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Looking backward to see a way forward

by **Tony McGrail**
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As we move towards greater application of, and reliance on, Artificial Intelligence and Machine Learning (AI/ML) systems, it's worth noting that there are some activities where they perform well, and some where they perform poorly. Recent experiences with large language models (LLMs) such as ChatGPT (1) have shown that it is going to be some time before the machines take over from humans in analyzing anomalous condition monitoring data and are able to extrapolate from experience: looking backward to predict the future.

I had heard that AI/ML tools can do all sorts of clever stuff, so I asked ChatGPT if it could help with some bushing data I'd collected from an on line condition monitor: it seemed like a good idea as 'What's the worst that could happen?' The case was a real one, with the data for one bushing plotted below, Figure 1, showing leakage current rms magnitude hourly; the data shows anomalous behavior – but what does it mean?

- If you read the limitations for ChatGPT on the landing page it does say:
- "May occasionally generate incorrect information"
 - "May occasionally produce harmful instructions or biased content"
 - "Limited knowledge of world and events after 2021"

So we proceeded with caution as we are dealing with some HV bushings and 'What's the worst that could happen?' is actually quite bad: catastrophic failure of the whole GSU power transformer with associated consequences: fire, safety and environmental issues, system disruption and so on.

The data in Figure 1 is real, and disturbing: why would a current rise then fall, repeatedly? Could it be a problem with the monitor itself? What does it mean? the question I asked ChatGPT was: "If I am monitoring a bushing and the leakage current rises sharply, but then falls rapidly back to nominal, then rises again, and falls again, then stabilizes close but just above nominal, what should I do?"

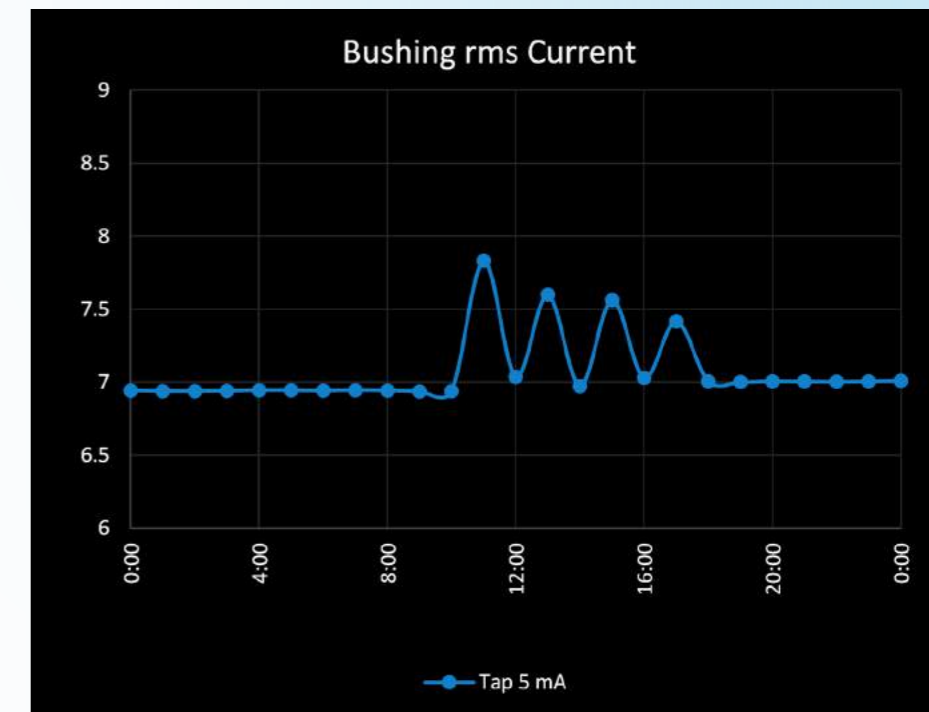
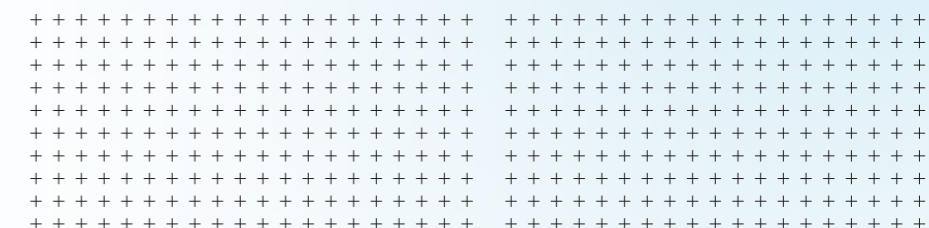


Figure 1: Raw Bushing rms Current Data Recorded hourly



the cooler return valve closed: subsequently, there was a temperature alert as the cooling was not functioning, and the rise in monitored DGA was a result of the cooler valve being opened and fresh oil reaching the DGA sensor: the transformer was actually de-energized at the time. How do we get all of that type of information, context, and insight into an AI system? That is going to be a challenge.

At DistribuTech this year, there was a significant number of companies offering AI/ML tools as part of their offerings: OEMs, consultants, service companies, data companies, and so on. What is perhaps most encouraging is that many of them understood quite clearly that while they may find interesting relationships or trends within supplied data, they also need the capability of industry experts to give meaning to the findings. This is a challenge when we are losing capability through retirement or career changes, and have fewer people than needed entering the industry each year. And, of course, new industry individuals will take some years before becoming the SME's of the future. AI/ML can fill some of the gap, but not all of it – over time it may be that AI/ML gets more adept

and the cases where real experience is needed are fewer, but the 'edge' cases aren't going away. And with the growth in DERs, and the increase in the need for condition monitoring, there is a corresponding need for humans who understand the data and can look for answers which may lie outside the box: such as would apply to the bushing in Figure 1.

Over time it may be that AI/ML gets more adept and the cases where real experience is needed are fewer, but the 'edge' cases aren't going away.

The work of Tom Rhodes and colleagues at Duke Energy is highly relevant – applying AI/ML to support

the engineers, not replace them: use the tools to identify where SMEs can most profitably spend their time. Initially the pure data scientists complained about the data 'It must be wrong as it doesn't fit our models', but after some 'learning' on both sides, the resulting hybrid approach provided great value to the organization (7). And it may be that, over time, the number of cases which the AI/ML passes over to the SMEs reduces, as the AI/ML learns, but that, too, will take time.

So, in the interest of experimentation, I did ask ChatGPT many other questions, but one sticks in my mind: "Can you give me some anagrams of 'Transformer Bushing'?". It shouldn't be too difficult to rearrange 18 letters into something interesting for a system with the language skills of ChatGPT, and it came up with several, but my favorite was "The Grim Buffoons Runes". This may seem pretty good, but it has a couple of extra letters, meaning it fails the basic definition of what an anagram is... sometimes you have to get the simple stuff right, like counting letters, before doing something difficult like rearranging them into new words.

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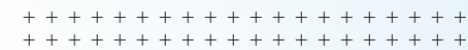
The role of SMEs in data analysis is not going to go away in the near future, and we still need someone who knows what is going on,



Conclusions: AI/ML can only work on what it has been 'shown' and fill in the gaps. It is very poor at generating 'new' knowledge.

The role of SMEs in data analysis

and can look at the data, the context and the details simultaneously to come up with something 'outside the box'.



is not going to go away in the near future, and we still need someone who knows what is going on, and can look at the data, the context and the details simultaneously to come up with something 'outside the box'.

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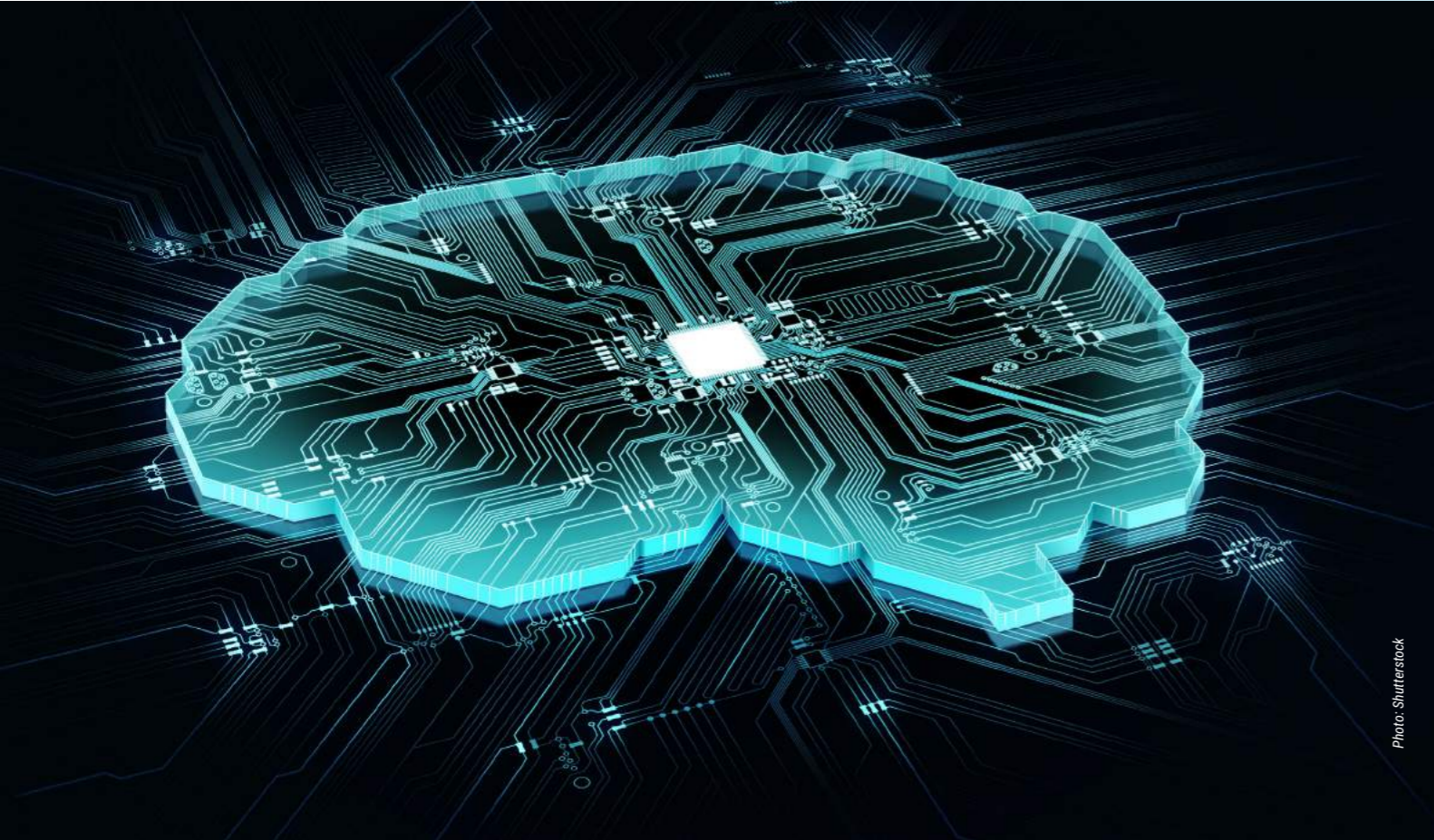


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