Consultancy Services for the development of a hydraulic model for the district heating network in the city of Ternopil, Ukraine

Project background

Name of applicant	Ternopilmiskteplokomunenergo (TMTKE)
Project info/Project name	Consultancy Services for the development of a hydraulic model for the district heating network in the city of Ternopil, Ukraine
Contractor	AX-Process Oy
Project duration	June 2020 – November 2021
Contract value	119,469.00 €

Project summary

1 Project summary

The scope of the project was the development of a hydraulic model for selected district heating networks in the city of Ternopil.

The two key objectives of this project were: (i) to analyse the operation of the Ternopil District Heating system and prospects for its further development, including performing computer simulations and calculations for selected case studies (scenarios) for both current and future scenarios and (ii) to train the beneficiary's experts to use the software for future needs.

In this project, the Finnish software Fluidit Heat™ was used for hydraulic simulation modelling and evaluating various scenarios. One floating three-year software licence with full support was also provided. Fluidit Heat was installed and updated on three workstations.

Delivery of a portable clamp-on flow meter was also included in the project. This meter will facilitate the efficient operation of the network on an ongoing basis. The Fuji Electric FSC portable type ultrasonic flow meter was chosen for its ease of use and reliability.

2 Project conclusions

A hydraulic model for five selected networks has been developed by AX-Process Oy and analysed in cooperation with Fluidit Heat. Furthermore, an additional three networks were modelled by TMTKE with the support of the contractor during software training. This enabled an investigation into the hydraulic behaviour of Ternopil's district heating system. The analysis of the modelled scenarios included:

- evaluation of heating energy consumption data, heat supply source performance data and heat distribution losses
- development of temperature charts at heat sources (95/70, 110/70 and 130/70 C)
- review of the operation of heat sources and recommendations for their optimal operation modes, including flow, pressure, load allocation and capacity
- analysis of possible changes to the heat supply zones, pipe diameters, pressure maintenance system and optimal pumping parameters
- analysis of 'weak points' of the system
- analysis of available heating system operation
- recommendations for municipal heating system development

Modelling has allowed TMTKE to locate exact bottlenecks in the network, identify the need for and possible locations of new pumping stations and analyse whether pumping stations are needed at all, calculate new network parameters and identify new connection routes to improve efficiency and reliability.

In the future, the developed model will be used to continue network optimisation and improve investment planning concerning the DH network layout, connecting individual networks and the need for pumping capacity.

The delivered flow meter can be used for checking operation conditions on site. This information could facilitate targeted renovations in networks.

3 Impact on Human Rights and the project's Sustainable Development Goals (SDGs)

The project positively impacts human rights by supporting improvements in infrastructure and living standards, ensuring environmental sustainability and energy security and providing consumers, including vulnerable groups, access to affordable, reliable and modern energy services.

The project covers the following SDGs:

4 Project deviations

Delays in the project implementation schedule occurred due to the Covid 19 pandemic.

It was expected that the flow meter would be delivered at the beginning of the project, allowing the measured data to be used for model calibration. Unfortunately, due to Covid 19 travel restrictions, a visit to Ternopil was postponed until the end of the project so no additional measurement data could be collected.

5 Project lessons learnt

Lessons learnt

The quality and accuracy of the developed model is strongly dependent on the quality of initial data.

For this project, measured historical data for power or consumption, pressure and temperature levels was not available in a digital format as the data from the local system is recorded by hand. A number of simplifications were made as not all the initial data that is normally required was available. It was learnt that the development of a network model requires site visits at the beginning of the work.

Ukrainian DH experts were easily able to learn to use the provided software.

Benefits of the project

Currently, hydraulic calculations for DH networks are made manually, which effectively prevents analyses of different operation modes, for instance the impact of lower temperatures or interconnection of separate networks.

The hydraulic model is a very practical tool for district heating utilities that enables analysis of functionality and the need for future repairs; it allows for the creation of an unlimited number of scenarios for network functioning, changes to various operational parameters and the comparison of results to identify an optimal configuration for the network during the modernisation and renovation process.

Network hydraulic simulation software also facilitates the identification of network bottlenecks and critical consumers, network connection analyses and design work for new clients.

Fluidit Heat software provides excellent visual feedback, and results are provided via graphics and easy-to-use result and profile windows. Schematics pages can be exported as image files.

As demonstrated, the portable clamp-on flow meter is useful for the district heating company as it helps to indicate network distribution losses.

Effectiveness of the project

The project was implemented successfully and the project deliverables met targets as well as FUTF objectives to promote cooperation between Finland and Ukraine. The project results are replicable, as many Ukrainian cities have district heating utilities with heating systems that need to be modernised and optimised, thus the technological solutions used in this project could be applied to various cities in Ukraine.