# Power Transformer Monitoring with the Miro-F TxM

## Importance of Monitoring Transformers

- Extend the functional life of the asset, leading to a higher return on initial capital expenditure
- Condition based maintenance provides an efficient deployment of labour resource, leading to lower operational costs
- Allows better network modelling for improved capacity management
- Optimises scheduling of outages, minimising downtime

## The Miro-F TxM

The Miro-F TxM offers both Power Quality and dedicated Transformer Monitoring metrics.

### Power Quality Metrics:

- Voltage & Current Harmonics/Interharmonics
- Power Factor, kVA, kvar, kW
- Three Phase/Single Phase analysis
- VRMS/IRMS & Phase
- IEC, IEEE Reporting and more!

### Dedicated Transformer Monitoring Metrics: (Applicable to Distribution and Power Transformers)

### Harmonic Derating:

- K-Factor (Dry-type)
- Factor K (Oil-type)
- Harmonic Derating Factors

**Figure 1: Miro-F TxM**

### Loss of Life:

- Top Oil & Hotspot Temperature
- Ambient Temperature
- Transformer Loss of Life

## K-Factor

| Typical Loads & K-Factor | |
|---|---|
| K-Factor | Types of Loads |
| 1 | Resistive loads, lighting, induction motors, transformers |
| 4 | Welders, induction heating, PLC, Solid State Electronics |
| 9 | Industrial/Manufacturing |
| 13 | UPS without input filtering, multi-wire receptacle circuits in healthcare etc |
| 20 | Mainframe computer loads, VSD’s |

**Figure 2: Typical Loads for different K-Factors**

Transformer K-Factors come in specific integers such as 1, 4, 9, 13, 20 etc. A higher K-Factor means the transformer is rated to operate in an environment with higher harmonic current distortion; This also means a larger and more expensive transformer.

The data in Figure 3 is taken from a power transformer (45MVA) operating for a mining facility. The measured K-Factor is below 1, indicating that the transformer does not require derating.

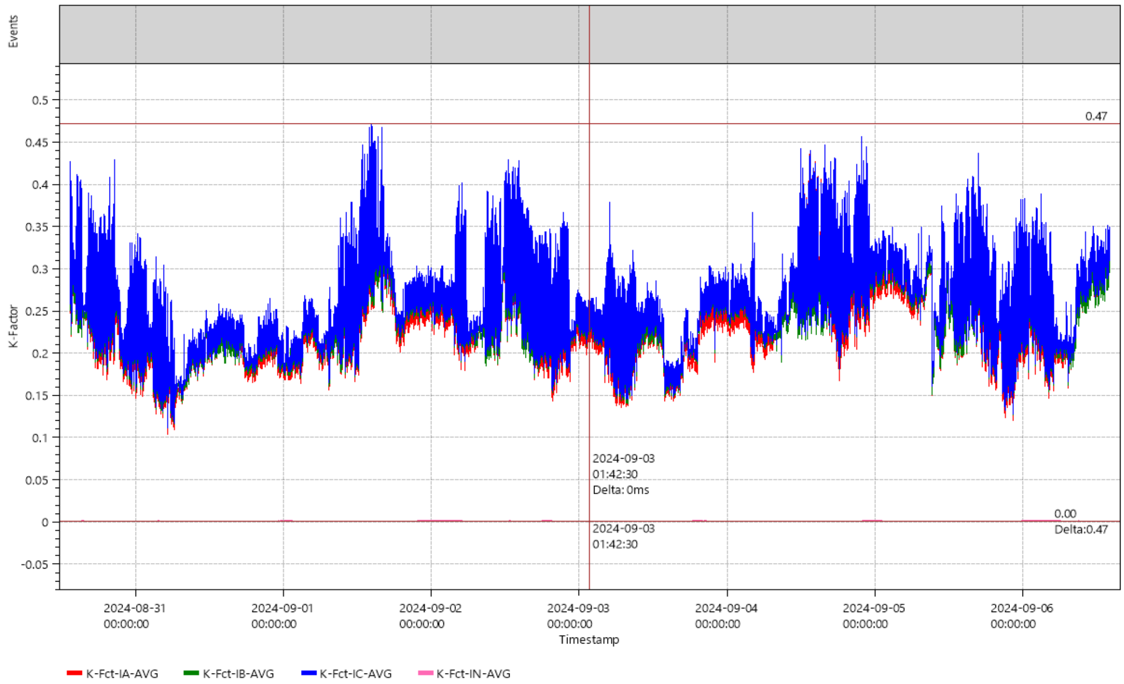


**Figure 3: K-Factor (Ideal)**

The data in Figure 4 is taken from another power transformer (45MVA) where the K-Factor ranges between 4 and 6.71. The high K-Factor implies excessive heating of the transformer due to harmonic current and requires derating. This supplier should change the transformer to a rated K-Factor of 9 (higher than 6.71).

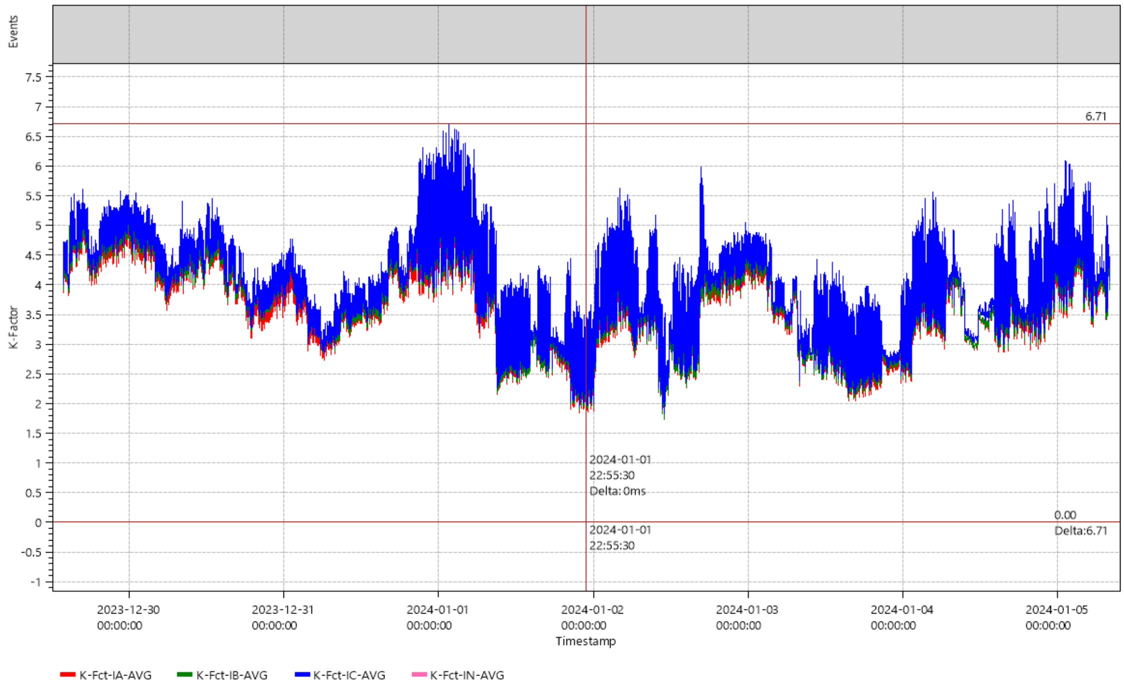


**Figure 4: K-Factor (Poor)**

## Transformer Loss of Life Tool

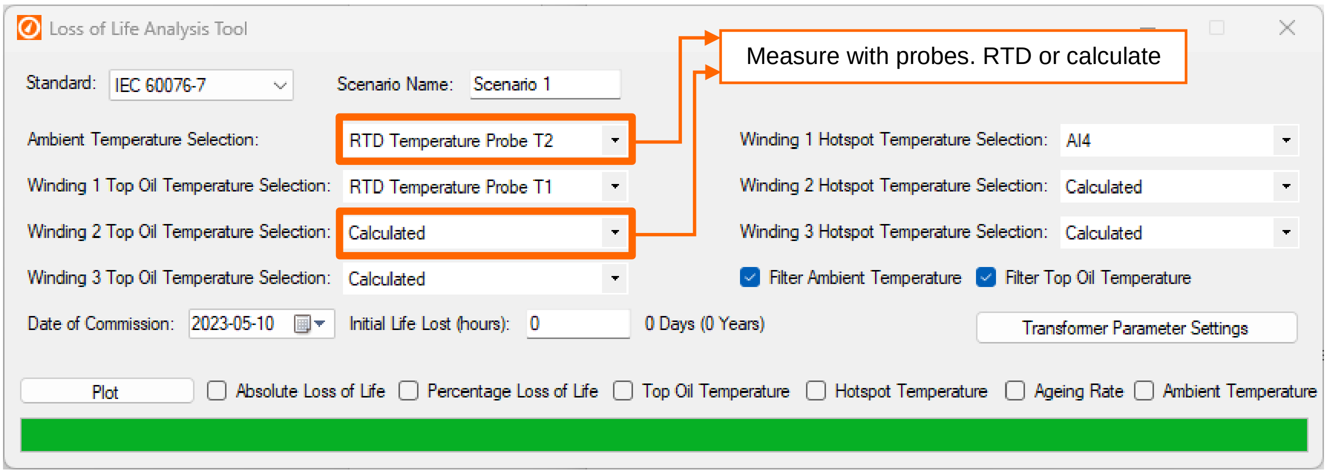


Figure 5: Loss of Life Analysis Tool

The loss of life analysis tool allows operators to estimate the lifetime consumption of their transformer. The Miro-F TxM offers three ways to derive the hotspot temperature consisting of: optical sensors installed in the transformer, a resistive temperature device or calculation based on a model. Parameters can be based on IEC or IEEE ensuring that any type of transformer is compatible with our analytics.

## Transformer Loss of Life Analytics

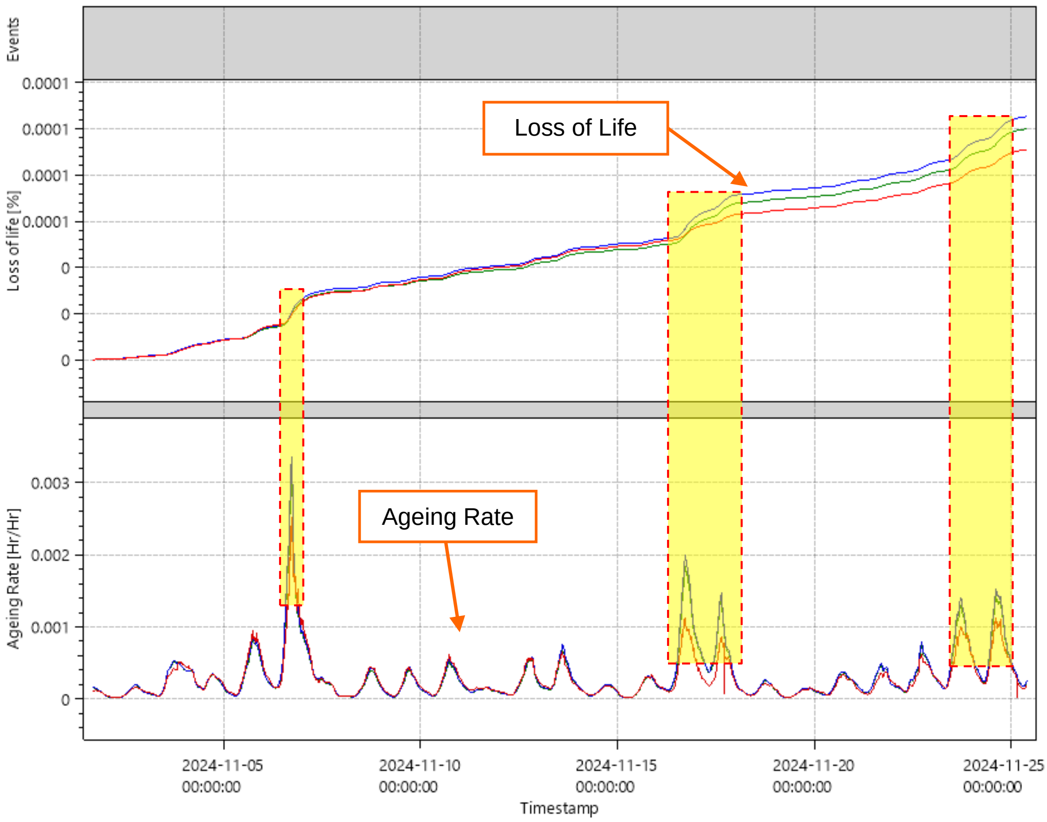


Figure 6: Ageing Rate & Loss of Life [%]

In Figure 6 (yellow boxes) show the jump in loss of life as the ageing rate spikes, indicating accelerated aging.

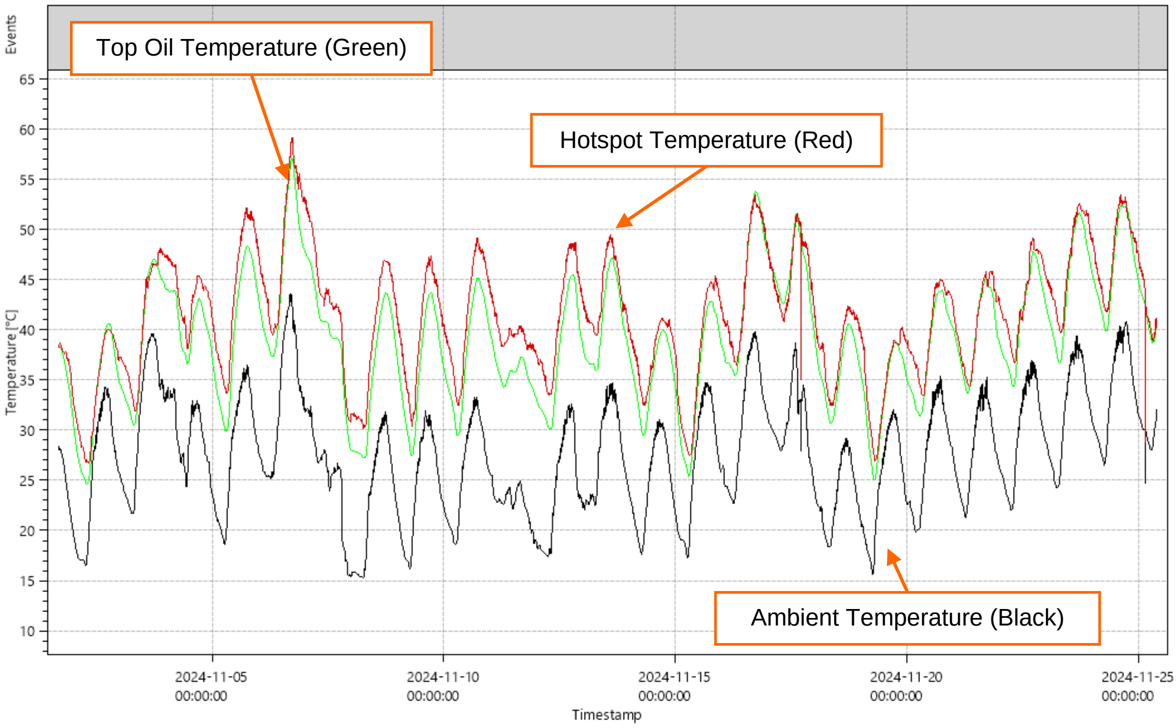


**Figure 7: Temperature Metrics**

The metrics in Figure 6 and Figure 7 offer operators at-a-glance analysis on the lifespan and associated temperatures of their transformer. It is noteworthy that ageing rate increases with rising temperatures, increasing the loss of life.

## Applications in Renewables

Electrical Vehicle (EV) charging equipment can either be a single-phase or three-phase system; this is similar for the inverters utilized in photovoltaics (PV). Both technologies generate large harmonic steady state and transient currents which can travel upstream to the transformer causing it to overheat. The harmonic current derating and loss of life metrics naturally lend themselves to the transformers in these applications.