Water & wastewater

Power company invests in irrigation scheme

The Mid Canterbury district of New Zealand's South Island has long been recognised as the premier farming district in the country. In order to maintain its status and improve productivity, an irrigation scheme has been developed that will ultimately bring more than 17,000 lt/sec of water to more than 40,000 hectares in the region and benefit the region by NZ$100 m annually. Bryan Orchard reports from New Zealand.

The fast-growing international demand for dairy products is changing the nature of farming in the region and it is this which is exercising pressure on the requirement for an improved irrigation infrastructure.

Ensuring that water is available for irrigation all year round has involved the construction of a large pumping station adjacent to the TrustPower Highbank Station on the Rakaia River. The Highbank pumping station has initially been equipped with five KSB RDLO 500-800A w 1500 kW pumps in a four operating and one standby configuration, providing a capability to pump 4000 lt/sec up a 112 m high terrace into a penstock.

In designing the pump station to supply Barhill Chertsey Irrigation (BCI), TrustPower has planned for future expansion of the irrigation scheme and eventually eight RDLO pumps will be installed providing a capability to deliver irrigation water to more than 17,000 hectares.

The Barhill Chertsey Irrigation scheme is a joint venture between the farmers' co-operative BCI and Electricity Ashburton (the owners of the electricity supply lines), working in conjunction with the Rangitata Diversion Race (RDR) and TrustPower, the fifth-largest power generator in New Zealand. As owners of the Highbank Power Station, TrustPower also has a shareholding in the RDR as it is from this 85-mile long canal that water is extracted to operate the turbines in the power station. Initiated by the farming community in the late 1990s, it was not until 2009 that the BCI irrigation scheme took off. Commencement of the scheme followed a successful share flotation and investment from Electricity Ashburton and TrustPower.

Highbank Power station was built around 75 years ago and generates electricity during the winter months by taking water from the RDR, which is fed by the nearby Rangitata and Asburton rivers. Water is taken from the RDR into a penstock at Highbank by gravity through a 112 m drop pipeline into the power station and from there the water is discharged into the Rakaia River.

About the project

During the summer when there is insufficient water in the RDR to meet irrigation needs, the new pump station built by TrustPower transfers water from the Rakaia River into the RDR via the Highbank penstock. Pumping water up hill is not without its challenges, and one of these is the volume and pressure of the water contained in the pipeline when being pumped. In order to protect the penstock from pressure fluctuations an air-chamber has been installed adjacent to the pump station to maintain pipeline pressure within acceptable bounds.

TrustPower came up with the suggestion to pump water up the embankment into the RDR during the summer using its existing pipeline as it was recognised as being the most cost effective solution for BCI to transfer water from the Rakaia River. This also made financial sense for all the parties involved in the irrigation project as a source of income generation and optimising water resources to the benefit of the wider Canterbury community.

"When we started looking for a pump supplier for the project, what we were

TrustPower Highbank power station and new pumping station located on the Rakaia River in New Zealand's South Island.

seeking was a company that offered reliability," says Deion Campbell, General Manager Generation at TrustPower.

"KSB were able to provide engineering support and give advice on what types of pump would work and what sort of motors we would have to use. Other companies may have had a more cost effective product, but they could not offer us the support nor long term back-up. We have a limited team and lack the necessary expertise in pump technology, so we did rely on consultants and the advice provided by KSB. It was the input from KSB's engineers, along with their experience in water transportation that convinced us to install the RDLO pumps. We looked at other irrigation installations where this type of pump is in use and visited KSB's plant in Halle, German, to evaluate their design, build and manufacturing capabilities."

The KSB RDLO pump is an axially split volute case pump, providing a maximum flow of 10,000 m^3/h at pressures up to 25 Bar and a discharge head of 240 m. With a double entry volute which compensates radial forces and a double entry impeller to compensate the axial forces, the bearings only experience a minimum load.

For Highbank, each of the pumps can deliver a flow rate of 1140 l/s running at 991 rpm and develops a head of 112.5 m. The inlet pressure is 1 Bar and the available NPSH is 10 m. Theoretically, the operating life of the pump is at least 100,000 hours and with low maintenance costs and components that are resistant to abrasion and corrosion, the RDLO satisfied the criteria set out by TrustPower.

The location of the TrustPower Highbank station is somewhat remote and being at the foot of a 112 m high bank in the river valley, access to the site for construction plant was limited. Furthermore, TrustPower had to live within the confines of the existing power station infrastructure. When it came to constructing the pumping station, getting materials and pumps to site was a serious logistical challenge. And if that wasn't enough to contend with, during the construction period the area was affected by the Christchurch earthquake.

The challenges

By far the most difficult part of the 12-month construction programme was making changes to the existing penstock utilised by the power station. In order for the pumps to transfer water back up the pipeline it was necessary to install a 'T' section pipeline to the penstock at the bottom of the hill where it enters the power station. This involved cutting a section out of the penstock, making it necessary to engineer a temporary support system for the external end of the penstock and the new 'T' section being installed until all the welding work could be completed and a permanent support structure could be built.

"When you are handling several hundreds of tons of steel penstock and more than a million dollars worth of new pipeline, an imaginative and safe method of supporting both structures was required," Campbell said. "Our internal engineers came up with a solution involving several cranes and a block and chain arrangement utilising an anchor block partway down the penstock slope that would provide adequate support. Fortunately, we were able to complete this part of the job just one day before the earthquake hit. In fact the easiest part of the job was installing each of the 4760 kg pumps which were lowered into place using cranes."

"Getting water from the river was easy with regard to consents," Campbell continued. "The design issues that did need engineering consideration were building the two catchment ponds alongside the river, together with the pump station itself."

The first water intake pond required infiltration galleries to prevent fish from entering the system and a diversion route to enable them to return to the river unharmed. The second pond slows the water flow down in order to allow the glacial silt to settle down, and it is from here that the water is passed on to the adjacent pump station. The pumps are contained within a high walled structure that prevents the incursion of river water.

Demand for the water is dictated by the farmers within the BCI scheme, so when called upon to supply water the pump station has to be fully available. The business case is to run the pumps throughout the night in order to take advantage of lower power costs.

Currently, there is sufficient pump capacity to meet the maximum take up requirement of 2.8 cumecs and store water in the RDR. When the demand does eventually rise to 4.8 cumecs, a sixth pump will be installed. "The objective is to provide farmers with a good level of reliability and we are looking to provide 85% reliability for irrigation water,," Campbell added. "Trying to get above this level does, however, become financially questionable in terms of infrastructure investment."

TrustPower sees a large proportion of its growth in New Zealand coming from irrigation sector, combining power generation and pumping water. It is anticipated that a second pump station will be built at High Bank containing another six KSB RDLO pumps. TrustPower has plans to irrigate the other side of the river, which is why this additional pumping station will be required and it intends to build a large storage facility on the RDR which will also require a pump station.

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Delivering the five KSB RDLO 500-800Aw 1500Kw pumps.

Installing the pumps in the purpose-built structure which has been designed to prevent the incursion of water even in flood conditions.