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Extended Abstract

Identification of fault patterns in turbine meters of the statistical analysis by means of the statistical analysis of the pulse ratio

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1 INTRODUCTION

This research is focused on a flow measurement system that uses a turbine flow meter as a primary element, in normal operation conditions turbine flow meter frequently present interrupts and causes can not be detected in a timely manner. Flow volumes losses not established during a period of failure , normally they are reconciled between the seller and his client through agreements that sometimes do not satisfy one of the parties; in such a situation both parties require valid methods to apply for all failure events.

The objective is to present a failure detection method by means of pulse registers generated by the turbine meters. in the first instance, the moment in which the failure occurs is determined secondly an estimated volume of the unaccounted period is determined.

Measurement system used in this research is composed of three measuring train of ten inches installed in parallel. Each flow element is calibrated yearly.

2 DEVELOPMENT OF THE METHOD .

Based on the historical records of failure events between meters, it was found that the occurrence is greater for a single meter, when all three meters operate simultaneously, therefore the failure scenario of two meters simultaneously is excluded. The use of the turbine pulse ratio is then established as valid for the monitoring of atypical variations caused by faults, [1] knowing that at least two of three of the data are true. The pulse relation methodology consists of dividing the pulse registers among their counterparts to rule out the effects of the process that are replicated in the three trains. Equation (1). What causes the observed relationships to be seen as continuous lines.

$$A_{Pulse\ Ratio} = \frac{Turbine\ Pulse\ 1}{Turbine\ Pulse\ 2}\ , B_{Pulse\ Ratio} = \frac{Turbine\ Pulse\ 2}{Turbine\ Pulse\ 3}, C_{Pulse\ Ratio} = \frac{Turbine\ Pulse\ 3}{Turbine\ Pulse\ 1} \quad (1)$$

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$$\left[\frac{\sum_1^n A_{PR-n}}{n}\right][100\% - 1\%] \leq A_{PRO} \leq \left[\frac{\sum_1^n A_{PR-n}}{n}\right][100\% + 1\%]$$
$$\left[\frac{\sum_1^n B_{PR-n}}{n}\right][100\% - 1\%] \leq B_{PRO} \leq \left[\frac{\sum_1^n B_{PR-n}}{n}\right][100\% + 1\%]$$
$$\left[\frac{\sum_1^n C_{PR-n}}{n}\right][100\% - 1\%] \leq C_{PRO} \leq \left[\frac{\sum_1^n C_{PR-n}}{n}\right][100\% + 1\%] \quad (2)$$

2.1 Fault patterns detected

It is defined as a normal condition when the pulse ratio does not exceed the variation of ± 1%, equation (2). This condition is the control mechanism to establish the existence of an atypical variation not premeditated. This description is represented in the sequence of figure 1.

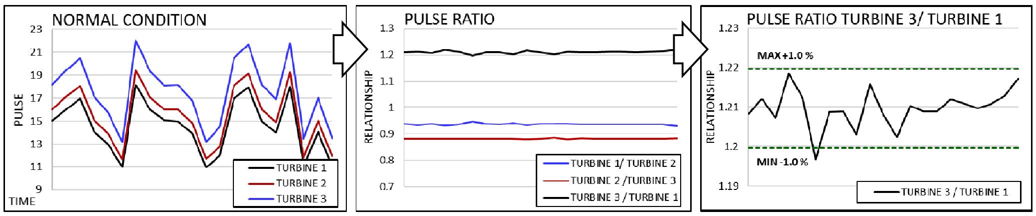
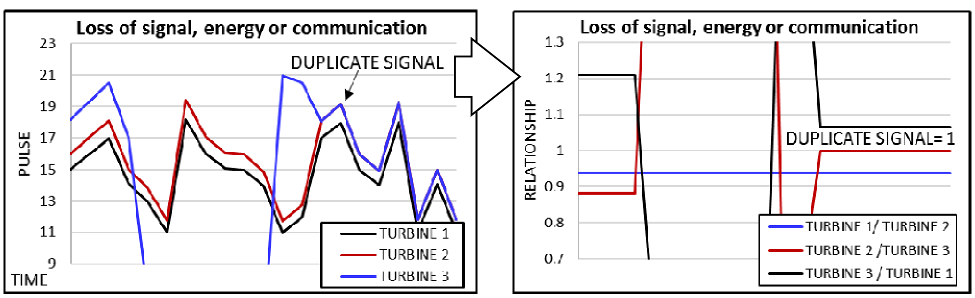


Fig. 1 – Normal condition with limits of variation of ±1%.

This method allows to observe the beginning of a failure immediately, when differences that exceed the limit agreed by the interested parties of 1% are presented, because the response of the pulse ratio is much more susceptible to this variation.

The most common faults detected in these measurement systems are related to the obstruction of the filters located at the entrance of the trains, followed by the loss of power or communication signal, and finally the least recurrent failure in the PICK OFF. Each indicated behavior is identified in the graphs of figure 2.



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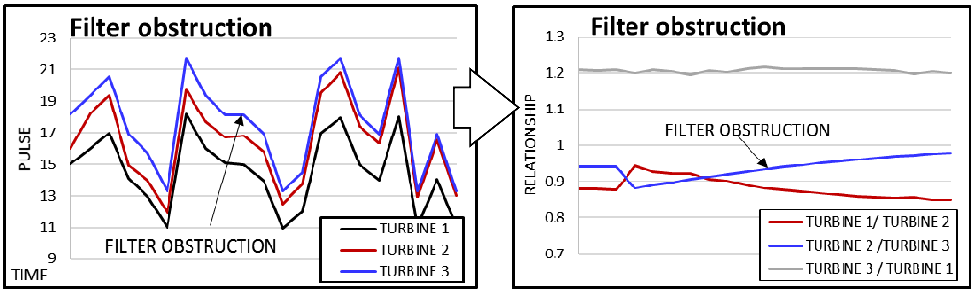

Fig. 2 – Recurring failures

Filter clogging is shown as curves upward or downward, and the fault for the train that share data relationships is determined.

2.2 Pulse estimation of the failure period and determination of the volume

In order to exemplify the method used for the estimation of unregistered pulses, the tendency originated by the ratio of two flow meters in the period prior to the fault is identified, for which the relations of the FE-01 turbines were plotted. / FE-02, FE-02 / FE-03 and FE-03 / FE-01. The graph allows to predict the trend to follow when the FE-01 meter goes out of operation. [2]

Within the graph of the relationship of pulses trends are identified, with the data of the period before and after the failure, it is observed that the behavior normally corresponds to a linear function, therefore it is possible to determine the missing section by means of linear regression, using the ratio of the meters that remained in operation. This methodology is shown in figure 3.

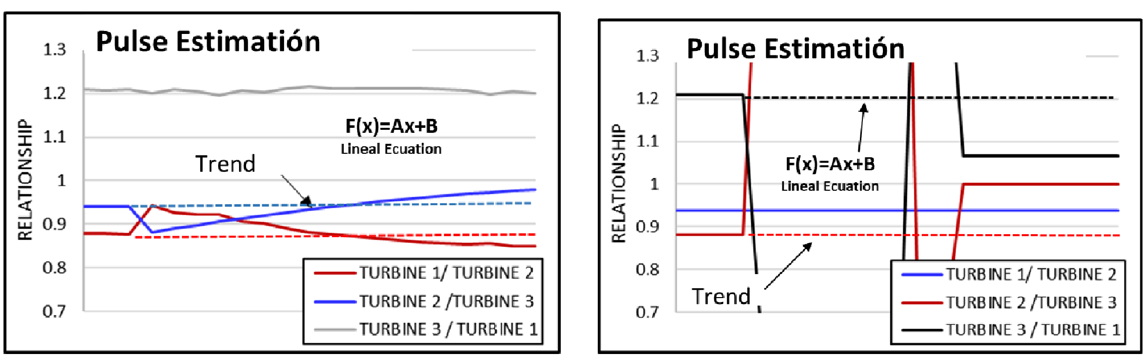

Fig.3– Estimation of pulses through trend.

Once the function is known, it is used to determine the unmeasured pulses, which allows the calculation of the corrected volume for the current of the meter that presented the fault by means of the K factor and the other variables involved.

3 RESULTS

The methodology applied based on the data relationship allowed to recognize the patterns that correspond to the faults that typically occur in a measurement system with turbine type flow meters. Also perform control mechanisms for fault detection and estimate corrections loss of pulses upon variation of ± 1%.

4 REFERENCES

[1] ISO 9000 (2000). Quality management systems - Fundamentals and vocabulary.

[2] NMX-Z-055-IMNC. (2009). ISO/IEC Guide 99. (2007). (s.f.). International Metrology Vocabulary - fundamental and general concepts and associated terms (VIM).