CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

Many petroleum and petrochemical processes ususally are not reliable and consistent with the law of conservation because of the process measurement failures. The reliability of measured data is very important for all processes, how we have to do this data satisfy the mass balance, energy balance and other physical constraints of the process. These constraints are generally disturbed because of the presence of two types of errors: random and gross errors in data measurements. Thus, this problem need to find the tools to eliminate such errors for improving the accuracy of the measured data. The method of reducing the effect of random errors is called *data reconciliation (DR)*, whereas the method for the detection of gross errors is called *gross error detection (GED)*. DR problems usually use a least-square objective function, which is derived from maximum likelihood estimation (MLE), based on the assumption that random errors follow normal distribution with zero mean and known variance (or standard deviation of estimation). The accuracy of reconciled data depends on many factors such as the number of unmeasured variable or measured variable, the number of equation, the set of historical data for statistical calculation, and the optimization algorithms, etc.

This work performed DR for heat exchanger systems consisting of a hot-oil heat exchanger and utility heat exchanger network. For both systems, the data which include flow rates, inlet and outlet temperatures of hot and cold process streams, and overall heat transfer coefficient were measured in each day for 1 year (365 values), except the system of utility heat exchanger network, the overall heat transfer coefficient for 1st heat exchanger in network was only measured, and both systems were reconciled by using a least-square objective function and nonlinear constraints of General Algebraic Modeling System (GAMS) software. DR was applied with GED method in this research, and the conventional GED and the traditonal measurement test modified by using NLP (Modified Measurement Test) was used for detecting gross errors, respectively.

When DR with GED was completed for a hot-oil heat exchanger, the estimated values can produce more accurate values of heat duty and other process

variables consistent with the constraints, showing reductions in the standard deviation when compared to case of only doing DR but some cases of the number of gross errors existing in the system, it cannot completely do the DR for this model due to the minimum number of measured variables is not enough for calculation to be more accurated, so some additional instruments must be installed in the process to gather relevant data of some streams. To obtain more accurate reconciled data, more information is needed to minimize the number of missing data. This problem can be solving by adding more equipment to measure such as more heat exchangers are added in the system and so on.

A case study with the utility heat exchanger network, when DR with GED was completed for this model, the estimated values can produce more accurate values of heat duty and other process variables consistent with the constraints, showing reductions in the standard deviation when compared to case of only doing DR as same the previous model and it can completely do the DR with GED for more number of gross error existing in the system, so the results demonstrated the capable of this approach to provide reliable and accurate results in the system which contain more equipment to measure.

From study of GED techniques, the conventional GED and the modified measurement test were studied for performance comparison. The modified mesurement test was significantly better than one from the conventional GED in terms of performance measures evaluation using overall power (OP), so the modified measurement test can be used for all cases which gross errors exist well.

So, when GED techniques were applied with DR techniques, the process measurement will be more accurated and we can calculate the energy consumption correctly from these precise measurements.