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Predictive AI Keeps Factories Up When Power Goes Down

Maintaining continuous operations is priority-one for any factory, and the stakes are particularly high for semiconductor plants. Even a brief power outage can cause major production disruptions. At one factory, a split-second outage caused a 20 percent drop in output.

Even in high-tech manufacturing zones, power blackouts can be a monthly occurrence, necessitating every factory to have backup generators. As a rule, semiconductor factories use diesel uninterrupted power supplies (DUPS), which store energy during normal operations to keep production running during an outage.

But DUPS systems are not infallible. In fact, with so many moving parts, and extreme factory conditions, DUPS systems are not 100 percent reliable. And unplanned diesel power generator downtime combined with unexpected power outages happen all too often.

Semiconductor production systems are complex, so once stopped, they can't easily be restarted. Once the production line is shut down, it can take days for a factory to recover, costing hundreds of thousands of dollars.

For example, a power outage shuts off the factory's air-purifying system. Depending on the length of the outage and the type of silicon in production, products can be irretrievably damaged. Even in situations where semiconductors aren't spoiled, production delays can result in broken client contracts and fines.

Avoiding a Shutdown

Clearly, keeping diesel generators in working order is essential, but they're complex mechanical systems that are not easy to maintain. Because semiconductor manufacturing processes demand a huge amount of electricity, a factory may need a DUPS system of 10, 20, or even more diesel generators.

Factories that rely on manual inspections risk downtime because they typically don't reveal actionable problem data. For example, an electrical current reading can indicate something's wrong, but it doesn't specify which part of the DUPS isn't working right. To make matters worse, by the time power use is affected, the system has already experienced significant damage and is headed for a breakdown.

85%

Of diesel uninterrupted power supply (DUPS) problems can be detected through vibration analysis

Some factories periodically bring in a portable diagnostic unit to test the DUPS, but if something goes wrong between tests, they have no way of knowing about it. And while a portable machine can catch serious problems, sensor limitations prevent the detection of less noticeable imbalances or wearing of parts. Without advance warning of DUPS problems, the factory can't make repairs until a disastrous breakdown is imminent or has already occurred.

Using Analytics for Predictive Maintenance

The NEXCOM Predictive Diagnostic Maintenance (PDM) system for DUPS enables uninterrupted production during sudden power outages. The PDM solution continuously oversees each unit in the DUPS system noninvasively. Using vibration analysis, the system can detect 85 percent of power supply problems before they do damage or cause failure.

Each unit in the DUPS system is connected to a set of accelerometers and bearing housings to collect vertical and horizontal vibration frequencies.

Vibration sensors interpret the inputs showing real-time status through indicator panels. Finally, as shown in **Figure 1**, a NEXCOM SCADA station completes the PDM solution for the whole DUPS system by storing, analyzing, and presenting different arrays of data in real time.

"Our system can identify specific damage at a very early stage, while it's still operational. For example, we can show not just that a bearing has damage but which part of the bearing," said David Lee, Vice President for NEXCOM Intelligent Systems. "This gives the factory manager two months or even more to order new parts. And repair can be planned ahead of time."
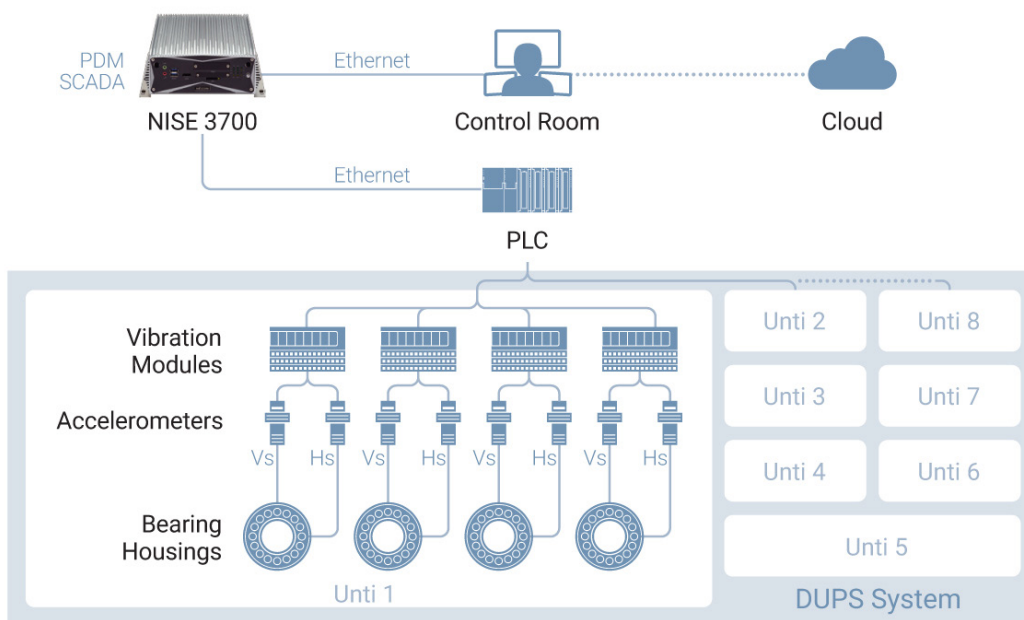

Figure 1. NEXCOM's PDM System measures DUPS vibration frequencies.

Remote monitoring capabilities reveal anomaliesin bearing behavior and prevent damages that endanger power supply. Factory managers can set up alerts to let them know when maintenance is required, eliminating the need for manual checkups.

Information processing for machine diagnostics is done at the edge—in the factory—to notify managers of problems as quickly as possible. When an anomaly is detected, an alert is sent to the control room or to a manager's mobile app. The manager learns which part is misaligned or starting to wear, though it may be months away from breaking down.

That gives managers time to order replacement parts far in advance. They can arrange for installation during a time when power consumption is relatively low, so that there's less risk of an outage during repair.

"With the DUPS PDM system, one customer was able to reduce their power outage related downtime to almost zero," said Lee.

NEXCOM's PDM system provides a graphic user interface for analysis and representation of large amounts of data. It offers real-time visibility of values and trends, as well as the option to set conditional alarms triggered within a specific range of values. Intel® processors enable high-performance graphics processing for analyzing abundant historical data as shown in **Figure 2**.

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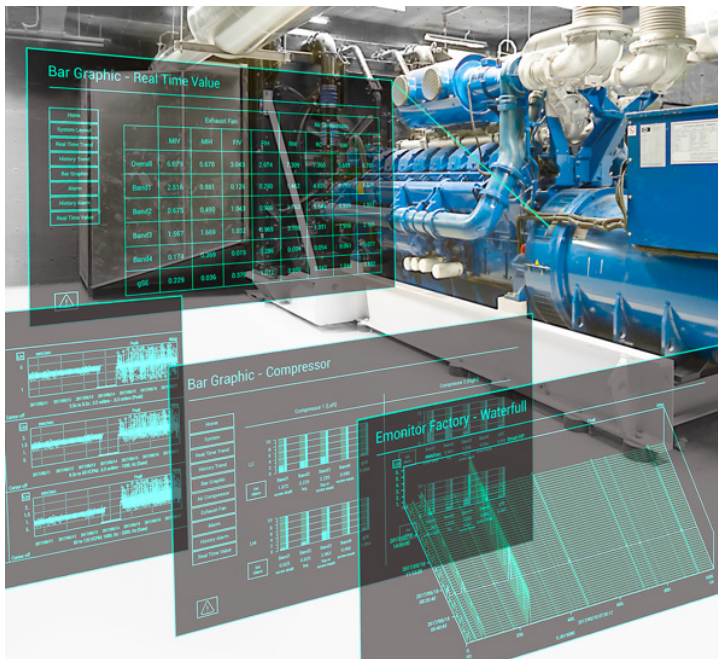> **David Lee,**
> **NEXCOM**

Figure 2. NEXCOM's PDM system collects data for real-time analysis at the edge and in the cloud.

Managers can view historical patterns in a user-friendly visual interface that turns massive amounts of data into comprehensible charts and graphs. Studying this data helps them know precisely where to set alerts. They avoid the false alarms that are common in other systems and resolve problems well in advance of a breakdown, avoiding costly downtime.

Improving Operations and Products

Data is also sent to the cloud, establishing a historical record of machine functioning that managers can access later, for predictive maintenance, operational costs, and other business analysis.

Factory managers aren't the only people who use the cloud-based data. Diesel power supply vendors use AI and data analytics to find ways to improve their products in the future.

Using sensors and predictive maintenance to monitor and maintain DUPS systems is a game changer for semiconductor factories, which have so much to lose if the system fails. Ensuring steady production is their first priority. With NEXCOM's PDM system, they can be confident that the diesel-powered backup will kick in every time it's needed.

As they realize the benefits of IoT predictive analytics, factory managers are looking to expand their use of PDM systems. Humidity and temperature control are critical in semiconductor manufacturing—making exhaust fans and HVAC systems a fitting application for PDM solutions such as NEXCOM's.