



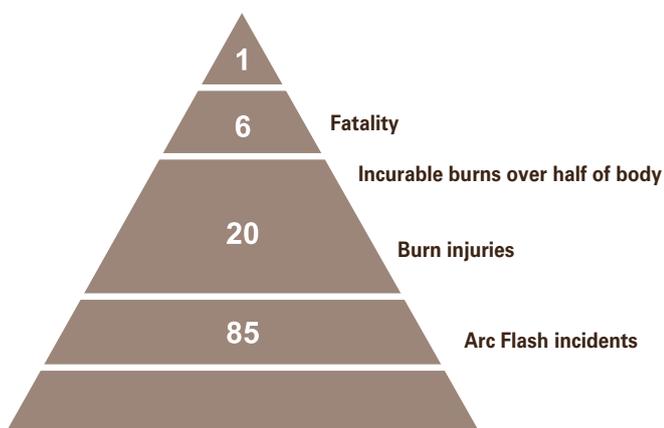
IR windows

By S Edwards, R&C Instrumentation

IR windows are intended to remove the risk of triggering an arc flash incident during a thermographic inspection.

During an arc flash, temperatures can reach as high as 20 000 °C causing rapid expansion of hot air around the flash area. Copper busbars vaporise and plasma expands. Molten copper becomes hot shrapnel which destroys assets and anyone in its path.

A company in the United States (US) dealing in Infrared (IR) monitoring of hot spots, produced the following Arc Flash pyramid:



In the US, out of 85 arc flash incidents, 20 result in burns, six in burns to over half the body and one fatality. In Southern Africa few or no statistics are available but searching the net has come up with figures such as one to two fatalities per month. South African 'statistics' seem to indicate one in two months, but this, although already alarming, is not the full picture, as occurrences are often reported as 'explosions' or 'burn incidents' instead of arc flash. So, how can we make this safer?

We can cut the power before inspection. However, the first problem with this is downtime. Then there is the time from de-energising the system to getting the green light to remove the panel.



By the time the panel has been removed, things will have cooled down significantly, making thermographic inspection ineffective.

IR	– Infrared
MMC	– Motor Control Centre
NFPA	– National Fire Protection Association
OSHA	– Occupational Safety and Health Association
PPC	– Personal Protective Clothing
PPE	– Personal Protective Equipment
UL	– Underwriters Laboratories

Abbreviations/Acronyms

fective. We could use resistive checking as is done when the panel is first manufactured. This is time consuming and has huge impacts on plant down time.

What about keeping the panel closed and doing the thermography through the closed panel?

A solution is available through the installation of IR windows, which means the inspection can be carried out efficiently with the energised system enclosed behind a closed door. In fact, the installation of IR windows will not only make the inspection process safer, but will also save costs. The common procedure for performing IR inspections in electrical panels and switchgear:

- Isolate equipment at MCC
- Put on PPE
- Open MCC door and remove covers
- Override mechanical interlock and switch power back on
- Leave on load for 20 minutes
- Perform IR tests on live electrical equipment
- Isolate and close panel door
- Re-instate supply to equipment

Have you ever seen your staff or contract labour in full Arc Flash resistant PPE? To say that it is not common may be a kind answer.

Solution

The solution lies in the installation of IR Windows in the electrical panels. There is:

- No downtime to open door
- No exposed live equipment
- No PPE required
- No sticking things into live panels

... *Most importantly... no one is hurt.*

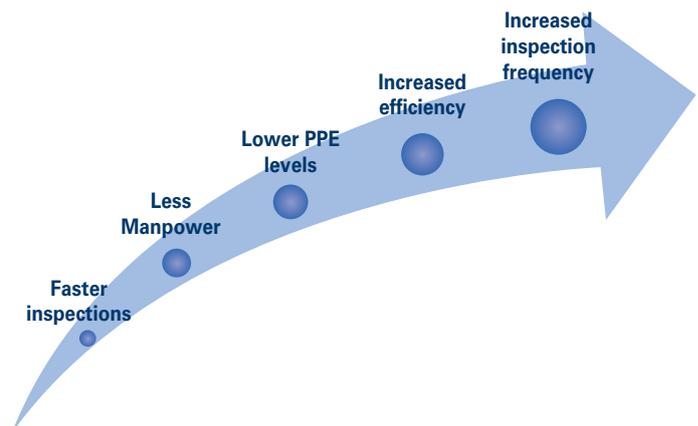


World leaders in switchgear manufacture have tested the IRIS Polymer version of the IR window and now offer Polymer IR windows as options when manufacturing switchgear.

The list of users is growing daily and across all manufacturing areas like power generation, paper and pulp, oil and gas, automotive and mining – to mention a few.

How can we justify the installation of IR windows?

Look at the model below and put some time and costs to the different areas; you will be surprised just how much you are spending. Refer to the brief case study in this article and see how Stansted Airport in London did it.



Types of IR window

There are two main types of IR Window, Crystal, (Calcium Fluoride) and Polymer windows.

Calcium Fluoride windows have been around for many years but have some disadvantages. They are very fragile so unable to contain an arc flash, they are hydroscopic so absorb water even if coated on the surface they absorb through the edges. This affects their Transmissivity of IR Energy, so need frequent calibration to give accurate readings. IR Inspection cameras utilise a wavelength in the 8 - 14 micron spectrum for best results, this is known as the Long Wave IR Spectrum Calcium Fluoride windows have good transmissivity in short wave but in long wave it drops off drastically around 9,5 to 10,0 micron. The life expectancy of a Calcium Fluoride window is about three to five years depending on the environment (humidity).

Polymer windows are the latest technology and have a good resistance to impact and load. They are resistant to water and low levels of acid and alkaline. The transmission of IR is very good and constant in Long Wave and Short Wave spectrums. They can be manufactured in almost any shape, dependent on application. They are guaranteed for the lifetime of the switchgear. This panel has undergone an Arc Flash test. You can see the bulging of the panel,

the heat damage to the label and the burnt off handle. The Polymer window remains intact.

IR windows are not intended to protect a user from an arc flash they are intended to eliminate additional triggers of an arc flash during an inspection and replace a high-risk activity with a risk reduction/elimination strategy during inspection. IR windows and closed-panel inspections help companies to comply with the OSHA and NFPA mandates to eliminate risk wherever possible; conversely, a protection strategy is acceptable only after other methods of risk elimination or reduction have been exhausted.



Conclusion

NFPA 70E [1] lists removal of panels on electrical equipment as one of the riskiest activities that a worker can perform on that piece of equipment. The risk is elevated because the most common arc triggers occur either because the panel covers are open or as a result of removing the panel covers. Closed-panel inspection using IR windows will eliminate 99,9% of arc flash triggers during inspection. Therefore, the core benefit of IR windows is that they comply with the OSHA and NFPA 70E [1] focus on removing the risk of an accident – protection with PPE is only used as a last resort, and the implementation of engineered controls is only used where risk elimination and substitution are not feasible.

Stansted Airport London installed 72 custom-made IR windows which allow the engineers to complete efficient, safe inspections of the fuses that feed terminal systems, such as computers and baggage belts.

IR windows are intended to remove the risk of triggering an arc flash incident during a thermographic inspection. That being said, the windows should also offer the same level of structural integrity that UL746 [2] requires of other common meters and controls, and the same integrity that IEEE C37.20.2 [3] requires for impact and load of 'viewing panes'.



Acknowledgement

The author presented 'IR windows' at the 2013 Electrical Arc Flash Conference organised by IDC Technologies.

References

- [1] NFPA 70E. 2015. Standard for electrical safety in the workplace.
- [2] UL746. Plastic material properties.
- [3] IEEE C37.20.2. 1999. Metal-clad and station-type cubicle switchgear.

Bibliography

- [1] ROI Case Study: Paper mill boosts RCM Programme with cost savings generated by its IR window programme. Martin Robinson. Level 3 thermographer, president and chief engineer, IRISS, Inc.



Born and educated in Yorkshire, England, Steve Edwards arrived in South Africa 26 years ago on a three-year contract. Involved since an early age in rotating equipment monitoring, he joined AECI (South Africa) in the consulting engineering department, he is now the owner of R&C Instrumentation, providing industries with industrial instrumentation and consulting services and applications design on infrared temperature monitoring and scanning.

Enquiries: Tel: 032 946 2805 or email stevee@randci.co.za

Case Study:

Stansted Airport, London

As the airport is open for business 24/7, Stansted's engineers only had four hours per night in which to conduct the predictive maintenance of low-voltage equipment. The entire inspection cycle was protracted and no system could be checked under load. This airport is classed as a strategic airport thus having to take re-directed traffic at any time of day or night. Any deviation from this ability is detrimental to air traffic safety around London and comes with large fines.

Chelmsford-based IRISS, clinched a deal with the airport to construct and install 72 custom-made IR windows which allow the engineers to complete more efficient safe inspections of the fuses that feed terminal systems, such as computers and baggage belts. Previously, the entire inspection cycle was a long process and it took engineers two nights to shut down the system and inspect just one electrical panel by hand. With the installation of the IR inspection windows and the help of a thermal imaging camera, checks of all the panels can be carried out in just five hours, making huge savings in survey times and equipment costs.