Influence of stray currents on district heating pipelines failure rate

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• 529 district and local heating and cooling networks around the world.
• Operates in 49 Polish cities: Warsaw, Łódź, Poznań and others.
• 3 core businesses: Water, Waste Management & Energy Services.

Heat-Tech Center
Research and Innovation

• R&D center for district heating of Veolia.
• 3 projects: Reliable DH, Smart Substation, Smart DH
• Laboratory for testing the quality of pre-insulated pipes
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Influence of stray currents on district heating pipelines failure rate

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Introduction

What is stray current and its influence?

• Stray current is electricity flow via ground, underground structures (for example pipelines), and buildings caused by imbalanced electrical supply.

• Stray current is generated by train and tram electricity supply systems.

• Stray current causes electrochemical corrosion, thus, it increases the corrosion rate and causes more pipelines failures.
Introduction

• Future district heating system should use preventive maintenance approach, it means to forecast failures and take actions before they happen.

• In case of stray current such an action is installation of cathodic protection.
Input data

This analyses used data from GIS (Geographical Information System) about:

• Pipelines
• Failures
• Zones of risk of stray current
Input data

Length of network: 1691km
(the biggest DHN in EU)
Lenght of duct channel network: 989km
Lenght of preinsulated network: 702km

Failures in years 2003-2012: 4616
Identified failures: 2096
Identified duct channel failures: 1803
Identified preinsulated failures: 113
Identified failures of devices: 180

Map of failures prepared by
Heat-Tech Center (Artur Pszczółkowski)
42 zones of risk of stray current
Created by tramway electrical substations.

• However, some of those zones have cathodic protection or are near it. Therefore, some types of zones should be created.
• Moreover, cathodic protection was installed moreless when the observation period started.
Methodology

In order to compare influence of stray current a failure rate indicators have to be calculated for each type of zone for traditional pipelines.

Failure rate indicator = number of failures/length of network/observation period
Methodology

Assumptions for analysis:

• Include failures of pipelines only (excluded failures of „devices” – valves, etc.)
• Include failures for traditional technology only
• Take into account zones with length larger than 3,2 km
## Results

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of failures</th>
<th>Length [km]</th>
<th>Failure rate indicator [failure/km/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>All zones</td>
<td>272</td>
<td>131.36</td>
<td>0.21</td>
</tr>
<tr>
<td>Zones without protection and longer than 3.2 km</td>
<td>231</td>
<td>98.31</td>
<td>0.23</td>
</tr>
<tr>
<td>Zones with protection or near it</td>
<td>41</td>
<td>33.05</td>
<td>0.12</td>
</tr>
<tr>
<td>Outside zones</td>
<td>1509</td>
<td>828.6</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Reduction of failures by almost 50%
Conclusions

• Stray current increases the failure rate of duct channel pipelines by 22%
• Cathodic protection can decrease a failure rate in zones with risk by 48%
• Applying cathodic protection can decrease cost of operation due lower number of failures:
  – cost of cathodic protection 5000 €
  – average cost of failure in Warsaw 6000 € (data for 2012)
Thank you for your attention.

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