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IMPROVEMENTS IN THE ENERGY METERS CALIBRATION PROCESS IN ELETROBRAS ELETRONORTE

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Abstract – The measurement of electrical energy is very important for Eletrobras Eletronorte, as this is their main product offered to its customers. This paper aims to implement improvements in the calibration process of this electricity meters used in measuring systems. These improvements presented achieve greater reliability in the calibration process, greater availability of measurement standards in the laboratory and the reduction of meter calibration time. This paper presents strategies to improve the calibration process of these meters, with results that characterize the effectiveness of the proposed improvements provided benefits related to quality of service and reducing the cost of calibration of the meters.

Keywords: calibration, energy meters, energy measurement systems.

1. INTRODUCTION

The amount of energy sold by Eletrobras Eletronorte is very high, so it's extremely important to control and supervision of the energy that is delivered to the distribution concessionaires, besides the electricity sold directly to large consumers.

The energy meters are instruments that allow the measurement of energy which effectively is being transmitted or generated. Therefore, the reliability of these instruments is essential. The National Electric System Operator (ONS) through the Grid Procedures - Submódulo 12.3 and 12.5, provides maintenance procedures and inspection of Energy Measurement Systems, and the responsibilities, the stages and deadlines for its implementation; and assigns responsibilities for certification standards and establishes the necessary activities to the orientation of the agents responsible for the maintenance of the measurement system with regard to the guarantee of traceability and calibration of their work patterns in reference to INMETRO standards or RBC (Brazilian Calibration Laboratories Network).

2. METHODOLOGY

In the calibration procedures used in the Laboratory of Technology Center of Eletrobras Eletronorte the period between readings adopted in the energy calibration process is 50 seconds. To improve the power meter calibration process, it was carried out a comparative study in order to verify the possibility of decreasing the period between readings. We also need to optimize the uptime of the reference standard in the laboratory. Currently the reference standard is calibrated annually and the cost of this calibration is increasingly high. To improve the time the standard is in the laboratory was made a study of temporal stability in order to improve their availability.

3. OBJECTIVES

This work has as main objective to promote improvements in the energy meter calibration process, improving the quality and reliability of the results, through the implementation of two proposals, they are:

1. Decrease the period between calibration readings;

2. Analysis of temporal performance (drift) of the reference standard.

4. RESULTS

After performing calibrations with different periods in the following table was filled and the *En* (Normalized Error) error was analyzed. The Figure 1 shows the comparison between different calibration periods in just one calibration point (Voltage 115V, current 5 A and power factor 1)

V	A	Tempo (s)	Leituras no Padrão (%)					Erro médio corrigi. (%)	Incerteza Expan. (± %)	En
			Leitura 1	Leitura 2	3	4	5			
115	5	50	-0,0264	-0,0271	...	...	...	-0,025	0,015	-----
		30	-0,0200	-0,0182	...	...	...	-0,018	0,015	0,33
		15	-0,0289	-0,0272	...	...	...	-0,026	0,015	0,05
		10	-0,0331	-0,0135	...	...	...	-0,026	0,017	0,31

Figure1: Normalized Error Table.

Normalized error, has the objective to normalize the mean corrected error of the tested periods (30s, 15s and 10s) compared to the reference period (50s), the standard error is satisfactory when less than or equal to 1.

$$En = \left| \frac{e_1 - e_0}{\sqrt{U_1^{\,2} + U_0^{\,2}}} \right|$$

e_0, U_0 - Error and the expanded uncertainty of the reading period tested, respectively.

e_1, U_1 - Error and the expanded uncertainty of the reference period, respectively.

The study of the temporal stability (drift) of the reference standard allows verifying the behavior over time. The observed characteristics are calibration error and the expanded uncertainty. The reference standard was calibrated in the years 2011, 2012, 2013 and 2014 and this calibration results were compared. Data from certificates were arranged in a spreadsheet and then calculated the change in error over the calibration intervals, obtained by the equation:

$$Drift = Error(year + 1) - Error(year)$$

In Figure 2 temporal drift values less than 0.0050% are highlighted in green and values less than 0.0100% are highlighted in yellow.

			2011		2012			2013
V	A	Cos Ø	Erro(%)	Deriva(%)	Erro(%)	Deriva(%)	Deriva 2011-13	Erro(%)
120	5	1	0,0007	0,0010	0,0017	-0,0005	0,0015	0,0012
		0,5i	0,002	-0,0020	0,000	0,0030	0,0050	0,003
		0,8c	-0,0001	-0,0028	-0,0029	0,0036	0,0064	0,0007
	0,5	1	-0,0004	0,0000	-0,0004	0,0008	0,0008	0,0004
	0,05	0,5i	-0,001	-0,0010	-0,002	0,0010	0,0020	-0,001
	50	1	0,0006	-0,0040	-0,0034	0,0022	0,0062	-0,0012
		0,8c	0,0004	-0,0010	-0,0006	-0,0025	0,0035	-0,0031
	120	1	0,0010	-0,0035	-0,0025	0,0024	0,0059	-0,0001
240	0,5	1	0,0008	-0,0036	-0,0028	0,0029	0,0065	0,0001
	5	0,5i	0,001	-0,0010	0,000	0,0020	0,0030	0,002
	50	0,8c	-0,0001	-0,0016	-0,0017	-0,0017	0,0033	-0,0034
	120	1	0,0008	-0,0029	-0,0021	0,0014	0,0043	-0,0007

Figure 2: Reference standard Drift

5. CONCLUSION

It is very important to look more and more alternatives that provide the improvement of energy meter calibrations. In this sense, the results obtained with the proposed improvements in energy meters calibration are extremely relevant, given that, as presented, provide time and cost savings, while increasing the reliability of the measurements, directly influencing the quality of calibration services offered by Laboratory of Technology Center of Eletrobras Eletronorte.

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