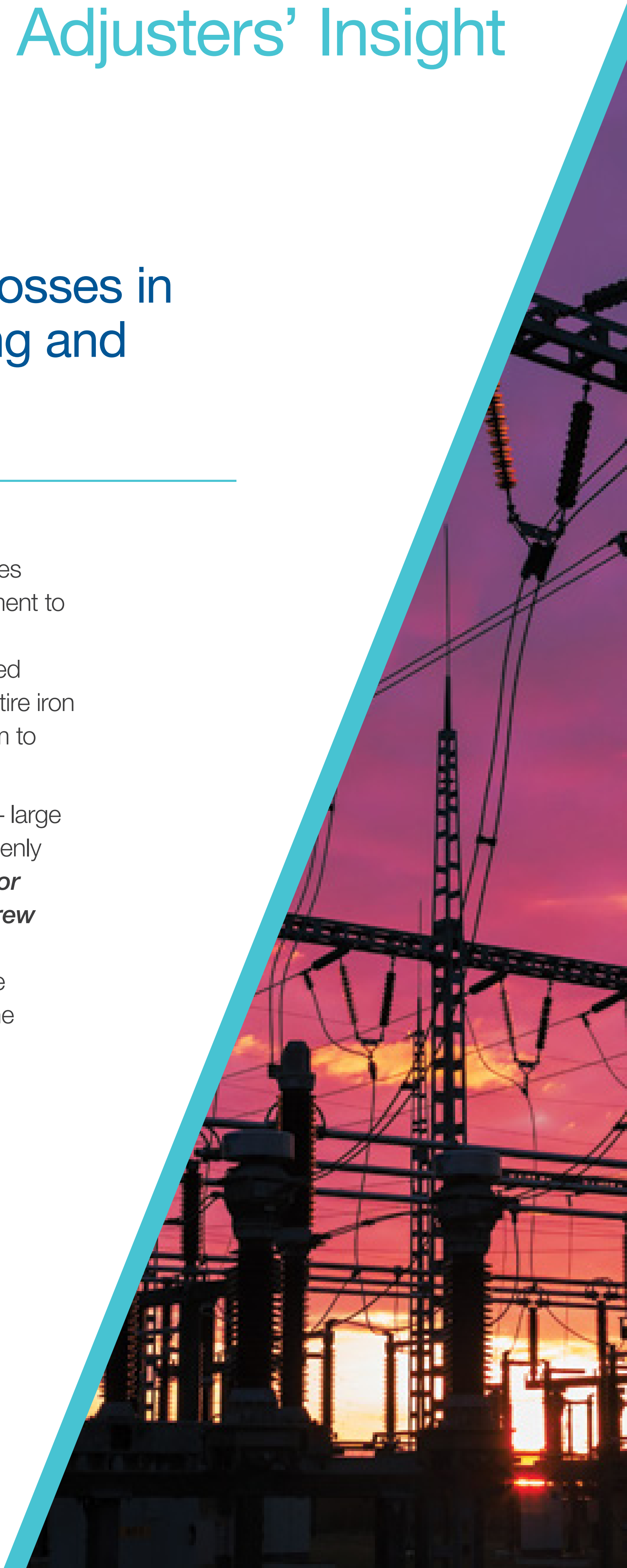
Charles Taylor ADJUSTING

Adjusters' Insight

Buzz Kill - Transformer losses in the Australian Engineering and Resources sectors

The kingpins of the Australian Energy and Resources sectors are oil, gas, and minerals. A common element to all sectors is the supply of electrical power, be it a temporary solution such as a bank of trailer-mounted generators, a bespoke power plant to power an entire iron ore site, or a renewable such as a wind turbine farm to power desalination plants.

Intrinsic to this process are industrial transformers – large and expensive assets with a propensity to fail suddenly and spectacularly. In this article ***Nigel Lloyd, Senior Engineering and Resources Adjuster, and Andrew Hodkinson, Regional Head – Australia & New Zealand of Charles Taylor Adjusting*** examine the intricacies of a catastrophic transformer loss and the necessity of appointing suitably qualified adjusters.



The life of a transformer is often a benign one leaving no particular legacy. It spends its life as the perpetual wallflower to the Insured's affections for other plant assets that more tangibly "do something". The life of the transformer often exceeds the particular application for which it has been designed so it ends up quietly decommissioned, abandoned, or mothballed at the conclusion of the project.

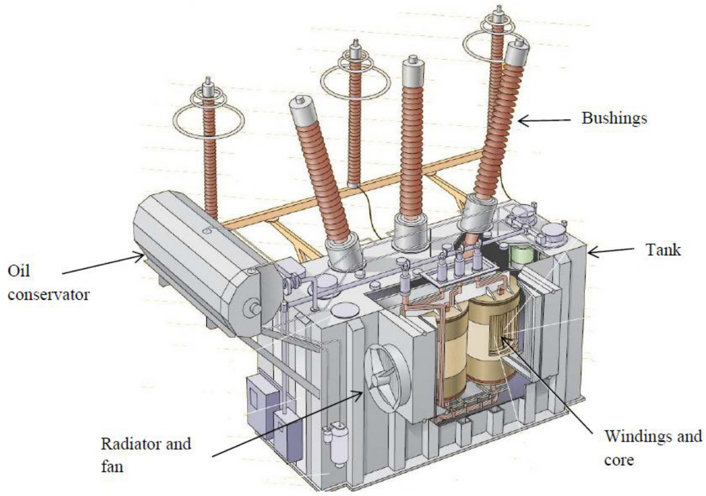
Of course, the focus of this article is on the proverbial black sheep transformer that bucks the trend and has some sort of issue. In the case of an industrial transformer, 100 Mega Volt Amps (100MVA) transmission capacity is common. At these power levels a direct to earth fault lasting just one second will produce the electrical energy equivalent to the kinetic energy of a fully-loaded mid-sized airliner in flight.

A fault event usually manifests as an explosion which ruptures the transformer tank, vaporises the fault evidence, and discharges hundreds if not thousands of litres of burning oil to the environment. Cue an insurance claim and the involvement of the loss adjuster – however before we delve into the particulars it is worthwhile considering some technical basics.

Transformer Overview

Transformers are electrical appliances named after their purpose; they transform the voltage and amperage characteristics of a power supply. Power is a function of voltage multiplied by the amperage, so in effect a transformer can be used to (e.g.) increase the voltage by a factor of 10 whilst reducing the amperage by a factor of 10. We note that the above holds true for an "ideal" (i.e. theoretical) transformer – a real transformer incurs marginal thermal and parasitic losses.

Typical Transformer schematic courtesy of ABB



There are several drivers to transform power and it mostly drives down to efficiency and necessity. Power transmission over long distances is usually completed at very high voltage to reduce the amperage, which reduces thermal power losses. The appliance at the end of the system – be it an industrial mill or a desk lamp – is designed to receive power at a specific voltage.

Accordingly there are many different types of transformers designed to suit a specific purpose. Power stations use large "Step-Up" transformers which operate virtually continuously and at full load to transform a low generating voltage to a high distribution voltage. At the other end of the line, a series of distribution transformers progressively step the voltage down again. In a mining application, it is typical to have one transformer serving the camp facilities with a separate transformer providing power for processing infrastructure.

The internals of the transformer vary depending on design factors, but rely on the principle of electromagnetic induction produced by the primary insulated coil or "winding" to induce voltage in a secondary winding. Critical to this process, industrial transformers feature an iron core which the windings are either wound around, or in other designs the core encases the windings. A three phase transformer common to industrial designs will have three windings.

The voltage change is proportional to the ratio of the turns in one winding compared to that of the other(s), and the ratio can be altered using a mechanical tap changer to engage/disengage the windings at different points. The entire assembly is encased in a robust tank which is usually made from steel.

Once filled with the oil which serves to insulate and cool the transformer, the gross weight of an industrial transformer can be over ten tonnes. The capital expenditure for a large network grid transformer and associated infrastructure can exceed AUD10,000,000.

Transformers are usually physically isolated from other plant, equipment and personnel, with additional measures such as blast walls and localised fire suppression systems predominantly concerned with containment of an event rather than mitigation of damage to the asset itself.

Significant Loss Event and Aftermath

We return to our earlier scenario of a fault leading to an explosion and fire event. This is actually a prevalent failure scenario – when transformers fail it tends to be catastrophic.

Once the immediate risk is contained and the transformer is accessible, the appointed adjuster will need to ascertain the Insured's plans with respect to Root Cause Analysis. Network operators and power providers will typically have in-house expertise or preferred consultants.

A resources entity may rely on the Original Equipment Manufacturer (OEM) of the transformer to assist in investigations. OEMs are often protective of intellectual property associated with the transformer and have a commercial interest in deflecting attention away from manufacturing or design issues.

It is therefore often prudent to consider early appointment of a suitably experienced forensic electrical engineer to monitor the inspections and ensure any evidence is being quarantined and suitably recorded.

Root Cause Analysis

Insurance claims are predicated on understanding the cause of the event which then allows the matter to be considered within the context of the applicable policy. The concept is no different when considering a transformer failure.

As an initial approach, the location of the fault can be constrained by looking for the area of most internal damage. Even more scrutiny should be applied to areas in which components have been vaporised completely, as this correlates to the highest energy levels and a likely electrical arc site.

In conjunction with analysis of physical evidence, analysis of what the transformer was doing immediately prior to the loss is often revealing. By way of example, if a tap change operation was occurring or had just occurred, it is highly likely this was a factor in the loss.

The status of failure mitigation devices such as the Buchholz relay (a relay triggered by a sudden surge in oil flow or accumulated gas) will usually be logged remotely and post-loss examination of these records can assist in determining the nature of the fault.

Prevailing network conditions are also of interest, for example a faulty recloser upstream of the asset can result in harmful power surges being transmitted to the transformer itself. A lightning strike is a typical cause of a power surge, or tree branches falling on power lines due to storm activity.

Another telling, if somewhat macabre, sign of a surge is the classic charred (ex) pigeon.

The maintenance and service records of a damaged transformer are also relevant considerations. Regular oil sampling of an operational transformer can detect early presence of gases associated with localised hot spots in the windings, which are present where insulation has degraded. Conductive sulphates can also be detected, which form under the right conditions from a reaction between the oil and the transformer infrastructure. These sulphates degrade transformer performance and can flake off and lodge between two insulated points, causing a short circuit.

Reinstatement & Salvage

A quirk of using oil as an insulating and cooling medium is the recirculation of contaminants following a fault event. Even for a basic transformer without forced oil circulation, the convection currents within the oil bath will circulate any contaminants throughout the internals.

Contaminants from an arc failure usually contain vaporised windings and other metallic components, consequently when they cool and solidify out of the oil solution they severely compromise the insulation upon which they are deposited.

Accordingly a significant fault event usually necessitates rewinding the transformer internals. This can be cost effective when the fault was contained within the transformer and the tank is unaffected. Whilst replacement is often the only viable solution from a technical perspective, Insureds with older assets are often predicated towards this result, which the adjuster should be aware of.

On a related note, asset obsolescence can have an impact on implementing a replacement transformer into the existing network, which may require necessary upgrades either to work at all, or to be compliant with regulatory code. Distinction between the two is usually pertinent to examination of policy coverage

and relevant sub-limits concerning betterment imposed by a regulating body. It is common for an Insured to consider replacement of undamaged external protection equipment to the transformer – this can often be an item of negotiation in an insurance claim.

Salvage potential of a transformer hinges upon the winding material. Cheaper transformers are comprised of aluminium windings which attract a low residual value, often less than the disposal cost. By contrast, copper windings attract a substantial residual value and this offset is often left quietly unsaid by salvage companies, which can result in claims leakage for the unwary adjuster.

Finally, in respect of large transformers it is not always cost effective to hold a strategic spare on site for the 'one in a million' event.

Thus it is often the case that when a large unit fails catastrophically the replacement lead time can be 8 to 12 months, leading to business interruption. Depending on the nature of the risk some policies will extend to cover business losses albeit most curtail to increased cost of working expenses due to the vagaries of supplier lead times which are beyond the control of the Insured and Insurers.

This can be an issue for some Insureds and the attentive broker should be mindful to see what cost effective cover can be purchased to minimise the exposure for the Insured.

The above brief discussion touches on various issues particular to transformer losses. As can be seen such losses may involve technical aspects and certain adjustments to claims may exist.

Charles Taylor Adjusting (CTA) Expertise

Typical transformer losses handled by CTA range from the run of the mill AUD50,000 loss during transit through to the catastrophic transformer explosion that can result in reinstatement and business interruption in excess of AUD10,000,000.

CTA has qualified engineers on staff throughout all Australian offices with diverse backgrounds ranging from “big picture” Project Engineering / Construction right through to detailed design work.

Our Engineering Adjusters hold Adjusting qualifications and are members of the Australian Institute of Chartered Loss Adjusters (AILCA), the Australian & New Zealand Institute of Insurance and Finance (ANZIIF), or other UK-based professional bodies of equivalent or higher standards.

Our team’s engineering qualifications and extensive experience in dealing with a multitude of losses involving transformers allows our adjusters to efficiently engage with the Insured, appoint and closely control the relevant specialist consultants as applicable, thereby ascertaining the root cause of the loss even when much of the physical evidence may have been eradicated in the incident.

Once the root cause has been ascertained and the rectification of the asset is underway, we can then rely on our adjusting expertise to ensure the relevant parameters of the Insured’s policy are correctly applied in respect of changing design codes, asset obsolescence, defects exclusions, expediting costs and relevant sub-limits.

We ensure outcomes are concisely reported to Insurers to match their requirements in documenting the circumstances of the loss in a clear and logical manner, allowing them to reach a conclusion in respect to policy response.

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About Us

Charles Taylor Adjusting (CTA) is one of the leading loss adjusting businesses in the market. We provide loss adjusting services across aviation, marine, natural resources, property, casualty and special risks along with average adjusting services for ship owners. The business primarily focuses on larger and more complex commercial losses arising from major insured incidents and claims. CTA is a business of Charles Taylor Plc (www.ctplc.com) which is quoted on the London Stock Exchange (CTR).

Charles Taylor plc is a leading provider of professional services to clients across the global insurance market. The Group has been providing services since 1884 and today employs over 2,000 staff in 76 offices spread across 29 countries in the UK, the Americas, Asia Pacific, Europe the Middle East and Africa.

The Group offers services, principally on a fee-based model and operates through three businesses – Management, Adjusting and Insurance Support Services. It also own insurers in run-off. Charles Taylor's vision is to become the professional services provider of choice to the global insurance market