

Capacitive Voltage Transformer (CVT) – Commissioning Test

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Outline

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IT Check – Market Rule Reference

- Ch. 6, Section 1.4.1 of Appendix 6.3 states:

The testing of currents and voltages applied to a *meter*, supported by independent confirmation of primary current and voltage, shall be used to test the correct operation of all *instrument transformers*.

- Ch. 6, Section 1.4.3 of Appendix 6.3 states:

Each *metering service provider* shall conduct the procedure referred to in section 1.4.1 in respect of each *metering installation* for which it acts as a *metering service provider* at the commissioning of any new *metering installation* and for all existing *metering installations* at the earliest of the following:

- as per the *instrument transformer's* manufacturer's recommended maintenance schedule;
- when the IESO has evidence that the *instrument transformer's* accuracy has been compromised; and
- in any event, no less than once in six years.

Commissioning – Market Manual Requirements

- Appendix B of Part 3.2 of Market Manual 3 – Meter Point Registration and Maintenance provides requirements for carrying out the commissioning of a *metering installation*, including:
 - Visual Check
 - Meters
 - Instrument Transformer Checks
 - Cross Phase Test
 - Secondary Wiring
 - Instrument Transformer
 - Time Synchronization
 - Communication Test

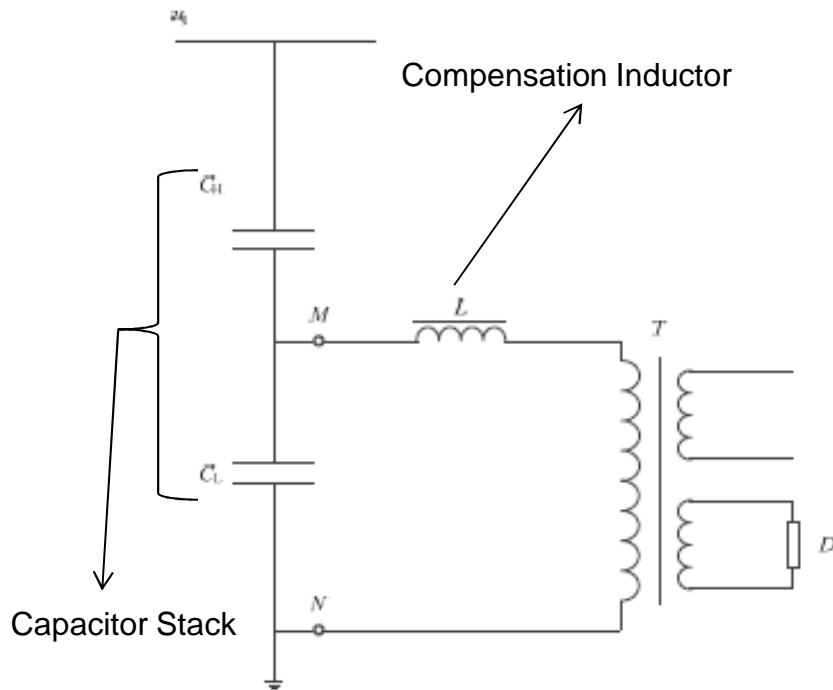


Capacitive Voltage Transformers (CVT)

- IESO has seen an increase in the use of CVT units in various meter installations across Ontario, particularly due to HV metering of renewable generation.
- With the increased use of CVTs, there is a concern for the accuracy of data being recorded. Research shows:
 - Measurement errors of a CVT are relevant to its equivalent parameters
 - Fluctuation in the equivalent parameters lead to measurement errors
 - Equivalent Capacitance affects magnitude error while dielectric loss mainly affects phase error



Capacitive Voltage Transformers (CVT)



Structure of capacitive voltage transformer (CVT).

- CVT ratio is determined by the capacitor divider and the intermediate transformer ratios.
- Compensation reactor is used to compensate the equivalent capacitance of the capacitor voltage divider.
- Parameters of a capacitor divider change more significantly compared to the electro magnetic unit in daily operations.

Measurement Error Estimation

- Insulation parameters fluctuation of the CVT's capacitive divider can contribute to a fairly larger measurement error.
 - As capacitance changes by 0.2%, magnitude error can reach -0.2%
 - As dielectric loss factor changes 0.2%, phase error can reach 5' (~0.0833°).
- An increase of equivalent capacitance and dielectric loss factor will cause:
 - Positive Real Power Measurement Error in a High-voltage Capacitor
 - Negative Real Power Measurement Error in a Low-voltage Capacitor

Source: <https://www.mdpi.com/1996-1073/10/3/357/pdf-vor> (Measurement Error Estimation for Capacitance Voltage Transformer by Insulation parameters)

Commissioning Requirements - CVTs

- Pursuant to Chapter 6 of Market Rules, Section 1.4.3 Appendix 6.3, *Metering Service Provider* is required to conduct the testing of currents and voltages to a meter as per the IT manufacturer's recommended maintenance schedule
- IESO consulted TRENCH – a global CVT manufacturer – on their recommended commissioning requirements for a CVT



Commissioning Requirements – CVTs (cont`d)

- At the time of commissioning the following tests should be conducted
 - Protective Gap Check
 - This can be done by testing the unit for sparkover voltage
 - Transformation Ratio Test
 - This can be done by using the Doble Test equipment
 - Power Factor Test
 - This can be done by conducting Dissipation Factor (DF) test of the Unit
 - Capacitance Test
 - This can be done by using Low Voltage Capacitance Bridge
 - IT Spot Check
- For regular maintenance program, following checks should be performed
 - Chipped Porcelain
 - Abnormal Pollution Accumulation
 - Oil Leaks

Commissioning Requirements – CVTs (cont` d)

- At the time of commissioning, record nameplate values for the CVT particularly the capacitance value. Compare this value to the capacitance test results. 2% variance is acceptable
- Protective Gap check needs to be conducted annually
- All other tests should be conducted once every six years*
- It is recommended, by the manufacturer, to record initial test readings when the unit is being commissioned and used these reading as basis for comparison with subsequent measurements made with the same test equipment

* This frequency is consistent with spot checks required for other instrument transformers.

Note: These tests can be found in the Instruction Manual for CCVT and CC produced by TRENCH

Next Steps

- A Policy section will be included in the revised Wholesale Revenue Metering Standard – Hardware which will outline these manufacturer recommendations for CVT commissioning by TRENCH.



Questions

