Extracting best possible **value from steam turbines**

MechChem Africa talks to Rudolf van Pype, the coordinator of projects for Zest WEG Steam Turbines, about the maintenance of steam turbines, some key mistakes operators should avoid, and how predictive maintenance can help deliver best value from these assets.

"As with any machine, operators need to remember that a steam turbine has no brain, so those looking after these machines still have to use their own," begins Rudolf van Pype, coordinator of steam turbine projects for Zest WEG Steam Turbines. "No-matter how automated the machine is or how much monitoring or predictive technology has been incorporated, one can never simply push a button and walk away. Operators need to tell the machine what to do and then continually watch what is happening to make sure that it is performing as it should," he says.

He cites two tendencies that plant operators need to be wary of: familiarity and complacency. "These are the common human failings that lead to problems. Familiarity causes hazards to become invisible: if the turbine is running as it was yesterday and the day before, personnel in the control room tend to relax, stop looking and they can easily overlook small issues such as oil or steam leaks.

"Then there is complacency, a feeling of comfort and security that keeps operators blind to the initial signs of problems. As long as the output power is being delivered, the machine is assumed to be in perfect condition," Van Pype tells MechChem Africa. When I give hands-on training to my clients, I use these two words to hammer home the need for constant vigilance to what is really happening in the background," he adds.

Keeping it clean

Van Pype goes on to suggest some easy-to-implement do's and don'ts around turbines, which he summarises as "keeping it clean" in three key areas: the oil, the steam and the water. When analysing the major reasons for steam turbine failures, he says water carryover – when solid, liquid or vapour contaminant from a boiler gets into the turbine – comes high on the list, with entrained boiler water being the most common culprit.

"Any boiler defect that prevents the boiler from delivering superheated steam to the turbine will cause problems, as well as reduce the turbine efficiency. Water in a turbine can produce erosive effects. The turbine will generally trip if water is detected in the turbine steam but if, for whatever reason, the operations staff does not open and drain the traps when such a trip occurs – which is common because the system can often simply be restarted – then the water carryover problem will persist, turning the turbine into a washing machine," he explains.

Carryover of other contaminants in 'dirty steam' can also cause huge problems. "Many industries are installing recovery boilers, for example, using a variety of waste derived fuels that can be associated with greater contamination risks. From the turbine's perspective, it all comes down to the quality of the steam that is being pushed from the boilers. This needs to be managed via proper boiler water treatment in order to minimise silica deposits in the turbine. Furthermore, the plant operator must perform pipe steam blows and install traps and filters in order to mitigate the ingress of solid particles in the turbine, because if it gets into the steam turbine, it will have a huge impact on the life and the reliability of the system," he warns.

A Turbine rotor in a transport cradle, being prepared for delivery for a service.

Left: A turbine upper casing being lifted off during a service. Right: Turbine labyrinth bushings.

Citing one example, Van Pype relates a breakdown some six years ago. "When the ESV (emergency stop valve) strainer was opened, we found a lot of debris inside it. Using a borescope, we examined the inlet pipe and found evidence of an old gasket from some pipe repair work. Particles of this gasket were ending up in the main steam pipe and, at temperatures of 480 °C and up, they were disintegrating into tiny particles that would end up contaminating the steam entering the turbine," he informs MechChem Africa.

Oil cleanliness is another key factor. "As with all rotating machines, steam turbines use oil for various reasons: to keep the bearings cool and properly lubricated, and turbines also need jacking oil, which is used to keep the turbine and alternator perfectly aligned," he says.

"With oil being continuously circulated through the barrel of the jacking system, into the bearings and onto the rotating shafts, debris can start to accumulate that can quickly score the barrel, shaft and raceway surfaces. When this happens, these surfaces will often have to be machine reground or bearings replaced, which involves opening up the turbine and significant amounts of repair work and downtime.

"This can be avoided by routinely monitoring the oil cleanliness, replacing dirty filters and changing the oil before it starts to deteriorate," says Van Pype, adding that these machines run at anything between 3 000 and 14 000 rpm, which significantly increases dirty-oil failure risks," he adds.

Operators and the human interface

Another main reason for steam turbine failures are operational errors. He says that the failure to routinely check the ESVs after a trip is a typical example, but there are several others. "One of these is the tendency of operators to try to 'catch a turbine' following a trip. Sometimes, the operator will clear all of the errors and, if nothing else appears to be faulty, they will try to restart the turbine while it is still running down and before it gets to the barring gear speed. This is never good and can be very dangerous if the root cause of the trip has not been properly identified and can potentially damage the turbine if the tentative start-up happens when the equipment is running at its critical speed.

"Following any trip, the machine speed should always be brought down to a stop or to the barring gear speed, if applicable, which is usually around 80 rpm. Only then should the restart sequence be initiated according to the OEM manual," he advises.

Explaining the purpose of the barring gear in a steam turbine, he says that, while it is still hot, a turbine needs to be kept spinning to prevent the rotor shaft from bending down (sagging) or up (hogging). The externally driven barring gear is used to achieve this.

Preventative maintenance

"In recent years, we have found that many clients have moved away from routine and preventative maintenance, believing instead in the 'no need to fix it if it isn't broken' principle," Van Pype tells *MechChem Africa*. "I am not sure why. Maybe turbines have become a little bit too reliable, causing complacency, or perhaps it's a direct result of financial constraints and budget cuts," he says.

Increasingly, maintenance management for turbines is now being incorporated into companywide ERP systems. So the manager logs into the ERP system to check inspection schedules and, if the valve was due an inspection yesterday, he can simply tick the 'done' box based on having been there and not noticing a problem today. So the preventative side, where a technician actually goes looking for evidence of a problem, is being neglected.

If preventative maintenance is genuinely applied, however, using the full cyber-monitoring toolbox, uptime and turbine life will be significantly extended and the plant will enjoy a long, efficient and effective machine life. Reducing unplanned maintenance and improving utilisation results in much lower costs, so budget cuts to predictive maintenance programmes are a fallacy.

Zest WEG offers a full predictive maintenance service programme to help operators to get the best value from their turbine assets. "Along with all of the condition monitoring sensors we have installed in our products, we offer a long-term service programme that involves inspections, minor services and a major service, where we will open the turbine casing and clean, sandblast, repair, reassemble and rebalance the whole turbine. The service programme also includes inspection and repair of other components of the system, including the gearbox, alternator, condenser and oil unit.

Describing the proactive monitoring systems incorporated into WEG turbines, he says that the company relies on a globally renowned OEM's suite of vibration, temperature, pressure, flow and other condition monitoring sensors. "These continuously monitor and provide records of all relevant operational data, which is collected and analysed by the dedicated PLC that controls the turbine, enabling it to respond to fault conditions and alert the control room," he says.

A final key maintenance issue Van Pype raises is the importance of keeping the recommended OEM spares in stock – and keeping them in good order.

Zest WEG's steam turbine and turbine generator offering in the 30 kW to 150 MW range is ideal for the sugar and pulp and paper industries and for any process steam user that wishes to register as an IPP or to reduce its dependency on the national grid. "To get best value from these assets in the long term, however, qualified and competent people need to be appointed, empowered and financed to deliver predictive and proactive maintenance that is inherently resistant to familiarity and complacency," concludes Rudolf van Pype.

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