**Nokia
SenseOps
Qualcomm**

Industry

Power Generation

Business Value

- Predictive Maintenance
- Remote Monitoring & Diagnostics
- Cost Reductions
- Service Optimization
- Performance Monitoring
- IoT

Solution Components

- The PI System from OSIsoft
- Private LTE base stations from Nokia
- SenseOps IIoT + SaaS bundle
- Qualcomm Snapdragon processor & LTE modem

Private LTE Provides Pervasive Connectivity for Early Detection of Pitch Bearing Failure in Wind Turbines

The Challenge to Detecting Pitch Bearing Failure

Wind turbine failure databases reveal that **pitch assemblies** have one of the **highest failure rates** and are among the largest contributors to overall downtime and lost production. Currently these issues are detected via visual inspections, 100m up-tower in remote locations where connectivity is poor or non-existent.

When pitch bearings fail, the repair costs are high. **The crane roll alone is often in excess of $100,000.** By the time the rotor has been lowered, blade removed, bearing replaced, and the rotor raised back in place, repair costs can pass the $150,000 mark. That figure doesn't include the lost energy value, which can put the total loss for a pitch bearing fail on a single turbine **in excess of $200,000**.

With the right data, **preventative maintenance of pitch rings costs less than $5,000**, according to studies by National Renewable Energy Laboratory (NREL). However, effective preventative measures require data access and network connectivity which is not currently available.

## The Solution: Plug & Play Connectivity

Nokia along with SenseOps and OSIsoft developed an end-to-end solution based on private LTE networks and industrial IoT gateways to capture and analyze data. The goal is to detect early signs of a problem before the damage has gone too far, and a crane roll is required.

The first step to enabling preventative maintenance of pitch rings is bringing network connectivity to the far reaches of the wind farm. Fiber lines exist at most major wind farms, but their use is typically limited to control networks (e.g. SCADA systems). Digging trenches and pulling additional wires is not an option in many environments due to the cost and complexity, not to mention the cows. A simpler, more affordable approach is to drop Nokia Digital Automation plug & play base-stations on site to provide an umbrella of unmetered LTE connectivity. Each private LTE base state (pico cell) provides miles of secure high bandwidth coverage that reliably connects turbines up to 3.5 miles away.
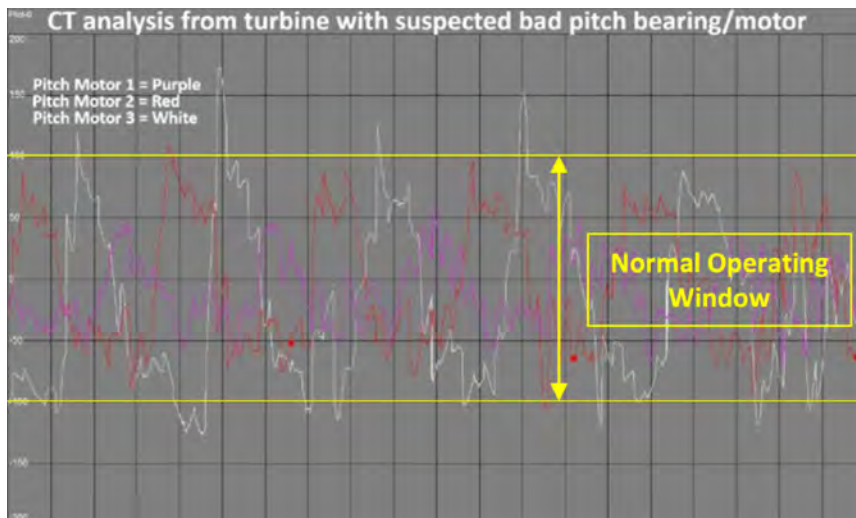
PI Vision display of current readings from a pitch motor operating outside the normal operating window.
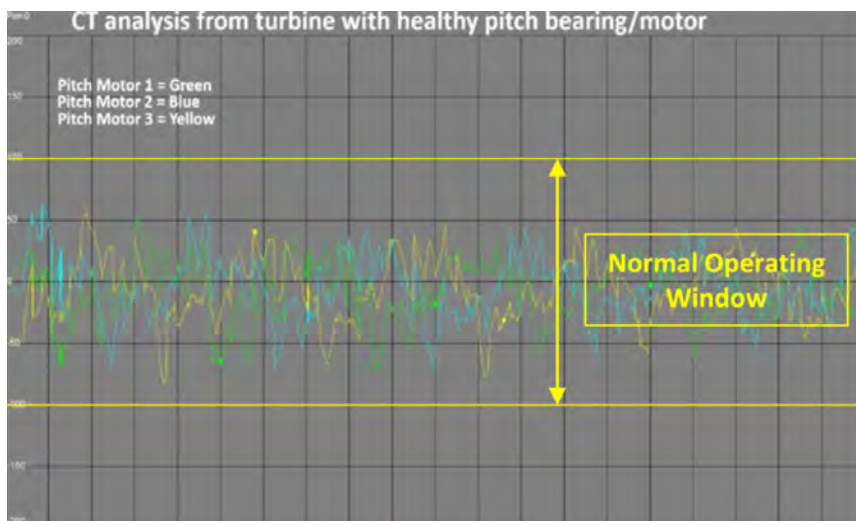
PI Vision display of a turbine who's pitch assembly was recently repaired. Operating within the normal operating window.

"By linking thousands of devices across a private, unmetered network, customers are getting a deep, granular picture into their operations."

– David Letterman,
Business Development
Manager NA, Nokia Digital
Automation Group

Next, a **SenseOps IIoT+ SaaS bundle** based on **Qualcomm Snapdragon processor and LTE modem** is installed in the rotor assemble and commercially available current transducer sensors are deployed on up-tower pitch motors. Asset data is captured and analyzed at the edge and seamlessly transmitted via secure **Private LTE network provided by Nokia**. This end-to-end solution is then integrated with other industrial IT systems using **the OSIsoft PI System without the need for costly SCADA additions or modifications**.

The solution has been deployed and field tested at large wind farms in the Midwest to detect pitch bearing and other wind turbine operational issues prior to catastrophic failure. With an all-you-can-eat high quality private broadband network, applications for improved **operational efficiencies, worker safety, site security, and personnel communications** are now possible, even at remote wind farms.

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