Detecting Hidden Risks: Advanced Endwinding Vibration Monitoring on a 110 MW Hydrogenerator

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Endwinding vibrations are a common phenomenon in rotating machines. Severe endwinding vibrations can lead to mechanical degradation of winding insulation, ultimately causing failures and short circuits due to continuous temperature and load cycling. Therefore, continuous monitoring of endwinding vibrations is crucial for large rotating machines such as turbo or hydro generating units.

Endwinding Vibration Monitoring

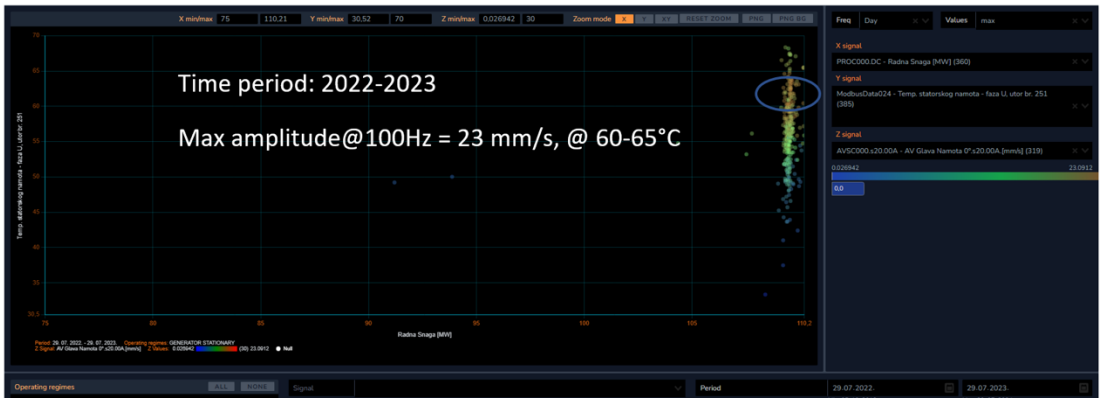
Monitoring endwinding vibrations requires Fiber optic accelerometer technology due to its ability to operate in high-voltage environments without being affected by electromagnetic interference. The monitoring system also includes software for data interpretation, tracking vibration progress, and preventing possible failures.

Endinwinding vibration sensor on a hydro generator endwinding (IRIS EVAII)

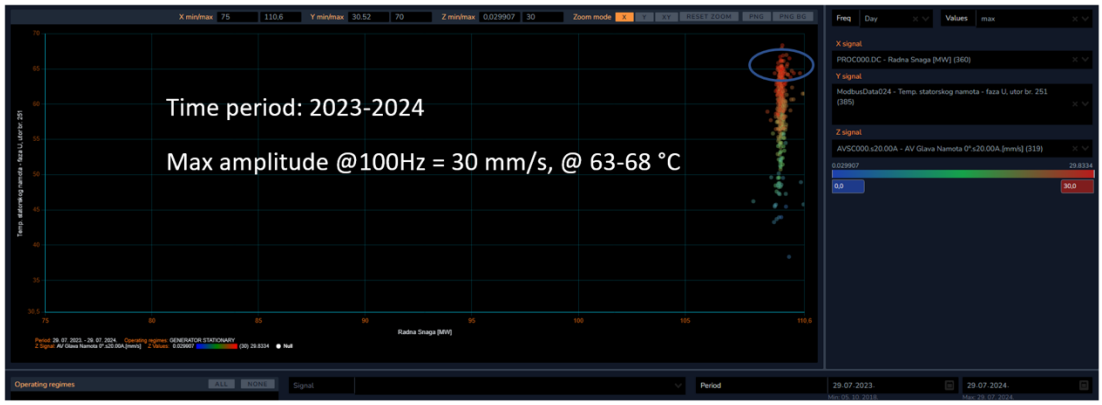
Endwinding vibrations vary with operating conditions such as stator core temperature and load. The primary driving force behind these vibrations is the stator current flowing through the windings, which generates a force at either 100 Hz or 120 Hz. Problems arise when the natural frequency of the endwinding falls within this frequency range, leading to elevated vibrations. This resonance effect often develops after several years of operation. Furthermore, temperature variations during operation often has an impact on overall stiffness, which then affects the vibration response to these driving forces.

Advanced Monitoring with AAnT Intensity Plot Module

Our latest **AAnT (Asset Analytics Toolkit) intensity plot module** simplifies the visualization and understanding of the complex dependencies between endwinding stiffness, temperature, and driving force. The module is designed to easily present the relationship between endwinding vibration response and various operating modes.



AAnT Intensity plot module



AAnT Intensity plot module

Case Study: 110 MW Hydrogenerator Analysis

In this case study, we analyze the endwinding vibrations of a **110 MW hydrogenerator**, correlating the amplitude with generator active power (MW) and stator winding temperature (°C). The analysis compares two consecutive years of endwinding vibrations under similar operating conditions.

Key findings from the analysis:

1. he **vibration amplitude (intensity value) has increased** over the observed period.
2. The **peak vibration amplitude has shifted** to higher winding temperatures.
3. This **shift indicates a stiffness change** occurring at elevated operating temperatures.
4. This progressive change can lead to further increases in vibration amplitude, posing **a risk of mechanical degradation and winding failure in operation**.

Conclusion

The observed trends highlight the importance of continuous endwinding vibration monitoring. The increasing vibration amplitude and its shift to higher temperatures suggest a deteriorating stiffness condition, which can escalate over time. The AAnT intensity plot module effectively visualizes these dependencies, enabling predictive maintenance and proactive interventions to mitigate risks.

By leveraging advanced monitoring tools, operators can ensure the reliability and longevity of large rotating machines, preventing costly failures and maintaining optimal performance.