



The **MIDEL** Transformer Risk Report

November 2018

Foreword

Transformers are critical components of our energy infrastructure, keeping the lights on and the energy flowing in everything from our schools and hospitals to our factories, offices and cities.

Transformer risk is a recognised element of asset management, and while individual utility and OEM companies are well-versed in managing that risk internally, there is little pan-industry understanding of attitudes to transformer risk mitigation and how that matter is regarded in different sectors and regions.

The MIDEL Transformer Risk Report seeks to address this by canvassing opinion from global transformer owners, operators, manufacturers and consultants. The cross-section of opinion it provides from around the world offers meaningful insights into what weighs on the minds of transformer users and how they are reducing their risks. The MIDEL team is proud to present these findings and hopes to spark an ongoing discussion about how we best protect these most crucial of assets.

We do hope you find it useful and look forward to the conversations to come.



Barry Menzies, Managing Director Global, MIDEL

Transformers fail

The 2018 MIDEL Transformer Risk Report shows that transformer failures happen: **61%** of survey respondents revealed they had experienced a transformer failure in the last five years. Over **80%** of respondents expressed concern about transformer failure.

Respondents also provided an insight into the serious implications of transformer failures. More than half expected a failure would either significantly impact (**41%**) or halt operations entirely (**9%**). A further third expected a slight impact and only **12%** were confident operations would carry on without interruption.

Nor are these just momentary hindrances, quickly fixed and forgotten. While **29%** of organisations were confident of reinstating power supply immediately, **19%** estimated it would take more than three days, **23%** said a week and **18%** feared it would take a month or more. When even three days of hampered operations is a significant business risk, these figures show how serious the threat of transformer failure can be for business continuity. For the **11%** who expected it would take more than six months, that risk is even greater.

Taken together, these factors go a long way towards explaining why over **80%** of respondents express concern about transformer failure, with over **50%** very concerned.

“Transformer failure is a very real concern for owners, operators and manufacturers. Real – and also legitimate, because they are based on lived-experience with transformer failure and an understanding of what it can mean for the business. Indeed, these figures may not tell the whole story: those who have not experienced transformer failure within the last five years were more likely to report lower expected time to reinstate power. It may be they are underestimating the difficulty due to lack of direct experience.”

– Barry Menzies

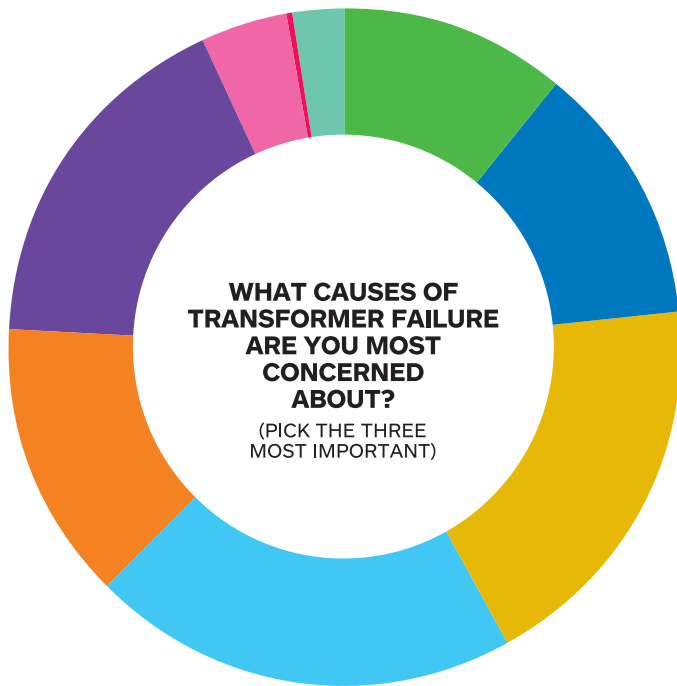
“Safety will always be a top priority but operations and maintenance also weigh heavily on transformer owners and operators. As well as being the top concern behind transformer failure, it also ranks highly for risk reduction. Yet, it takes a third leading position as a motivation for improving transformer performance – so that operation and maintenance costs can be reduced.”

– Barry Menzies

A 40-50 week delivery cycle

In July 2018, the Cookeville Electricity Department in Tennessee received delivery of its new 72 ton transformer, drawing an end to a nearly year-long wait. After one of its two power transformers failed, the other struggled to meet demand, forcing the utility to move load to other substations until the replacement arrived. “It failed about 40-50 weeks ago,” a CED Director explained. “And it takes 40-50 weeks to get a new one.”

Source: The Herald Citizen, July 26th, 2018



- LACK OF MAINTENANCE - **61%**
- AGING / DAMAGED EQUIPMENT - **56%**
- ELECTRICAL FAILURE - **52%**
- QUALITY OF EQUIPMENT - **40%**
- OVERLOADING - **37%**
- LIGHTNING STRIKE / EXTREME WEATHER - **33%**
- MECHANICAL FAILURE - **12%**
- VANDALISM - **7%**
- TERRORISM - **1%**

Causes and consequences

Transformers can fail for any number of reasons, from lightning strikes and terrorism to lack of maintenance and aging equipment.

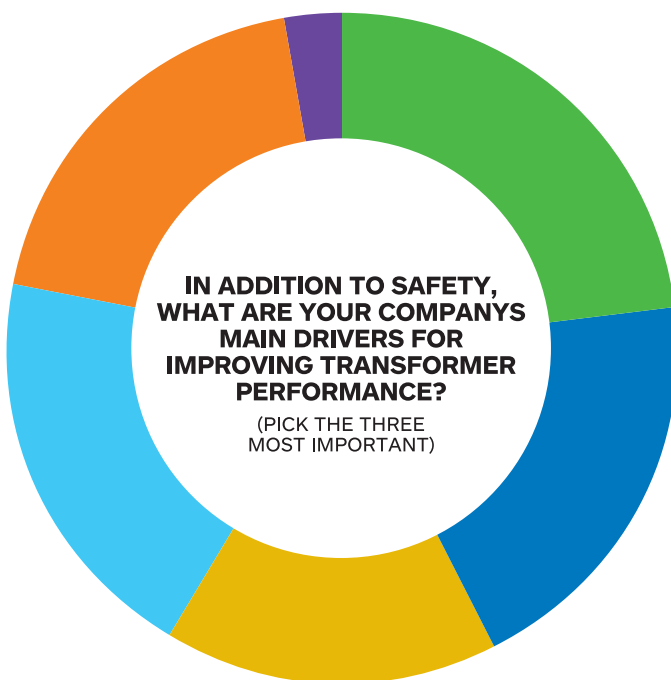
When asked to identify the three potential causes that concern them most, respondents pointed to lack of maintenance (**61%**), aging and damaged equipment (**56%**) and electrical failure (**52%**). To a lesser extent quality of equipment, overloading and extreme weather also scored highly.

“The good news is that many of the causes of transformer failure are largely within the operators’ control. It’s relatively straightforward to replace old equipment and components and upgrade maintenance regimes; however, the level of concern suggests that industry needs to think more strategically about asset management and dedicate more resources to mitigating the risk of failure.”

– Barry Menzies

When asked which three factors were most important when assessing the impact of a transformer failure, businesses surveyed were quick to highlight the risks to others above those to their operations. Nearly three quarters (**73%**) emphasised the risk to staff, customers and the general public, with business continuity and loss of revenue being selected by **53%** and **56%** respectively. In a similar pattern, **44%** of respondents worried about environmental impact, edging ahead of concerns for corporate reputation and cost of replacement.

However, among ester users, loss of revenue takes top spot, nudging risk to staff, customers and general public to joint second with business continuity.



- REDUCING OPERATING AND MAINTENANCE COSTS - **69%**
- SAFEGUARDING BUSINESS CONTINUITY - **58%**
- REDUCING FIRE RISK - **58%**
- IMPROVING ASSET SUSTAINABILITY - **57%**
- MEETING NEW HEALTH, SAFETY OR REGULATORY REQUIREMENTS - **48%**
- OTHER - **8%**

“Organisations are clearly taking their responsibilities seriously. It would be easy to place profitability above all else but that’s not the case. It’s also interesting that ester fluid users focused on other issues than safety – presumably because using esters already helped them to mitigate risk.”

– Barry Menzies

Reducing risks

When it comes to reducing the risk of transformer failure, the solutions quite closely track the causes. The quality of equipment and components emerged as the frontrunner, with **87%** selecting it as one of the three most important factors. More than three quarters also pointed to the importance of operations and maintenance schedules and just over half opted for the use of fault monitoring systems.

Nearly half then selected fire safe transformer fluids as a key risk reduction strategy, before a sharp drop-off for other factors.

Similar patterns emerged again when respondents were asked – after safety – what the three most important drivers for improving transformer performance are. The top response was to reduce operating and maintenance costs (**69%**), with reducing fire risk in second along with business continuity (**both at 58%**).

Planned maintenance also ranks highest when it comes to measures taken to protect the local environment. Nearly **80%** of respondents said this was a measure taken as part of their environmental protection policy. Next highest were containment structures (**65%**) and the use of biodegradable, non-toxic transformer fluids such as esters (**61%**).

“Of the measures taken to protect the local environment, planned maintenance and containment structures were the two most common. Clearly, there is a need for further education regarding proven alternatives to these measures; the fact is that the costs for both those methods can be reduced and in some cases removed by using fire-safe and biodegradable ester fluids.”

– Barry Menzies

Costly fire

June 2018 - Transformer fire could cost SSAB Europe US\$11.3 million

A transformer fire at SSAB Europe's Hämeenlinna steel mill last Tuesday will cost in the region of SEK100 million (US\$11.3 million) according to the Swedish steelmaker.

The company estimates that things will get back to normal in about five weeks.

SSAB Europe's cold rolling mill at Borlänge has increased its production to compensate as much as possible for the losses at Hämeenlinna.

Source: Steel Times International, June 18th, 2018

“Companies are feeling the strain of ongoing operation and maintenance costs, which worries them as they recognise the importance of a good O&M regime. Operators also care about the impact transformers can have on their local environment. Selecting environmentally safe transformer fluid suggests they are wary of leaks and the damage conventional transformer fluids, such as mineral oil, can do.”

– Barry Menzies

Transformer takeaways

Taken together, the results of the 2018 MIDEL Transformer Risk Report survey point to a number of key conclusions:

Transformer failure is a significant concern:

The majority of respondents have experienced transformer failure within the last five years, are very concerned about transformer failure and estimate it would take more than a week to reinstate power supply if they suffered one. In other words, transformer failure is neither a niche concern nor a minor business risk.

Operation and maintenance regimes are key:

Lack of maintenance was the top concern when it came to causes of failures. Operation and maintenance (O&M) schedules were also highlighted as the second most important factor in reducing the risk, after the quality of equipment and components. Yet, reducing O&M costs was the primary motivator for improving transformer performance. This implies that operators know O&M best practices to be vital, but struggle with the cost of implementing them.

There is a transformer fluid disconnect:

Across the board, factors such as safety and environmental protection ranked very highly. At the same time, though price is very important, fire safety and dielectric performance are reported as the most important factors when selecting a transformer fluid.

These findings would suggest a high uptake of ester fluids, given their superior fire safety and environmental performance. However, mineral oil remains the default choice in practice.

What might explain this disconnect? Some transformer operators may not realise that ester fluids are an option that meets the needs they describe. Others may understand the benefits but be constrained by upfront budgets.

“Transformer failure risk is taken very seriously, and it stands to reason that transformer owners and operators would do everything in their power to reduce it. Using ester fluids is just one of the ways to address some of the causes of failure; not only do they better protect against fire and avoid harming the environment, they can also lessen the operations and maintenance burden, which was consistently cited as a top concern. The price point of ester fluids may sometimes give buyers pause for thought. However, this overlooks the lower risk, reduced O&M costs, improved asset health and longevity that esters can provide.”

– Barry Menzies

Methodology and demographics

The MIDEL Transformer Risk Report survey was launched in September 2018 and ran for three weeks, collecting 75 complete responses.

Respondents shared views from all over the world, with the majority listing their main operating areas as Europe (**49%**), followed by Africa (**16%**), Asia (**13%**) Americas (**11%**), Middle East (**7%**) and Australia (**4%**).

The survey attracted responses from transformer OEMs (original equipment manufacturers), accounting for **39%**; industrial and commercial transformer operators (**19%**); and both transmission (**8%**) and distribution network operators (**8%**).

Of those which answered ‘other’ to type of business (**26%**), organisations ranged from transmission and distribution companies, to wind power, to consultancies.

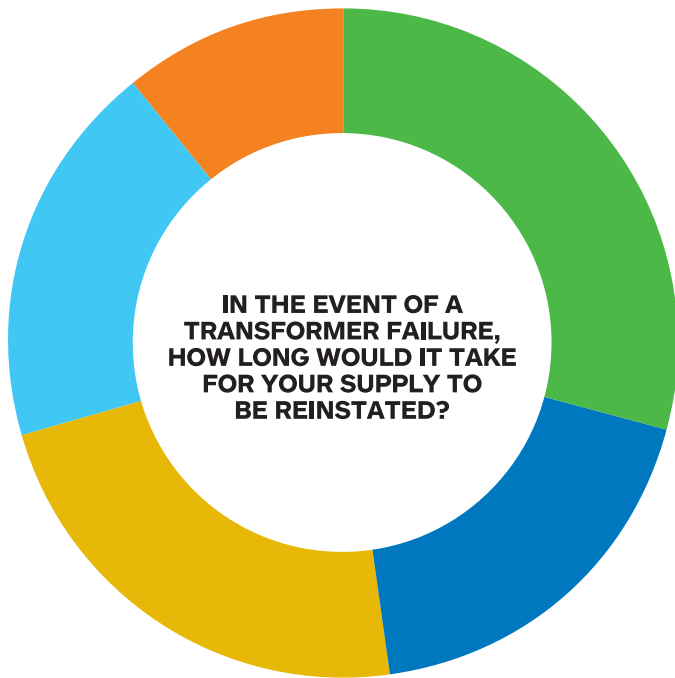
As such, it is unsurprising that **41%** of respondents don’t operate any transformers themselves. However, of those that do, **41%** operate a fleet of more than 50, with **18%** managing smaller fleets. There was an even split between those operating distribution and power transformers.

When asked the main transformer fluid they use, the majority (**68%**) cited mineral oil with **18%** opting for ester fluids. A very slim minority (**2%**) used silicone and some respondents specified that they use both esters and mineral oil.

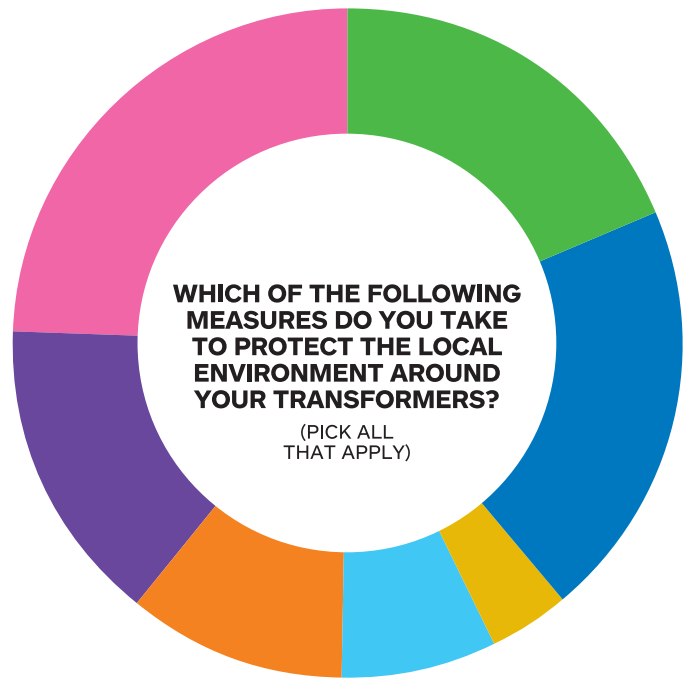
“It’s reassuring to see an industry so mindful of its duty to both human and environmental safety and making tangible efforts to protect both alongside their own assets. This shows a positive and proactive attitude when it comes to transformer risk.”

– Barry Menzies

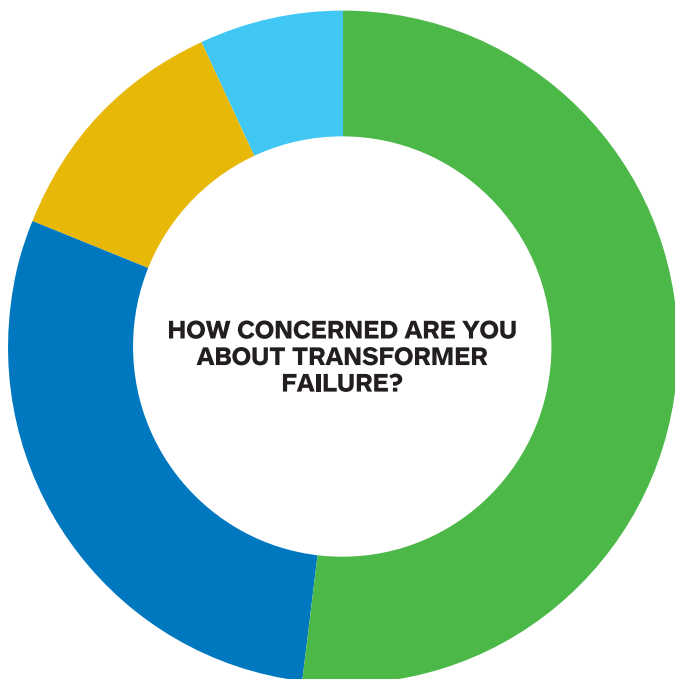
Concerns and mitigating measures



- IMMEDIATELY - 29%
- MORE THAN A WEEK - 23%
- MORE THAN 3 DAYS - 19%
- MORE THAN A MONTH - 18%
- MORE THAN SIX MONTHS - 11%



- PLANNED MAINTENANCE - 79%
- CONTAINMENT STRUCTURES - 65%
- USE BIODEGRADABLE, NON-TOXIC TRANSFORMER FLUID (E.G. ESTERS) - 61%
- FIRE RESISTANT OR NON-COMBUSTIBLE WALL - 48%
- ACTIVE FIRE SUPPRESSION SYSTEM - 35%
- RAINWATER REMOVAL - 24%
- ABSORBENT RUGS OR PADS - 13%



- VERY CONCERNED - 52%
- SOMEWHAT CONCERNED - 30%
- SOMEWHAT UNCONCERNED - 12%
- UNCONCERNED - 6%

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When it comes to protecting what matters, there can be no compromises. MIDEL natural and synthetic ester transformer fluids are the first and only choice for unrivalled risk mitigation. Superior fire safety and biodegradability give you complete reassurance that your network is protected. It's time to go beyond mineral oil. MIDEL is transforming asset performance, reducing risk and delivering cost savings every day across the world. Call MIDEL - let's make it safer together.

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