

Forward-thinking municipality uses pumps to generate electricity

A technical team serving the requirements of the Drakenstein Municipality in the Western Cape has designed one of the country's largest pump and turbine stations to be used for water reticulation to the nearby town of Paarl in dry periods, and as turbines to generate electricity for the city during the remainder of the year.

The City's engineer for water operations, Hein Henning, says the city was faced with the dilemma of having to pump water to its neighbour for just one month a year. For the rest of the year the pump station would be dormant and need hundreds of thousands of Rands maintenance due to possible corrosion, perishing, lubrication and bearing damage to the idle infrastructure.

Instead, the progressive municipality chose to innovate and rather generate an income while simultaneously reducing the requirement for maintenance by effectively allowing the pumps to run backwards against the pressure of water from its elevated Leliefontein reservoir and generate electricity for the region's electrical grid.

Generating power

The commissioning of the pump and turbine station (PaT) effectively brings online one of the largest such project of its kind in South Africa, able to generate 57 kW (all mechanical & electrical efficiencies taken into account) with 3 turbines, which is enough to power the entire region's water infrastructure of treatment plants, pumphouses, offices and other infrastructure for an entire year.

"The water comes from the City of Cape Town Wemmershoek Dam and is gravity-fed to our city regions via our main reservoir. For one month of the year during the driest month the pumps need to be switched on to pump 400 litres per second upstream to Paarl where after the pumps would usually be switched off.



Leliefontein pump and turbine station (PaT)

"However, the higher elevation of the reservoir allows us to rotate the pumps backwards to act as small turbines for the rest of the year which is able to generate electricity at more than an 80% efficiency. Unlike turbines however, the pumps are standard stock items from the supplier, KSB Pumps and Valves and does not require specialised support and servicing. What's more, the pumps are durable enough to allow us to design the infrastructure with a 40-year lifespan.

"With this long lifespan in mind, we decided to make use of KSB pumps as we already have a number of these installed throughout our municipality and are aware of their reliability, as well as long track record of support to our municipality, as well as many other municipalities and water utilities throughout South Africa," says Hein.

Upgraded pump station

Before commissioning the project, the municipality had spelled out its requirement to replace its existing 96 litre-per-second pump station with a new one and discussed the ability to generate electricity in the off season with consulting engineers, Aurecon. Having designed and planned a solution, the main contract was awarded to Hidro-Tech systems (PTY) Ltd for mechanical and electrical work.

Kiewiet Viljoen, projects director for Hidro-Tech systems (PTY) Ltd, said the primary role of the project was to develop an efficient and reliable booster pump station to ensure uninterrupted water supply to nearby Wellington. Only once that need had been fully met could the project managers consider its secondary role to generate power in off-peak season.

"We therefore knew we needed a technologically savvy and reliable service provider and approached KSB Pumps and Valves to procure three KSB ETA200-40 pumps to meet and exceed the requirements of the tender. These not only perform brilliantly as pumps, but in turbine mode have a better than 80% efficiency even considering hydraulic and electrical losses. This speaks volumes for the overall efficiency and design of the pumps," says Kiewiet.



Electrical systems integrator, Brian Cooper at the main control HMI



Kiewiet Viljoen, projects director for Hidro-Tech systems (PTY) Ltd with Drakenstein Municipality engineer for water operations, Hein Henning, at the KSB pumps that are being used as turbines in the wet season

Technology integration

Electrical systems integrator, Brian Cooper, of Hidro-Tech systems (PTY) LTD, says despite the relative simplicity of the mechanical design, it does require complex integration of controls to deal with the hydraulic force and convert the electricity generated into a useable form. This required pump speeds to be controlled via a variable speed drive to prevent overspeed as well as convert the wave produced to a pure 50hz wave form that is compatible with the city's power grid.

"Thereafter the system is designed with full PLC control which can be managed on site via Human Machine Interface (HMI) or can be accessed remotely via computer or a mobile device to give users infinite control and monitoring of the site wherever and whenever required. The industrial network also provides automated control of the entire system including controls of the three pumps, valves, level indicators, flow meters and other parameters that are critical to the systems efficient operation to either pump water or generate electricity.

"In addition to providing seamless control of the system, it also ensures redundancy in all operating conditions and provides emergency measures in the event of failures of any part of the system, including valve controls, bypassing of the system or parameter changes as required to rectify any problems incurred.

Solution provider

KSB Pumps and Valves specialist, Stefano Testi, applauded the project, saying its success paves the way for numerous similar projects throughout the Southern African region, wherever there is a reliable supply of water at a high enough elevation to drive the PaT.

"It is particularly useful in areas that would otherwise require the installation of pressure reducing valves to deal with water from high elevations, as a PaT can fulfill the same requirement while generating electricity for nearby infrastructure or communities, especially rural ones.

"KSB internationally is a leader in the supply of PaT solutions and



KSB Pumps and Valves' branches and dealer manager for South Africa, Francois Naude with regional sales manager (Sub-Sahara Africa), David Jones

we have a wide range of pumps that are suitable for this purpose. With growing pressure on the country's power generating infrastructure, it pays for local authorities, farmers and landowners with access to water to investigate the installation of PaT systems as a cost effective and reliable source of electricity that is not reliant on wind or sun to drive it," Stefano adds.

Project success

Following the commissioning of the pump station and turbines the system has begun operating at full capacity and the Drakenstein municipality has started reaping the rewards of its forward-looking water management systems.

"We are pleased with the outcome and commend everybody involved in the project for their innovation and dedication to building a system that can be used as a blueprint by other municipalities around the country and across the globe. It has been a brilliant project with lots of challenges and innovation and the end result being the delivery of a successful project. We will definitely do similar projects with this team in future," concludes Hein.

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