Case Study

Power Generation

AUSTA Electric

Queensland drought affects power station - Flowmaster helps to engineer solution!

Today, we all take the availability of electricity for granted. The [Australian] power shortage of the ‘50s and ‘60s have long passed. In Queensland, however, the drought over the past four years has created the potential for a loss of water supply to one of our major power stations.

Prompt action by AUSTA Electric, and the use of tools such as Flowmaster, has ensured that the power supply will be maintained despite the prolonged drought. AUSTA Electric is the major electricity generation authority in Queensland. Therefore, it has a responsibility to ensure the reliable delivery of electricity. It employs about 1,400 staff and operates Power Stations which produce about 4,900 MW of power.

“There is little doubt that Flowmaster assisted significantly in the Wivenhoe to Tarong Pipeline to be accurately and safely designed in a such a short time.”

Jurgen Sprengel, Pumping Systems Engineer, AUSTA Electric

Tarong Power Station supplies about 40% of Queensland’s electricity requirements so any threat to its generating capacity is serious. Its cooling water is drawn from the Boondooma Dam, about 100 km away. Unfortunately, after four years of drought, Boondooma Dam has fallen to about 13% of its capacity. This is sufficient to supply Tarong only until December 1995.

AUSTA Electric’s Pumping Systems Engineer, Jurgen Sprengel, said the state’s electricity grid would be strained if Tarong was no longer able to

operate at full capacity. “AUSTA Electric has a responsibility to keep the lights on - losing capacity from Tarong would be totally unacceptable to the people of Queensland”, he said. It was decided to examine ways in which the supply from Boondooma Dam could be augmented. As a consequence, in September 1994, the design of a pipeline from Brisbane’s main water supply, Wivenhoe Dam, to Tarong was initiated. This 78 km pipeline was approved in February ‘95 and construction began at the end of March. The pipeline is expected to be operational by 1 November 1995. The design and construction of this pipeline faces a number of challenges including the situation of Wivenhoe Dam in the Brisbane Valley requiring water to be lifted over the Blackbutt Range. Sprengel said “The water has to be lifted 500m to the top of the range before falling 100m to Tarong Power Station”, he said.

Sprengel said the pipeline incorporated five sections. “The first is only 300m long with a lift of 35m, the second is 36km long with a lift of 100m, the third 12km with a lift of 210m, the fourth 25km long with a lift of 160m, and the fifth is a 4.5km fall toTarong”. Each stage has its own pumping station and a 2 million litre capacity storage tank to act as a buffer between stages. These intermediate storage tanks are needed to balance pump operation by providing 20 minutes supply in the event of failure of an upstream pumping unit.

The first pump station uses four submersible pumps of 150 kW each to lift water from the Wivenhoe Dam to the first balance storage. Each of the remaining pump stations incorporate two pumps with a motor power of 1.5 Mw each, resulting in a total pumping capacity over the length of the pipeline of 9.6 Mw. This provides a system flow rate of 75,000 cubic metres of water per day (approximately 40 Olympic swimming pools). Each of the pumping stations is capable of working at half its normal capacity, providing operational flexibility. The 900 mm [diameter] pipeline is all underground, using a steel tube with inner concrete liner and an external sheath of polyethylene. A 250 mm fixed cone dispersion valve is incorporated at the pipeline discharge to dissipate the energy accumulated during the drop into the storage dam at Tarong Power Station.

Flowmaster has been used to assist in the initial design phase by carrying out initial pipe and valve sizing, and component optimisation. It has also been used to carry out the initial transient analysis to simulate pump and valve operation and power failure conditions. This initial design was then submitted to an independent consultant to carry out detailed design work, including design of the surge suppression equipment such as surge towers and air valves. Pipe pressure envelopes were calculated and the worst case results were used to determine pipe wall thickness.

Once the consultant had finalised the design, Flowmaster was used to carry out a complete hydraulic analysis in order to validate it. Flowmaster simulations included a range of operating scenarios from the normal operating modes to extreme power failure conditions. Pressure envelopes, surge tower draw down, pump operation and air valve activities calculated during the Flowmaster simulations were used to further optimise the pipeline design to enhance safe and economical operation. With a system pressure of up to 3,500 kPa, the potential effect of a component failure is not only expensive but dangerous.