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Title of the dissertation: The influence of the measuring instruments accuracy on the reliability of the leak detection and localization systems.

Abstract.

Most of the media transported by long-distance pipelines in case of leakage occurrence becomes threat to life and environment. Natural gas, oil and other liquid fuels belong to such media. Gas or liquid leakage, caused by pipelines degradation or human interference (intentional or unintentional), may cause among others contamination or economical losses. It is therefore essential to monitor natural gas transmission pipelines, during operational life and to detect and localize possible leakages.

From the user point of view, leak detection system should be able to detect leakage in shortest possible time and localize leakage with best possible accuracy. This allows to reduce time and expenses necessary for damage repair and to limit negative effects of the failure.

Many of the existing systems are based on the analytical methods. The telemetric data from the pipeline system (flow rates, pressures, temperatures) is continuously compared with the mathematical model of the system. The analysis of the differences between the model and the real pipeline (so called residua) enables to detect leaks and to localize them.

So far, there are no publications concerning the estimation of localization accuracy, which is closely connected with uncertainty of measurement equipment used in the system and uncertainty of the pipeline data (diameter, length, roughness etc.). There are also no rational principles to determine the accuracy of this equipment to ensure desired sensitivity and accuracy of the leak system detection. This issue is very complicated, because localization accuracy depends not only on mentioned above parameters but also on flow rate values in grid branches, distances between the place of leakage and points of gas supply and many other factors.

Mathematical model of the leak detection system has been elaborated, and on the basis of this model, also the methodology for determining sensitivity coefficients. Sensitivity coefficients are factors, that inform, how much given parameter influences the localization accuracy. Procedures used in metrology for uncertainty estimation in indirect measurements have been applied. Criteria for leakage alarm generation were worked out. It was determined, how accuracies of particular measuring instruments influence uncertainty of residuum. If the value of residuum is higher than uncertainty limit, the localization procedure is activated.

A numerical approach to the issue of sensitivity factors calculation was also elaborated. Mathematical model of leak detection system was implemented into software for simulation. By an appropriate modification of input data, sensitivity factors were calculated numerically.

Results of the project make it possible to asses the accuracy of the leak detection and localization system, as well as correctly match the accuracy of the measuring instruments to the required accuracy of the system.