

# Better crystal

Advances in plant condition monitoring, especially equipment that eliminates the cost and difficulty of wiring, are making the infeasible feasible. Dr Tom Shelley reports



Above: acoustic emission monitoring, with AV Technology  
Below: Vibration monitoring, with INA FAG equipment

With a breakdown in plant sometimes so catastrophic (failures of lubrication pumps have resulted in shutdowns of more than a year before new parts could be made), it is astonishing that so few plant engineers make use of increasingly sophisticated, easy and low-cost equipment to monitor and predict trouble.

One of the earlier hurdles – miles of cabling – is no longer necessary. Entire monitoring systems can now use either the Internet or low-power wireless. Emerson Process Management has been installing wireless mesh networks for device monitoring since October 2006, and Wireless HART (where digital communications are superimposed on the 4–20mA signal) since last September.

Speaking at this year's mtec exhibition at the NEC, Andy Wallace, Emerson's business manager for so-called 'smart wireless solutions', described how wireless transmitters can now be screwed into the back of existing hard-wired instruments to enable remote diagnostics. Systems work across distances of more than 400m with good line of sight, despite running at 1mW. At a demonstration, members of the audience were invited to commission six ATEX-compatible Rosemount instruments, fitted with the wireless units. The network set itself up in less than a second. Wallace explained that the units identify themselves and, in the event of network problems, quickly find new paths, via other instruments that act as repeaters.

Battery life is typically five to 10 years and there are five levels of security, while, if there are problems with interference or jamming, the units frequency hop, like military radios. Wallace expects the power industry to show biggest uptake, although, to date, the major implementations have been on offshore oil rigs, BP's Wytch Farm (where a system monitors 40 pressure transmitters), an oil storage terminal and a power station in East London.

## Hydraulic hoses

But it's not just process transmitters that can be equipped for wireless diagnostics. Belts, hoses and hydraulics equipment manufacturer Gates' Hose

Diagnostic and Monitoring System, which is designed to anticipate hydraulic hose failures, is also wireless.

Its equipment makes use of sensors that detect temperature and

pressure at critical points, storing information in electronic control units that indicate incipient fault conditions on LED displays. The units can also be connected to laptop PCs, GPS or cellular phone transmitters to relay fault data and warning signals.

Tim Bull, Gates' regional sales manager, explains that the system uses collected data to calculate likely hose life and advise when this has reached 80%. To further assist hose management, he says, the company is putting RFID tags on its hose assemblies, so that fleet managers can identify hoses likely to need checking and/or replacing. Anyone who wonders why this might be necessary has not had a hydraulic hose burst in his or her vicinity. Apart from causing machine failure and spraying everyone around with oil, the flying end is capable of causing serious injury.

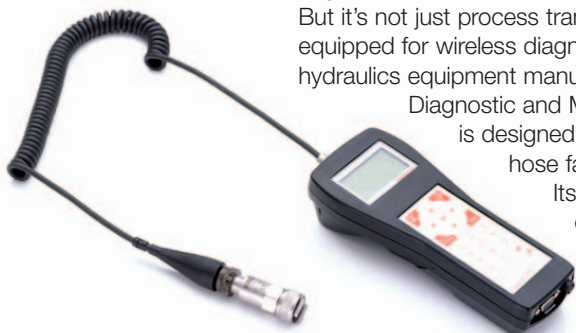
## Wind turbines

In some sectors, wireless condition monitoring is the norm – and that's particularly the case with wind turbines, where bearings, gearboxes and mountings are generally monitored over the Internet. Bruel and Kjaer's Vibro Surveillance Centre has been remotely monitoring several hundred turbines in this way for four years. Several major plant failures have been avoided – for example, by detecting sidebands around first and second order gear frequencies, which turned out to be due to metal shavings in an oil filter associated with the gearbox second stage. In that case, since it was caught early, the damaged gearbox required minimal repair.

On another occasion, the system detected RMS vibration exceeding the danger alarm limits; subsequent inspection revealed sheared coupling links. And, in a further incident, engineers were able to see a rapid and progressive rise in second stage gearbox vibration, in that case caused by a cracked rubber bushing on a support bracket. All of these problems would have led to major failures, heavy costs and long periods without producing power.

Following a similar philosophy, steel-maker Corus says that installing an eight-channel Fag Dtect X1 vibration monitoring system, from Schaeffler UK, on its two-stand reversing mill at Skinningrove, has made a huge difference to maintenance. One sensor was fitted to each of the six-spindle support bearings, with a plan to connect the two remaining sensors to the pinion box.

Previously, bearing monitoring amounted to



# balls

physical inspection during shutdown for routine maintenance. That involved two skilled engineers stripping down the bearing housings for inspection, followed by reassembly and refitting, with each bearing pair inspected every six weeks. Under the new system, all that has gone – yet two faults were discovered on two separate occasions within the first week. Engineers were then able to plan replacement and avoid a breakdown. As operations engineer Scott Boyd says: “By preventing two plant stoppages, the system has already paid for itself.”

Similar plant condition monitoring can also be undertaken using hand-held equipment. That made by Schaeffler is the Fag Detector III. But it's not only about monitoring for vibration; acoustic emission devices, such as those from AV Technology, are also now easy to set up and use, and work very well. Its equipment runs in the 20kHz to 1 MHz range and can detect problems, such as failing lubrication, before they get so bad as to be audible to human ears.

The technology can also be used to detect flow-related issues, such as blocked filters or changes in particulate content (for example, sand in crude oil) by listening to pipework. Ultrasonic acoustic signals are also good at detecting leaks and valve operation problems. Valves in reciprocating machines, for instance, produce a clear acoustic spectrum, which changes when wear or damage occurs to valve heads or seats. AV's Spi-VR hand-held acoustic emission vibration data collectors are being used at Montupet's cylinder head plant in Belfast, which manufactures for Ford and PSA Peugeot Citroen.

## Electric motors

Where machinery is driven by electric motors, however, it is possible to monitor developing problems remotely – and without attaching sensors. Artesis' motor condition monitoring (MCM) system monitors the way power is being used and relies only on electronic detector units attached to motor power leads, typically in the motor control centre. Once switched on, there's minimal user configuration, since it runs an automated learning mode to establish normal operating conditions not only of the motor, but also its driven load. It then uses mathematical modelling to establish a norm for each item of equipment, after which it monitors for potential problems. If a fault is detected, it provides diagnostics of mechanical and electrical problems and indicates the fault severity.



Artesis director David Bates explains that units are available for fixed-speed motors and variable speed drives. For low voltage installation, only current transformers or transducers are

required, while voltage transformers are added for high-voltage systems. An adaptor then links each unit to the software package, typically using network or wireless devices. Applications so far have been very wide-ranging, from monitoring escalators to liquid ring vacuum pumps on pharmaceutical plant (where it reportedly detected cavitation before it could cause pump damage) – wherever failure of the motors and/or driven system can cause high cost and downtime.

One enthusiastic user is Graeme Brown, business development director at James Fisher Mimic, which provides maintenance services for marine organisations. The company has integrated MCM into its Mimic condition monitoring equipment, and, Brown says, it has proven itself particularly useful for machinery space ventilation fans.

Brown explains that such fans are usually situated in inaccessible locations, so monitoring the condition locally from an electrical switch room provides “an excellent solution”. He also points out that failure of these fans would involve high-cost craneage bills and lost revenue, due to unplanned downtime. “Mimic helps to achieve savings in maintenance costs ... and traditional maintenance work can be significantly reduced. We are now trialling the MCM units on salt water pumps and are extremely impressed with the results so far.” **FE**

**Emerson's wireless instrument diagnostics are rewriting the rules of condition monitoring**

## Pointers

- Remote, wireless diagnostics can now be added to existing plant instrumentation
- Modern wireless networks are auto set-up and self healing
- Hydraulic hoses can be monitored using wireless kit
- Vibration monitoring services are available over the Internet
- Conventional vibration kit is transforming plant
- Acoustic emission equipment is now easy to set up and use
- Ultrasonic equipment is ideal for detecting leaks and valve operation problems
- Electric motor monitoring is about to take off