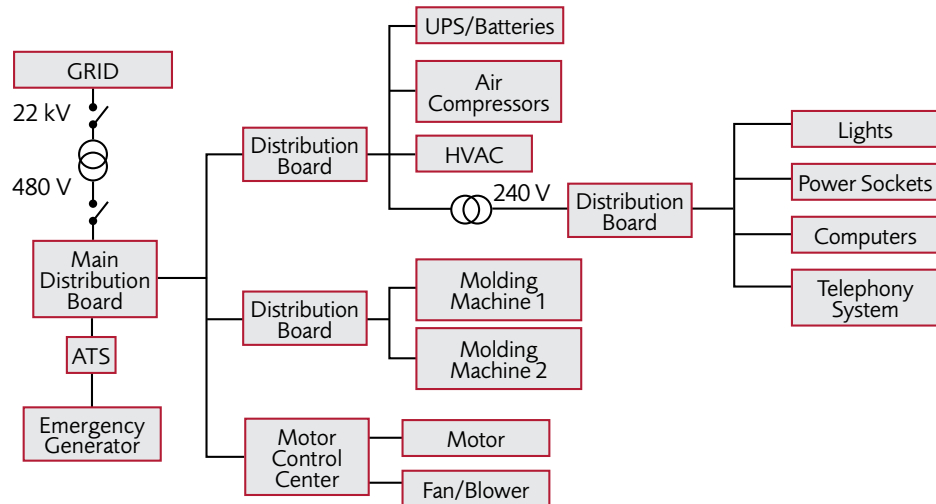
Electrical distribution systems typically include combinations of equipment such as transformers, electrical distribution boards, circuit breakers, motor control centres, cables, protection relays, uninterruptible power supply (UPS), batteries and emergency generators – each with a unique function. For example, transformers either step up or stepdown the incoming voltage, while the main function of circuit breakers is to interrupt the flow of current in the circuit when an abnormal current condition is detected. In the unlikely event of a sudden power outage from the utility company, emergency power systems using UPS, batteries and emergency generators provide back-up electricity

to essential services such as critical production equipment, fire protection system, and emergency escape lighting. One critical but often forgotten fact is that UPS/batteries also supply auxiliary power to the protection relays intended to trip the circuit breakers when abnormal conditions are detected. Failure of the protection relays to operate when needed can have an adverse consequence.

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Example of an Electrical Distribution System



What are the common breakdown mechanisms?

Three of the most common factors driving electrical equipment breakdown are:

Loose connection – an improperly torqued or tightened connection develops high resistance. Excessive heat is generated when current flows through a highly resistive connection. If overheating persists for a long period of time, there can be enough energy to burn a connector and ignite its surrounding cables, causing a fire.

Moisture – water and electricity do not mix! Moisture comes from leaking water pipes, roofs, seepage through walls and floors, condensation from air conditioning systems and humid environments. Moisture in an electrical switchgear cabinet can corrode bolted connections, circuit breakers, busbars and cables. A rusty connection develops high resistance and when current flows pass this connection, overheating can occur. A corroded circuit breaker might not function properly when an overloading condition is detected, leading to overheating and arcing. Moisture can also form an unwanted path between a live conductor and earth, causing potentially deadly short circuits.

Insulation degradation - insulation deteriorates over time due to normal ageing. Moisture, contamination, excessive heat, mechanical damage and excessive electrical stresses can further aggravate the problem, leading to premature failure. When insulation no longer withstands electrical stresses, short circuits and arcing can occur.

Keep on top of the matter through preventive maintenance programmes

Equipment deterioration and subsequent failure are normal and inevitable. A preventative maintenance programme will help identify these issues as early as possible and action can be taken to avoid imminent failure. By regularly checking and anticipating failures, risk managers can avoid costly failures and unscheduled down times as well as keeping the workplace safe.

Step 1 – understand your assets

It is important to identify your equipment and systems by using an updated electrical single-line diagram (SLD) to determine:

- Criticality and service function
- Duty and operating cycle
- Current operating condition
- Breakdown history
- Past inspection and maintenance records

Each equipment and system is unique and requires different maintenance needs.

Critical equipment and systems may need to be inspected more rigorously and more regularly, by referring to:

- Manufacturer's operation and maintenance manuals
- Engineering codes and standards (IEEE, IEC, NEMA, NFPA 70, NFPA 70B and others)
- Statutory requirements

Step 2 – keep up your skills

Whether in-house or through a contractor, it is essential your maintenance teams are highly skilled. Only trained and qualified personnel should work on electrical systems.

Step 3 – regular housekeeping is essential

It is important to carry out regular visual inspections to identify anomalies such as moisture, high temperature, abnormal noise, dirt, vermin and others. If left unattended, the potential of failure increases significantly. Keeping your electrical systems in clean, cool, dry and tight conditions will significantly increase their reliability.

Keep good records – and review them regularly

To make informed decisions about when to plan for equipment repair or replacement, it is essential that risk managers keep all inspection and test records - and review them regularly.

Tracking test results can help to identify a potential failure that can be corrected before it occurs. In addition, you should review the effectiveness of the preventive maintenance programme from time to time, considering the following factors:

- Breakdown history
- Newly added equipment/loading
- Equipment obsolescence
- Spares
- Load shredding plans

Consider using infrared thermography

Infrared thermography inspection is a useful technique to detect impending trouble before it occurs. It is a reliable way to detect abnormal heat signatures associated with loose connection, overload, unbalanced loading, inductive heating and faulty equipment. Ideally, it should be carried out under normal plant loading prior to a scheduled shutdown. When an abnormal temperature rise is detected, it can be rectified during the shutdown and reinspection should be carried out when operations resumed. However, an infrared camera cannot see through electrical cabinets. It requires direct access to live electrical circuits and components. This raises safety concerns, especially on arc-flash exposure. That said, there are other alternatives such as installing thermal viewing ports on electrical cabinets and permanent thermal sensors for critical equipment.

Electrical breakdown is a leading cause of fire – but it can be mitigated

An incipient fire from a circuit breaker failure can spread through cables by burning its insulation. Here are two ways to mitigate this risk.

Passive protection – install electrical distribution cabinets and associated equipment in a non-combustible electrical room. Whenever possible, avoid installing oil-insulated switchgear and transformer within the building. All cable penetration through walls, floors and roof should be sealed with an approved fire stop material. Keep combustible materials away from electrical rooms and electrical distribution cabinets.

Active protection – provide a fixed-fire protection system for critical electrical installations by installing a water-based sprinkler system or a gaseous extinguishing system. Although there are safety concerns over electrocution and water causing more

equipment damage, automatic sprinklers are still the most reliable and effective means of fire protection. Pre-action sprinklers which reduce the risk of accidental discharge to a minimum are one solution. Alternatively, gaseous extinguishing systems such as carbon dioxide (CO₂), FM 200 and other inert gas mediums are also effective against electrical fires. An adequately designed system — whether water or gaseous-based — combined with an early detection system is key to prevent a fire from spreading from its origin.

Prevention is better than treatment

Electrical breakdown is a nuisance to business owners, risk managers and asset managers. It often ends up with costly repairs, extended downtime, or even a fire. Proper inspection, maintenance and testing is essential to prevent expensive property damage and business interruptions. Recognising the benefits of preventive maintenance and understanding the consequence of equipment loss, business owners and risk managers should commit to allocating appropriate resources and budget to implementing an effective electrical preventive maintenance programme. Reliance on fire protection system to avert electrical fires should be the last resort.

For more information about Allied World's Risk Management services or our insurance and reinsurance solutions, please visit www.alliedworldinsurance.com

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Yuen Cher Ng is a Mechanical Engineer by training and has over nine years of experience in property and machinery breakdown loss control with a specialization in power generation facilities. Yuen Cher built his technical expertise as a Commissioning Engineer in turnkey combined-cycle power projects in Singapore, Argentina, Australia, Vietnam, England and Brazil.



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