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Risk management for maintenance of district heating networks

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Abstract

Underground infrastructure such as buried district heating pipes are difficult to inspect. The methods available to assess the status of the district heating pipes are often both expensive and do not provide enough evidence to determine the condition of the pipelines. This paper discusses how utilities systematically can work with risk assessments and risk classification to plan the maintenance and renewal of district heating networks. The results were based on interviews with a selection of Swedish district heating companies that were already using risk and vulnerability analysis as a tool for maintenance and renewal of their networks, as well as on a literature study of methods for risk and vulnerability analysis. The study showed that a rather limited number of methods were used by the selected utilities, mainly those based on risk matrices. Risk classification of pipes were carried out based on age, type and dimensions of pipes, identification of pipes to customers with greater need for security of supply, history of damages on the pipes and statistics over probability of damage for different kind of pipes, working environment and safety. Personnel involved in the management and maintenance planning of reinvestment in the district heating network emphasized that strategic work with risk management really can aid the foreseeing of coming needs for reinvestments and planning of maintenance. The study rendered in advices and a checklist for how district heating companies can start working with the area of risk management.

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1. Introduction

Underground infrastructure such as buried district heating pipes are difficult to inspect. However, the example of 23.000 kilometers of district heating pipes, with an estimated value of 12 billion euros in Sweden alone, shows that such infrastructure constitutes substantial values.

Fixed assets in the form of a distribution networks for district heating could be even more valued in the future, in networks where the network owner allows other operators to deliver thermal heat to the district heating network through a so-called third-party access (TPA). With such a procedure supply security will be even more important and thus the network condition.

The methods available to assess the status of the district heating pipes are often both expensive and do not provide enough evidence to determine the condition of the pipelines. Financial considerations speaks for keeping the pipes as long as possible, but without compromising reliability of supply, the working environment and safety for the general public and without risking damage on property. In newer pipes, moist alarm are inbuilt, which gives better possibilities to monitor the grid. For older types of pipes, however, the technique for moist alarm was not yet developed when the pipes were placed in the ground.

This paper aims at illustrating how district heating companies can plan renewal without the full knowledge of the status of the underground pipes and how the district heating industry tackle this problem by the use of risk rating and risk and vulnerability analysis.

2. Methods in study

To provide a background for risk and vulnerability assessments from a broad perspective, a literature review was conducted. The literature study focused on describing definitions of key terms and concepts, and describing different methods used for risk and vulnerability assessments in general.

Personnel from the three largest district heating utilities in Sweden (Vattenfall, E.ON and Fortum) were interviewed about their methods of using risk management for the planning of renewal and maintenance of the grid. The selection of companies to interview was done on the basis that these three had probably made the most progress in their work on risk management in the Swedish district heating industry. Interviews were made with personnel on different levels within the utilities, including persons with technical expertise of maintenance as well as persons with financial responsibilities for planning the maintenance of the district heating network.

3. Planning of renovation

Normally district heating pipes are exchanged only when there has been detection of leakage. The common procedure is that the leak is repaired urgently, and then more permanent measures are planned and budgeted. The choice of whether the whole pipeline should be replaced or not is based on a consideration of the pipe condition, the replacement cost and the impact of an additional injury [1]. Although it is a rather reactive strategy with some risks involved to only exchange pipes when leaks or other injuries have been detected, there are no economic benefits to exchange well-functioning district heating pipes prematurely. Although older district heating pipes typically have a lower degree of insulation, the reduced heat losses from replacement do not constitute a large enough financial incentive to replace lines prematurely [2].

With the current reinvestment rate in the Swedish district heating networks (as has been explored in this and other studies, see for example Sernhed et al, 2012 [3], parts of the district heating networks would reach an age of 300-800 years before exchanged. It goes without saying that the pipes do not last that long, but it is not until injury rate begins to increase that the reinvestment rate also will be increased. An explanation for the low reinvestment rate is that the district heating networks in Sweden are relatively young. The first networks were set up in the 1940s, but the greatest expansion of district heating took place in the 70s and 80s, which means that the pipes built in this period most likely has not reached its service life yet [3]. This means that most of the Swedish district heating pipes are located at the horizontal part of the bathtub curve showed in Figure 1 and hence have a low failure rate.

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