Water Reticulation Network – Midvaal Water Company

Industry application: Water Utility

Introduction

Midvaal Water Company is a water utility which provides service to an area of about 900 km^2, this covers residential as well as mining and industrial undertakings.

Midvaal Water Company approached M-Tech Industrial with the need to optimize their existing reticulation network. Their intention was to not only use the thermal-hydraulic model of the water reticulation network as a cost effective solution to their immediate problem areas, but also as a basis model for pump scheduling and possible future integration with their plant control system.

Overhead View of Midvaal Water Company site facilities

Challenges

The basic challenges faced by Midvaal Water Company were to determine the current status of the very old existing reticulation network in terms of flow rates, flow distribution, pressure drops and the integrated effect on pump performance in pumping stations when there is multiple end-user demand during peak and off-peak periods. Another challenge was to propose changes that could be implemented successfully in the network to reach optimal operation of pump stations during many different end-user and pipeline maintenance scenarios.

Additional requirements by the client was the detailed modeling of the effect of water hammer within the network to lower “pipe break” costs as well as the integration of new control philosophies and pump scheduling for Eskom’s demand side management program (DSM).

All the above mentioned challenges required a detailed and thorough network analysis and with the added pressures of a limited budget and the ever increasing strive to become a bigger and better water utility, the challenges faced needed to be handled efficiently and ensure first time positive results. Any

unplanned water shortages or even water cut offs to the mines due to wrong water reticulation system changes could result in costly claims from the mines.

Solution

Midvaal approached M-Tech Industrial with these challenges and required a versatile thermal hydraulic model to investigate different scenarios from a techno-economic point of view. Through accurate geometrical measurements, process data and with Flownex as a tool, a complete integrated simulation model of the Midvaal Water Company reticulation network was set up.

With the complete water reticulation network simulated in Flownex, the current status of the network was determined. Various areas of concern were identified, as well as possible future modifications to certain pipelines. Typical examples of this is the identification of pumps running at conditions far from their Best Efficiency Point (BEP), worn or damaged pumps relative to new pump performance, typical areas where pressure drop can be significantly reduced by using short lengths of larger bore pipes, etc.

The model is also used to determine the required pump sizes, pump station combinations and control methodologies during upgrading of plant infrastructure using Flownex's designer feature during steady-state solution.

Pressure fluctuations due to the water hammer effect is planned to be investigated using the transient feature of Flownex and the results plotted to determine the required minimum pipe wall thickness and/or pipe wall material to avoid pipe break costs. The best possible positions for accumulators and a change in valve closure times can then be investigated and compared.

Using the Flownex network of the Midvaal water reticulation network a basis model for pump scheduling was successfully set up.

Results

The speed, efficiency, accuracy and wide range of possibilities with Flownex ensured Midvaal Water Company a cost effective and accurate solution, saving many hours of testing and calculation. Most importantly, with a single network Flownex was able to solve all the challenges, not to mention the added bonus of a basis model for pump scheduling and any further modifications to the existing network.

From Figure 1 it can be seen that a user friendly interface allows the user to interact and customize the network and get feedback in terms of "alarms" that indicate when velocities or pressure exceed allowable limits.

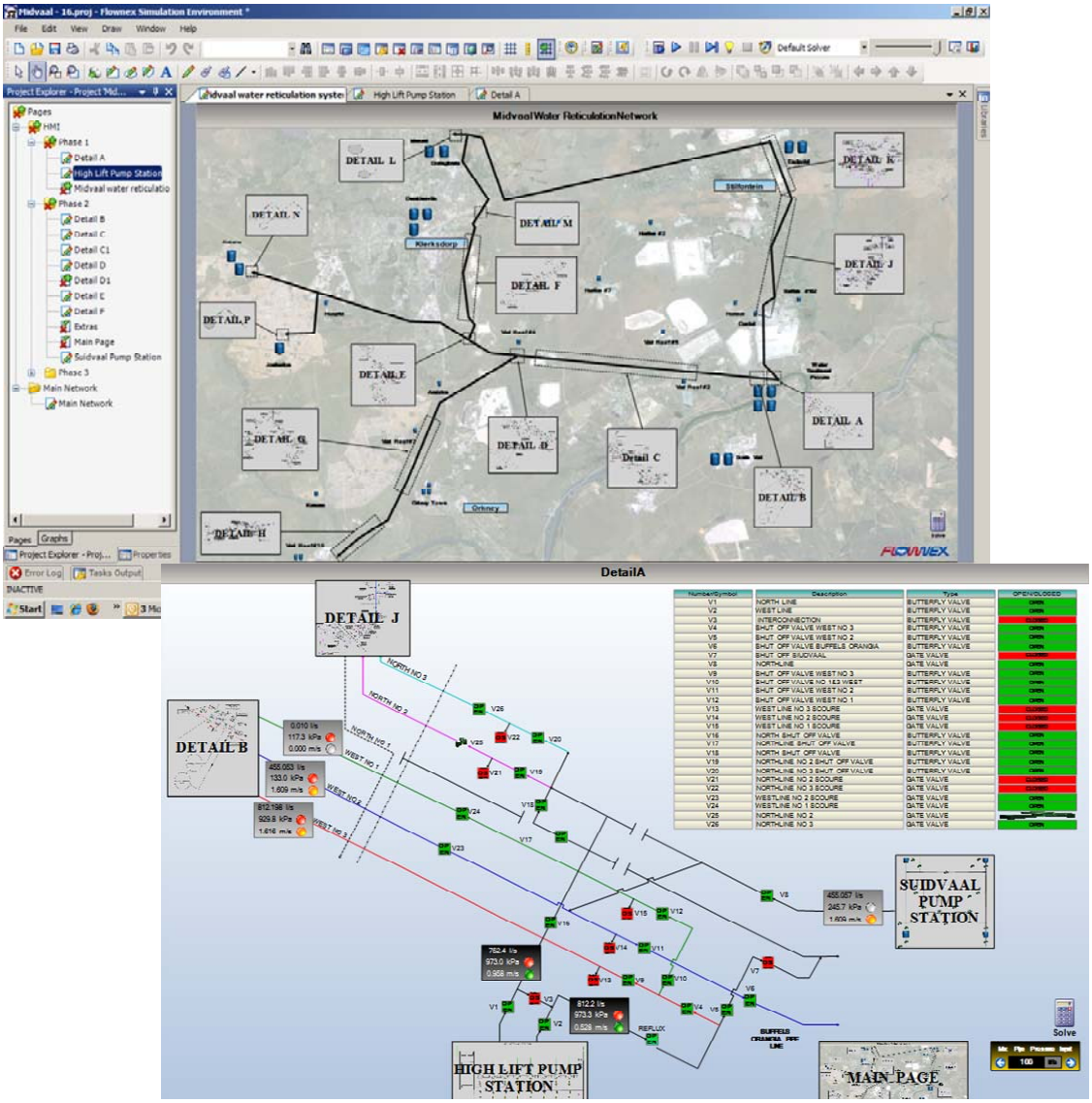

Figure 1: Flownex User Interface of Water reticulation network.

Quotes

"*Flownex gave us the ability to pinpoint areas of concerns within the vast reticulation network within seconds. The model also gave us the flexibility to model the virtual implementation of additional end-users and proposed infrastructure changes and additions*"