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Nonadiabatic Condition on the Natural Gas Energy Custody Transfer Using Orifice Flow Meter

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Abstract
In practice of natural gas energy custody transfer using orifice flow meter, the result was calculated based solely on the measured pressure drop resulted by the orifice disk in the flow line. Therefore, the total energy that was delivered in custody transfer was calculated based on adiabatic condition, i.e., an ideal condition of the gas flow rate. Using the orifice flow meter in such condition has weakness on its accuracy. To improve its accuracy, the delivered energy using orifice flow meter system should be calculated by considering non-adiabatic condition, which was influenced by thermodynamic parameter such as compressibility factor (Z), internal energy (U), enthalpy (H) and other energy components. In this research, it has been shown that in non-adiabatic condition the flow rate of energy (Q) was not linear with the increasing of temperature of the environment. This research was started by constructing a mathematical model of energy flows under conditions of both adiabatic and non-adiabatic condition in an orifice flow meter measuring system. The calculated flow rate of energy (Q) in non-adiabatic condition was highly determined by the internal energy (U) and enthalpy (H). In the non-adiabatic condition, the calculated flow rate of energy was affected by environment temperature. This temperature influenced the internal energy (U) and enthalpy (H). The values of U and H in this measurement were not linear. The average of calculated flow rate of energy (Q) increases 0.67 Mmbtud by the increasing of 1 K of temperature. The difference of the flow rate of energy of the natural gas in non-adiabatic conditions (in the operational temperature of 298 K) was 5 % higher than in adiabatic condition.

Keywords
Adiabatic and non-adiabatic condition – Orifice flow meter – Natural gas – Flow rate of energy – Internal energy – Enthalpy