

CASE STUDY

Replacement Strategy for Gas Distribution System

Problem:

A large, Australian gas distributor owns and maintains 7,200 kms of distribution mains and 240 kms of transmission mains pipelines. The distribution pipes are made of different kinds of material, ranging from polyethylene to cast-iron. Cast-iron pipes currently represent about 15% of the total by length, but they account for over 50% of maintenance spending on gas mains. The cast iron pipes vary in composition and have widely varying diameters. There are two types of joints: hemp/lead and mechanical. Some factors affecting the life and behavior of the network of pipes include soil moisture and acidity, conductivity, and the presence of sulfur. Furthermore, third-party damage and poor workmanship during maintenance can also damage the joints and pipes. As joints deteriorate, they can affect the integrity of the network leading to escapes and blockages.

Phased replacement of the cast iron pipes with newer pipes is scheduled to be completed over the next 30 years. The decision when to replace a specific segment of pipe was originally based on the predicted number of failures. The gas company decided to review its current replacement plan for the pipes and joints in order to optimize its corrective maintenance versus replacement decisions to achieve minimum overall lifetime cost while meeting certain performance and safety objectives.



Analysis:

The customer provided Clockwork modelers with data based on work orders for the past 15 years. Clockwork created a system model and validated it against known results. The validation process showed that the data had to be reclassified in order to produce a failure distribution that was consistent with past behavior. That is, a further re-iteration process had to be performed.

For this analysis, life-cycle cost was defined as the total cost of maintaining the pipes before replacement, plus the cost of replacement (if performed), plus the total cost of maintaining the new pipes after replacement. To compute the cost of maintaining the pipes before and after replacement, the predicted number of pipe and joint failures on a year-to-year basis was combined with the maintenance cost data provided by the customer. For each pipe segment, the optimum replacement year was calculated so that life-cycle cost was minimized.

RESULTS:

Clockwork determined that the customer's cast-iron pipe replacement plan was too aggressive; the majority of pipe replacement could be delayed and the customer would still meet performance objectives while significantly reducing costs. A sensitivity analysis in which we widely varied the statistical parameters and the rate of return on investment (ROI) reinforced our determination. Even in the worst-case scenario, where predicted pipe failures were allowed to be unrealistically high and the ROI was set to a lower bound, our replacement recommendations were not significantly altered.

We proposed an alternative replacement program that considered the likelihood of failure, the cost of replacement, asset return, and the cost of maintenance. A prioritized pipe replacement table was constructed so that the customer could immediately take advantage of the study results in implementing the recommended pipe replacement strategy and thereby significantly reduce the outlay for pipe replacement while maintaining the necessary level of performance.

Contact:

Email: info@clockwork-solutions.com

Website: www.clockwork-solutions.com