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The establishment of power/energy standard at China Electric Power Research Institute and its comparison with NRC

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$$UI_x = \frac{1}{N_x} \left(\frac{N_r U^2}{R} \pm jN_c U^2 \omega C \right) \quad (1)$$

Thus, the in-phase and quadrature components of the current, and hence the test condition, are set by the turns N_r , N_c , and N_x .

The ac voltage source that provides the test voltage has a short-term stability of better than 1 $\mu\text{V/V}$. The DC voltage standard used in the CCBPB calibration system for setting up the appropriate test ac voltage through an ac/dc thermal transfer standard is traceable to the dc voltage primary standard maintained at CEPRI. During calibration, the ac test voltage in conjunction with a capacitive voltage divider is continuously compared to the dc reference through the ac-dc transfer standard. The dc voltage source has a short-term stability of 0.2 $\mu\text{V/V}$, while the ac-dc difference of the ac/dc transfer standard is less than 4 $\mu\text{V/V}$. Further detailed explanation of the CCBPB calibration system at CEPRI, including sources of error and uncertainty analysis will be presented and discussed.

Comparison with NRC

The comparison was implemented using a commercial time-division multiplier power converter as a transfer standard which belongs to CEPRI. The stability of the transfer standard has been monitored for more than 10 years at CEPRI. The comparison calibration was done at 50 Hz, 100 V, 5 A, at power factors of 1.0, 0.5 lead (C) and 0.5 lag (L). The transfer standard was calibrated at NRC in October 2009, and then calibrated at CEPRI in November 2009. The calibration results obtained by the two laboratories and their differences are shown in Table 1.

Range	Applied condition Test	PF	CEPRI ($\mu\text{W/VA}$)	NRC ($\mu\text{W/VA}$)	CEPRI - NRC ($\mu\text{W/VA}$)
120 V 5A	100V 5A	1.0	4	-4	8
		0.5 L	-21	-12	-9
		0.5 C	27	12	15

Table 1. Calibration results at CEPRI and NRC

Considering that at CEPRI the estimated uncertainty ($k=2$) of the CCBPB calibration system is less than 25 $\mu\text{W/VA}$ and that at NRC is less than 10 $\mu\text{W/VA}$ (improved since [1] was published in 1983), the differences of not more than 15 $\mu\text{W/VA}$ between the two calibration systems at CEPRI and NRC indicated good agreement within the uncertainty of measurements, and that there are no significant differences between the CCBPB calibration systems at both laboratories.

Conclusions

The comparison results with NRC indicated good agreement and confirmed the good performance characteristics of the CCBPB calibration systems at CEPRI. Further improvement in the system estimated uncertainty to achieve lower than 20 $\mu\text{W/VA}$ will continue. Also, further investigations to expand other system calibration functions to facilitate the calibrations of reactive power meters will proceed. Expanding the CCBPB calibration system capabilities would enhance the calibration ability of CEPRI on active/reactive power and energy meters.

Acknowledgement

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References

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