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Melbourne Pipe Renewal Planning

Optimization of a pipe asset management program for future demands and planned/unplanned outages

CITY WEST WATER modelers and system planners worked closely with Optimatics to optimize and update the pipe renewal program for Melbourne's Preston and North Essendon Zone.

KEY POINTS

- Outage analyses to determine critical isolation blocks
- Optimize pipe replacement/ rehabilitation costs
- Complex pipe network (~50,000 pipes)
- Distributed computing

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PROJECT OVERVIEW

City West Water has developed a pipe renewal program for the Preston and North Essendon Zone, located in Melbourne, Australia. Optimatics worked with City West Water modelers and asset management planners to optimize and update the pipe renewal program. The pipe renewal program was optimized to determine the least risk pipe replacement/abandonment solution for the lowest cost.

PROJECT AREA

The Preston and North Essendon Zone is located to the north and west of Melbourne and includes the Melbourne CBD.

The Zone supplies approximately 106,000 properties and has an estimated population of 320,000. There are a number of transfer flows through the Zone to other zones and water companies.

City West Water has undertaken condition assessment work on several of its critical distribution mains in the Zone and has identified a list of mains which require works to reduce risks associated with their potential structural failure.

PROJECT OBJECTIVES

The aim of the asset management project was to minimise the cost of the proposed pipe renewal program while ensuring that the resultant pipe network will have enough redundancy to cope with critical pipe outages.

Yarra River, Melbourne—the study area incorporated the Melbourne CBD

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The optimization determined a solution that could continue to perform adequately subject to an outage of any existing large diameter main (diameter 250 mm and above).

PROCESS

The project was undertaken in three major stages. In Stage 1, the feasibility of undertaking an outage analysis and pipe network optimization on the large pipe network (~50,000 pipes) was assessed.

In Stage 2, outage analyses were carried out using a software tool developed by Optimatics called *OptiCritical*. *OptiCritical* was first used to incorporate all known shut-off valves in the system into the hydraulic model. There were around 15,000 valves incorporated into the hydraulic model. *OptiCritical* was then used to carry out a system-wide criticality analysis (simulating breaks and isolations of every main in the network with diameter 250 mm and above) to identify the critical shut-off blocks. A shut-off block is a block of mains that are isolated when shut-off valves are closed to isolate a planned or unplanned pipe outage. The outage analyses identified approximately 600 shut-off blocks.

In Stage 3 of this work, an optimization model was formulated and run using Optimatics' water distribution design software, *Optimizer WDS*. The optimization model was formulated to replace, abandon or rehabilitate (slipline) existing pipes considered for renewal and size new pipes in new or existing alignments.

There were approximately 1,250 existing pipe sections with low to extreme risk ratings considered for renewal. The optimization model was linked to the hydraulic model so that 'solutions' proposed by the optimization could be simulated for the peak hour demand condition and the 600 outage scenarios identified in Stage 2. Hydraulic analysis results (pressures, velocities, etc.) were compared to specified system performance constraints to determine whether proposed solutions are feasible.

KEY STUDY OUTCOMES

A series of optimization runs were carried out and a list of proposed near-optimal pipe improvements developed. The total cost of proposed new pipe was estimated to be in the order of $275 million (including pipe abandonment costs).

Perhaps the most interesting aspect of the proposed pipe improvements was the large diameter mains proposed to traverse the system and connect the major sources of supply to the system adding greatly to system security. The proposed system performs adequately subject to an outage of any existing large diameter main. However this high level of redundancy requires an expensive solution and a review of the specified system performance requirements will be performed to determine if they can be relaxed slightly to achieve the best mix of system security and cost.

Optimizer WDS screen showing new pipe diameters selected by the optimization.