

Condition monitoring should not be treated as an isolated technical challenge, but rather as an integrated component of the organization's overall asset management strategy

### ABSTRACT

In the previous article, published in Volume 4 Issue 1, we reviewed the basics of an effective condition monitoring program: the forethought, planning and response required for success. Condition monitoring can provide significant benefits and value, but to achieve a return, it must truly be part of the organization – it is not an isolated technical challenge but an integrated component of the overall organizational asset management strategy. This article will go beyond the basics, diving into detail around proactive risk management and the specific questions teams need to ask themselves to make informed and confident decisions.

### KEYWORDS

condition monitoring, asset health management, power grid, testing and maintenance

# Beyond the basics of condition monitoring

**T**raditional approaches to asset management worked in traditional business environments, where time-based maintenance, fix on fail and redundant capacity were common, but times have changed. Power and utility teams now face a complex world with mounting pressure to keep assets in service and loaded to a high level, while simultaneously reducing the risk of failure. Changes in strategy and approach, such as moving to new maintenance schemes like Reliability Centered Maintenance (RCM) or Risk and Criticality Based Maintenance (RCBM) systems have helped teams target specific asset conditions and needs and keep systems up and running.

As needs for a reliable power grid grow, it becomes even more important for teams to get actionable insight into key indicators beyond what condition an asset is in. Teams need to know the condition it will be in depending on loading and operational scenarios. The basic approach to loading, in IEEE C57.91 for loading mineral-oil-immersed transformers, for example, is not just a set of arcane rules – these methods should also be applied in practice to improve asset utilization.

## 1. Navigating a complex power landscape: How condition monitoring can help

An increasing number of power and utility teams are turning to condition monitoring tools to get a better understanding of the complexities of their transformers. They understand why

condition monitoring matters, how to create an effective strategy and the key data points to track and are now looking to take this a step further with even deeper planning, strategic thinking and collaboration among all team members.

To ask the right questions and make critical decisions about asset health and maintenance under pressure, teams don't just need a framework, they also need to fully understand how to use available data to their advantage to meet the unique asset health needs of their transformer fleet. Transformers are not commodity items, and though they have families, some siblings may be somewhat tenuous relations. Working out how these family members react under pressure could be a challenge.

## 2. Next level condition monitoring: It's all about proactivity

Condition monitoring programs fail when the organization applies monitoring mechanisms without considering who will manage the process over time – someone needs to ensure continued operation and communication and that the data is providing useful and relevant insights. Many organizations have installed monitoring devices over many transformers, but never connected the devices into a network or enabled the data to be used in decision-making. This occasional review is not going to bring the benefits condition monitoring holds.

To ensure success, an organization must support the ongoing training and



education of field staff who consistently interact with the data and the alerts. Most data insights will indicate no problems, but being prepared to react to alerts is key for getting the full value out of condition monitoring.

### 3. Adapting to change

Let's assume a team has some sort of monitoring system in place that we have started small and appropriately. We know how to get contextual data and can bring together the relevant pieces – even if it is in a spreadsheet and not housed within a powerful platform or tool. This is a great start, but gaining value from condition monitoring is all about acting on a plan that addresses common management issues and ensures effective implementation and data understanding. While some health parameters change slowly over the course of days and weeks, some can change rapidly. Understanding the heartbeat of your assets helps when trying to understand the variations in data.

Condition monitoring needs to be seen as an element of a holistic asset management program – it is part of what the organiza-

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tion does. Many organizations have small, focused programs which work for them – single value dissolved gas analysis (DGA) devices or partial discharge (PD) sensors where the failure modes are known, the symptomatic parameters are identified and the data is used in isolation as an early warning of something to look at – something for the in-house tech experts.

### 4. The three C's of condition monitoring

We can look at embedding the condition monitoring program into the overall generation of condition data, which includes insights from maintenance activities, regular site inspections and the occasional use of survey tools: Infra-Red and PD surveys. Individual parameters need certain context:

- **Control the measurement.** The timeline and parameters around how often teams should be looking at the different types of data depends on failure modes and symptoms. The monitoring system should allow you to look at data whenever you want and alert you to look at anomalous data. In terms of transformers, we can also look at tap changer monitoring and vibration, but most teams need to get the basics right to start with.
- **Understand the context.** When applying monitoring, the first thing teams need to do is understand that they may not know as much as they thought they did. Parameters change in unexpected ways, and data will be different than what was thought. Low level alarms may be generated from loading variations that were

never considered. It is important to set expectations so that teams can see where they are.

- **Draw a reasonable and justifiable conclusion.** It's important for teams to not just look at the data, but also be able to draw reasonable, justifiable and actionable conclusions from what they uncover in their condition monitoring efforts. Having data is great, but it's only impactful for the organization when it's used in a way that protects the business from risks and moves it forward. Teams can use condition monitoring to make informed and confident decisions that set the strategic direction of the business, they just need to uncover and act on the right insights.

## 5. Condition monitoring and your maintenance strategy

Condition monitoring can often be used to drive maintenance. For example, bushing monitoring may indicate a need to intervene with the bushing – off line test/checks and possibly subsequent maintenance; DGA on a power transformer main tank may indicate a deteriorating condition, at which point it may be more appropriate to plan major refurbishment or replacement ahead of a regular maintenance schedule. Tracking condition allows for more focus on useful maintenance activities, in a timelier fashion.

To put this into context, a power station had a generator step-up unit (GSU) transformer with a bushing found to be in questionable condition during regular maintenance. Offline testing showed it was deteriorating. Online monitoring was used to track the deterioration over time – allowing the bushing to be used and the GSU returned to service while a spare was brought in and made ready. With minimal loss of generation, the monitoring paid for itself within hours of the plant going back online. The deteriorated bushing remained in service for several weeks before being replaced in a controlled manner.

## 6. Moving your business forward with condition monitoring

In a world of 'big data', there is a surprising amount of basic rule application which will yield benefit: simple thresholds and trending values to generate alerts. What

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The trending topic in the industry right now relates to asset health reviews and the generation of an asset health index. These activities allow for collation of data and generation of a number or index for each

transformer. Usually these activities are looking at the long-term strategic plans. Condition monitoring is about confirming the long-term, but also about looking at our assets, right now, to make sure there isn't an urgent need for action. It may just mean maintenance – but without it the whole asset may fail, rather than just a component, leaving you with a costly dilemma and big headache.



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**Tony McGrail** is Doble Engineering Company's Solutions Director for Asset Management & Monitoring Technology, providing condition, criticality and risk analysis for utility companies. Previously Tony had spent over 10 years with National Grid in the UK and the US; he has been both a substation equipment specialist, with a focus on power transformers, circuit breakers and integrated condition monitoring, and has also taken on the role of substation asset manager and distribution asset manager, identifying risks and opportunities for investment in an ageing infrastructure. Tony is a Fellow of the IET, a member of the IEEE and the IAM, is currently chair of the Doble Client Committee on Asset and Maintenance Management and a contributor to SFRA and other standards at IEEE, IEC and CIGRE. His initial degree was in Physics, supplemented by an MS and a PhD in EE and an MBA. Tony is an Adjunct Professor at Worcester Polytechnic Institute, MA, leading courses in power systems analysis.