

Focus topics | April 2025

BLOX - from breakdowns to breakthroughs

IIoT health monitoring software turning
X-ray module data into preventive insights.

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Introduction

As inspections are increasingly integrated into production lines, the tolerance for downtime drops. Inline, 100% inspection processes demand continuous reliability. Our core competency at Comet is in developing high-performance X-ray modules. The challenge our customers face is clear: unplanned downtime.

Our solution:

BLOX – a smart, data-driven IIoT health monitoring system that enables operators to plan maintenance precisely when needed. The following chapters explore how BLOX achieves this through real-world examples.

What is NDE 4.0?

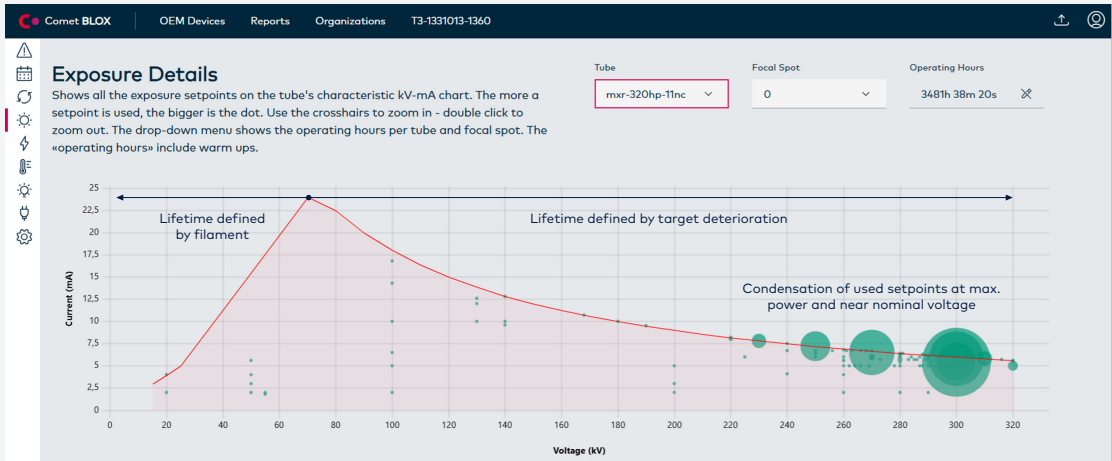
NDE 4.0 (Non-Destructive Evaluation 4.0) refers to the digital transformation of inspection technologies, integrating AI, data analytics, and real-time monitoring into traditional NDT (Non-Destructive Testing). It aligns with Industry 4.0 by enabling smart factories to proactively detect anomalies, reduce downtime, and continuously improve production processes. For operators, NDE 4.0 means fewer surprises, better resource allocation, and optimized uptime.



Discovering lifetime-reducing stress for the X-ray tube

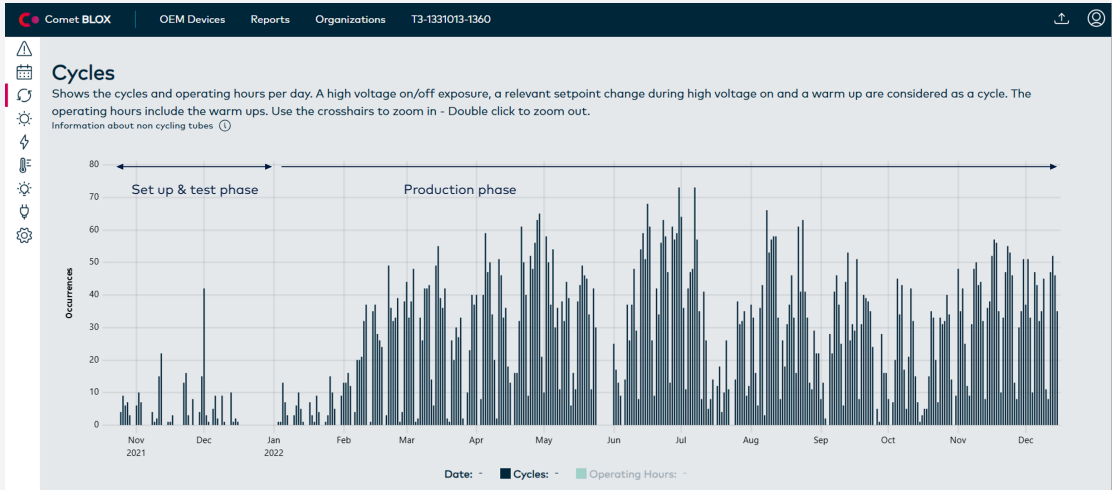
Understanding stress patterns on X-ray tubes helps predict failure modes and schedule timely interventions.

Figure 1: Inspection equipment use and stress on the characteristic power curve of the X-ray tube



Inspection equipment use and stress on the characteristic power curve of the X-ray tube

Figure 2: User behavior and exposure patterns over time



Low exposure rate during setup followed by high cycling rate during production, when performed at nominal power, indicating thermal stress and likely target deterioration.

When Figures 1 and 2 are combined, we can confidently predict the tube's end of life will result from thermal target damage, not filament aging. This

insight shifts monitoring priorities toward exposure cycles and heat-related stress.

Avoiding unplanned downtime from X-ray generator overheating

Overheating is one of the most avoidable – and disruptive – issues in production X-ray systems. In harsh manufacturing environments with every-day dust and debris, thermal buildup can trigger automatic shutdowns designed to protect sensitive components. These unplanned stops can result in hours or even days of lost productivity.

This section highlights a case in which BLOX monitoring helped visualize, detect, and resolve an overheating issue before it caused lasting disruption.

The setup

In this case, the generator was housed in a sealed IP54 enclosure to protect against conductive dust. While effective at shielding internal components,

the cover also restricted cooling airflow – an unintended side effect with long-term consequences.

Figure 3: Generator with IP54 cover



Dust protection housing reduces airflow, making temperature monitoring critical.

Over time, the restricted airflow caused gradual heat buildup. Using its integrated exposure monitoring system, BLOX tracked this behavior and

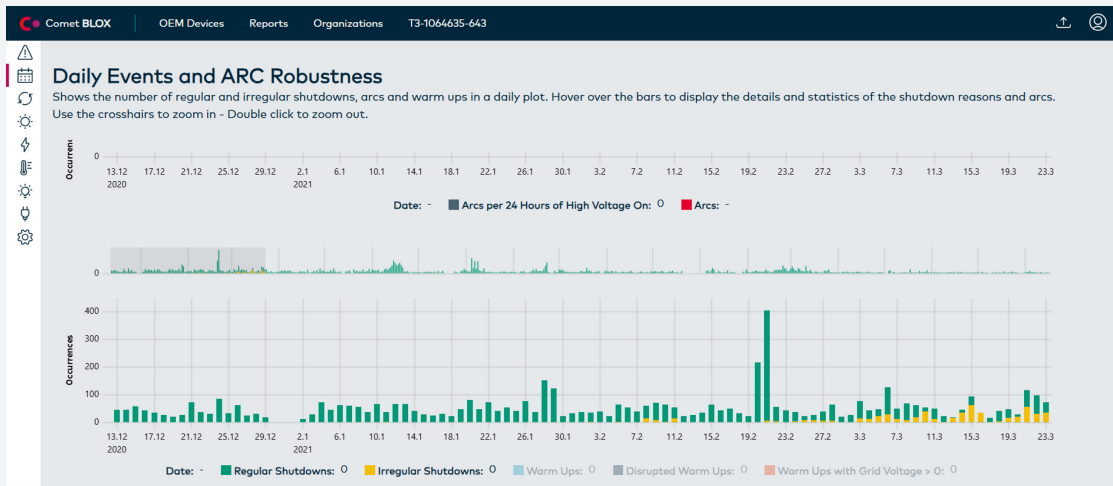
flagged the deviation with its intuitive traffic light visualization.

The early warning

Initially, the system operated usually, showing green status with only regular shutdowns. On February 7, the irregular exposure patterns began to emerge. By February 8–11, the system status turned slightly

orange – an early indication of rising thermal stress. Soon after, the ratio of irregular shutdowns worsened in March, and the system entered into red status and shut down to prevent damage.

Figure 4: Traffic light visualization of system status

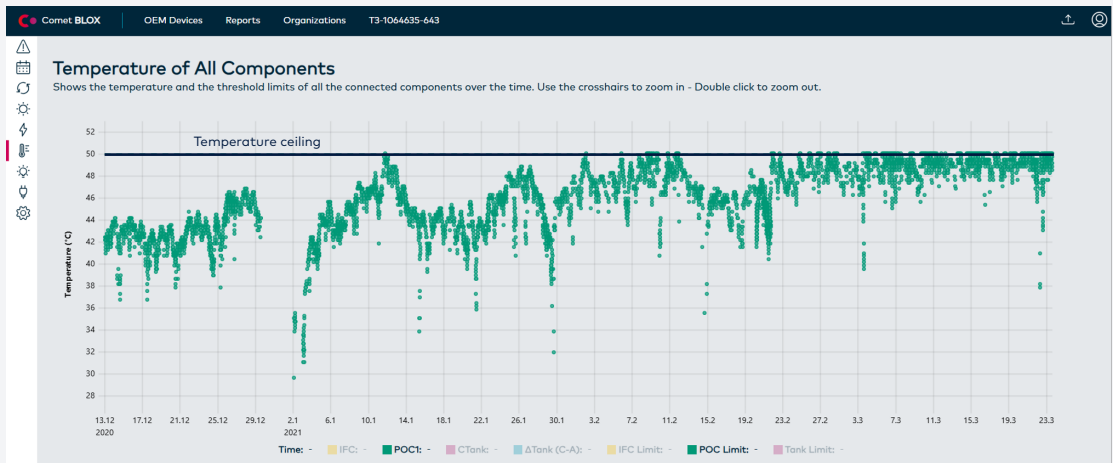


Regular operation (green) gives way to warnings (orange) and, finally, shutdown due to heat buildup.

This pattern revealed an invisible, slow, persistent temperature drift without live monitoring. One

internal component finally reached its thermal threshold, triggering a system lock

Figure 5: Temperature drift before system shutdown



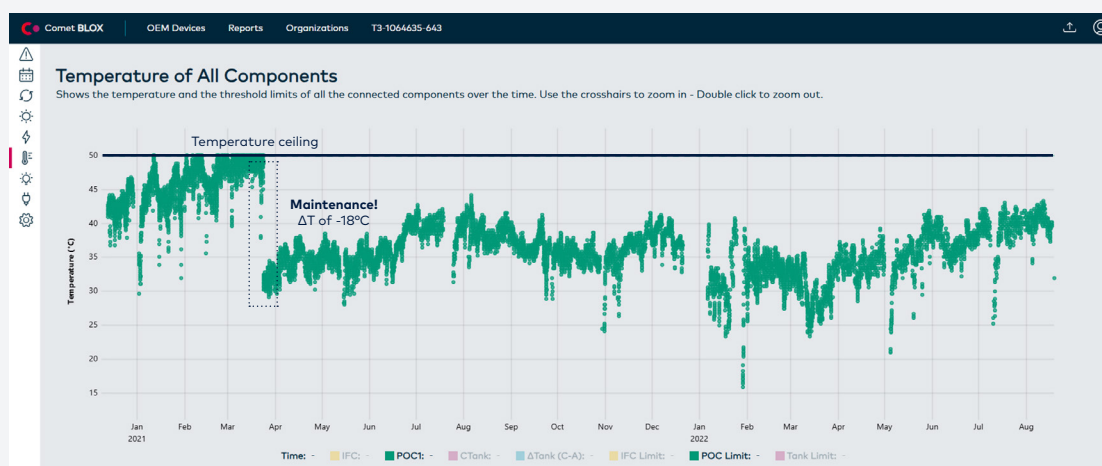
Accumulated heat and poor air circulation trigger critical temperature thresholds and system lock.

The root cause – and the fix

The investigation uncovered the cause: a clogged filter. With airflow compromised, the cooling system could no longer maintain stable temperatures. The

generator quickly returned to normal operation once the filter was manually cleaned and replaced.

Figure 6: Temperature response after maintenance



A timely filter replacement leads to sustained temperature recovery and stable operation.

This maintenance could be done proactively before any component damage occurs, thanks to BLOX. Production resumed with minimal interruption.

"With BLOX, we can move from guesswork to clarity - it helps us identify and manage risks in a more structured manner, make better decisions more quickly, and reduce the time spent troubleshooting."

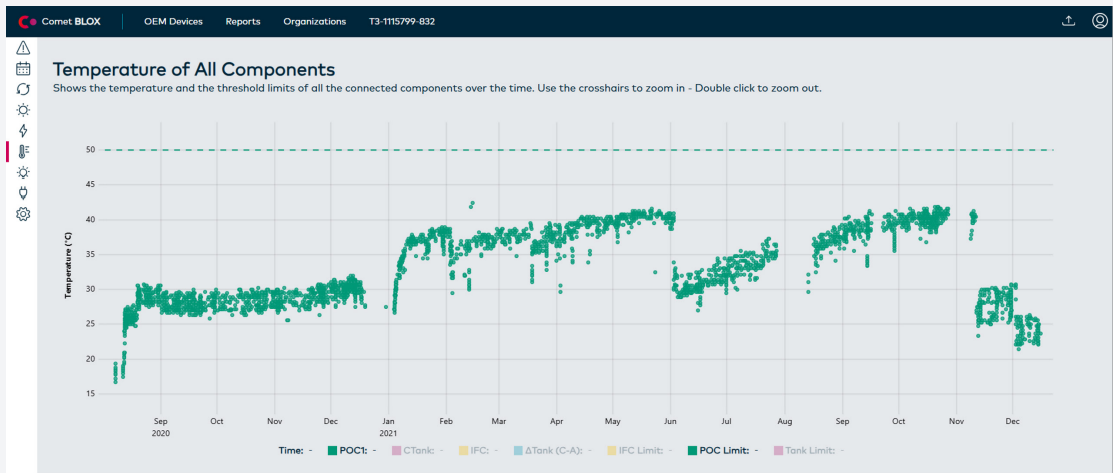
Pascal Corbat, Product Manager for BLOX

Prevention going forward

In future cycles, BLOX applied the lessons learned – identifying similar early warning patterns well before thresholds were reached. Maintenance teams

received timely alerts, allowing low-impact interventions that kept production lines running.

Figure 7: Monitoring from the beginning



Applying BLOX lessons early ensures long-term uptime and avoids unplanned interventions.

This case highlights how predictive analytics and live system insight align with the principles of NDE 4.0 – shifting maintenance from reactive troubleshooting to proactive planning.

Takeaway: Thermal monitoring and trend analysis transformed what could’ve been days of lost production into a simple filter swap.

Evidence from the Field

Feedback from users confirms that preventive maintenance through BLOX meets an urgent need. In both presented examples, downtime was reduced or completely avoided through early detection.

BLOX’s data collection and evaluation integration lays the foundation for live health reporting and smart maintenance planning.

Call to action

BLOX demonstrates how NDE 4.0 can be practically applied to X-ray equipment. But its full potential depends on collaboration across systems and suppliers.

If you’re operating in high-throughput environments and facing downtime challenges, it’s time to consider how BLOX can support your uptime strategy.

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