Wivenhoe Power Station - Sub Millimetre Turbine Maintenance

Time and space constraints make turbine maintenance at the Wivenhoe Power Station quite the challenge. But these days a Trimble DiNi digital level employed by F. R . Daniel, Huston and Associates makes measuring easier and faster, and gives better results.

"When we adjust and analyse the data, it's a much tighter data set than we ever got before."

Warren Huston, Surveyor F.R. Daniel, Huston and Associates

BENEFITS:

- *Faster - two days work reduced to five hours.*
- *Higher quality results due to less variance in observations.*
- *Shorter turbine shutdown time reduces costs for client.*
- *Improved health and safety due to less time spent in cramped, hot conditions.*

The Challenge

At 1,450 tonnes each, the hydromachines at Wivenhoe Power Station are the largest in Australasia. Each turbine and pump set is housed at the power station inside a circular concrete silo of about 32m (105 ft) internal diameter. Inside these silos, regular turbine maintenance and checks take place—with an impressive spin rate of 120 rpm, the turbines are subject to considerable wear and tear.

In particular, each turbine's thrust bearing must be checked to ensure the bearing is exactly perpendicular to the turbine's shaft. Vibration in the power station moves the bearing out of position, which is corrected by Wivenhoe engineers, who can adjust the levels using hydraulic rams. A surveyor must then verify the thrust bearing's position and shape. The job is tough due to the cramped space inside the machine's housing and the time sensitivity of achieving accuracy in between demands for power—shutting down the turbines for the survey is also very costly.

The Solution

Until recently Warren Huston of F.R.Daniel, Huston and Associates, surveyor for the Wivenhoe Power Station, measured the thrust bearing levels with a precise levelling kit comprising an etched glass scale for optical observations, and a parallel plate chronometer to achieve hi-precision leveling. This solution, a Koni Microptic Level purchased in 1985, provided accuracy that they could estimate to 10 microns. However, Huston now uses a Trimble DiNi Digital Level with an invar barcoded high-precision staff. Huston had the invar rod customised with a casing that would keep the rod stable and vertical for lowering down into the face of the thrust bearing—seven floors down inside a 4m diameter shaft.

Custom Invar Staff and Tooling Mounts

Access to inside the turbine is cramped, dark and hot.

The Trimble 0.3 DiNi instrument measures directly to 10 microns, which is more precise than the old solution. “We’re very happy with the instrument,” says Huston. “It gives excellent results. No one makes a mini staff housed as a staff for an invar, but we bought the invar tape then manufactured a custom housing we could use live.”

This custom staff uses a 'ball point' shaft to ensure a perfect interface with the machined surface of the bearing face. The face has to be wiped perfectly clean prior to measurements, even the protective oil will vary results if not cleaned prior.

Before each survey, the turbines are turned off and a waiting time of about 24 hours allows vibration in the structure to subside. Otherwise harmonic motion affects the surveying instruments. Huston then enters the bearing housing via a hatch to perform the survey—the bearing is less than 4m in diameter, so the space inside is cramped. “The ceiling is low and it’s fairly dark inside the turbine,” says Huston. “It gets pretty warm in there too sometimes.” Seated inside the housing, Huston manoeuvres the custom staff assembly to interface with the face of the bearing. “We’re dealing with basically a flat surface to within a tiny +/- 50 micron (.05 mm)".

Huston levels a series of points around and adjusts levels as he has always done—the difference now is that the Trimble 0.3 DiNi records measurements to 100th of a millimetre. He feeds the data into office software that contours the bearing surface, which shows the bearing’s tilt and undulation within the required 100th of a millimetre tolerance. The thrust bearing can tolerate 50 microns per metre tilt, so across the 4 metres of the bearing it would still operate if it was 0.3mm out vertically. However, the optimal tilt is 0.05mm.

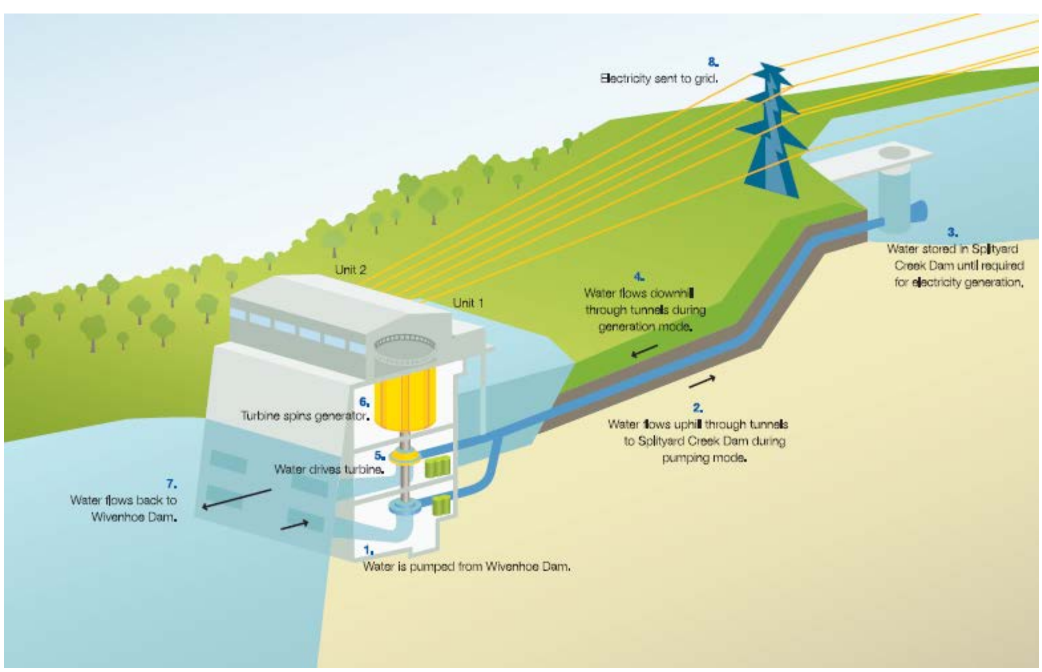
The Results

Previously, Huston’s thrust bearing surveys took two intensive days, but with the Trimble DiNi system results are achieved in just five hours—300% faster. Also, his confidence in the results is greater because of less variance in the observations. “When we adjust and analyse the data, it’s a much tighter data set than we ever got before,” he says.

"Previously it would take a few days to reduce the data, confidence that we achieved our goal was delayed. Now, we can confidently leave the turbine with results in our hand".

Huston’s next steps are to experiment with how soon they can start surveying with the Trimble DiNi after the turbines are turned off. Will the vibrations affect the Trimble DiNi as much as they did the older system? It remains to be seen, but the goal is to shorten the time the turbines are powered down in order to minimise costs—and to ensure the power station is available when the call comes through for extra energy.

To achieve 10 microns, the surface must be perfectly cleaned of oil and debris.



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