

Optical Instrument Transformers

Revenue Metering Sub-Committee Meeting

March 8, 2006

Dave Wilkinson



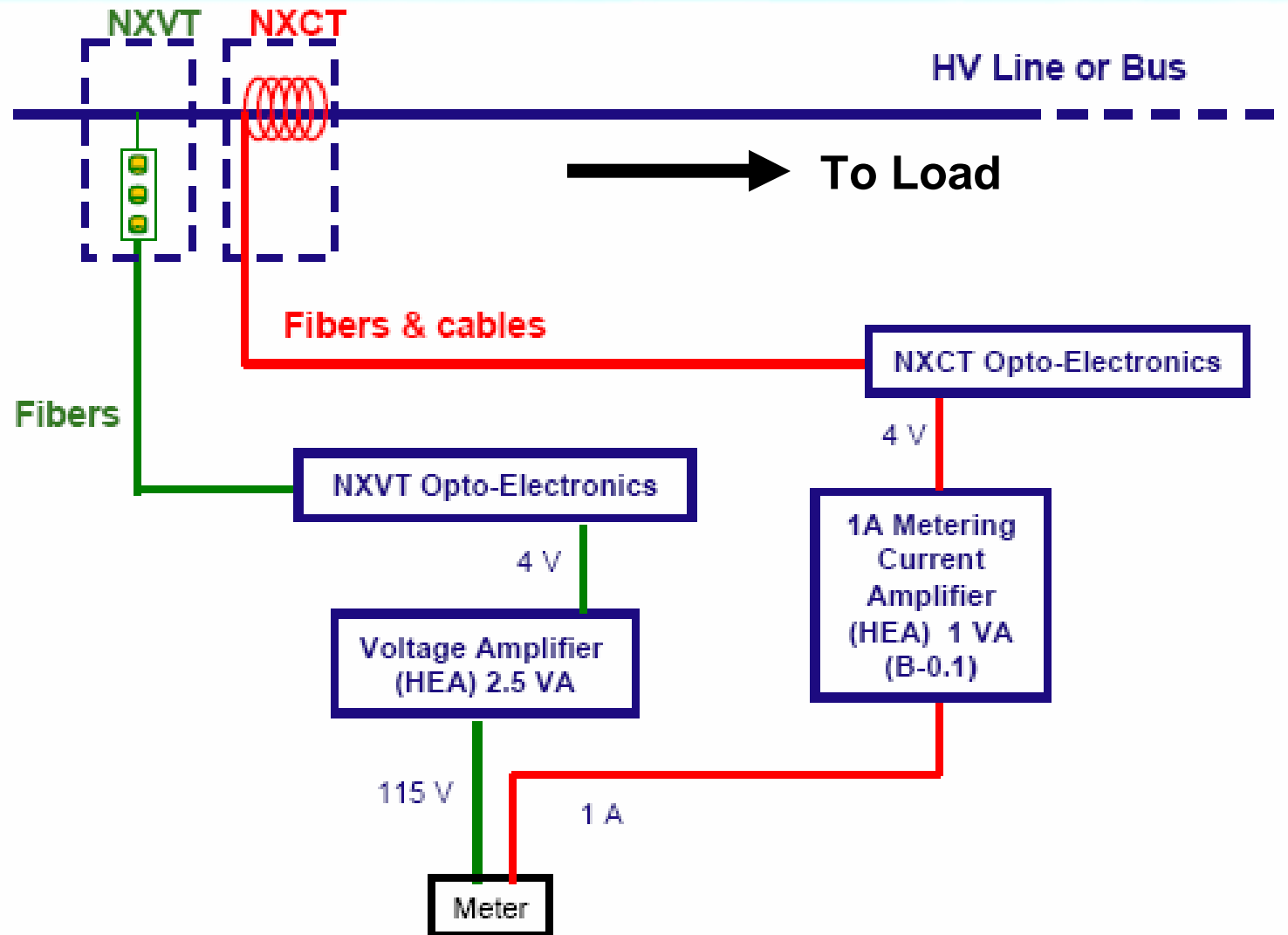
- q What are Optical Instrument Transformers?**
- q Where do Optical Instrument Transformers “fit” in the Ontario Wholesale Electricity Market?**

q IEEE Draft Standard P1601/D04

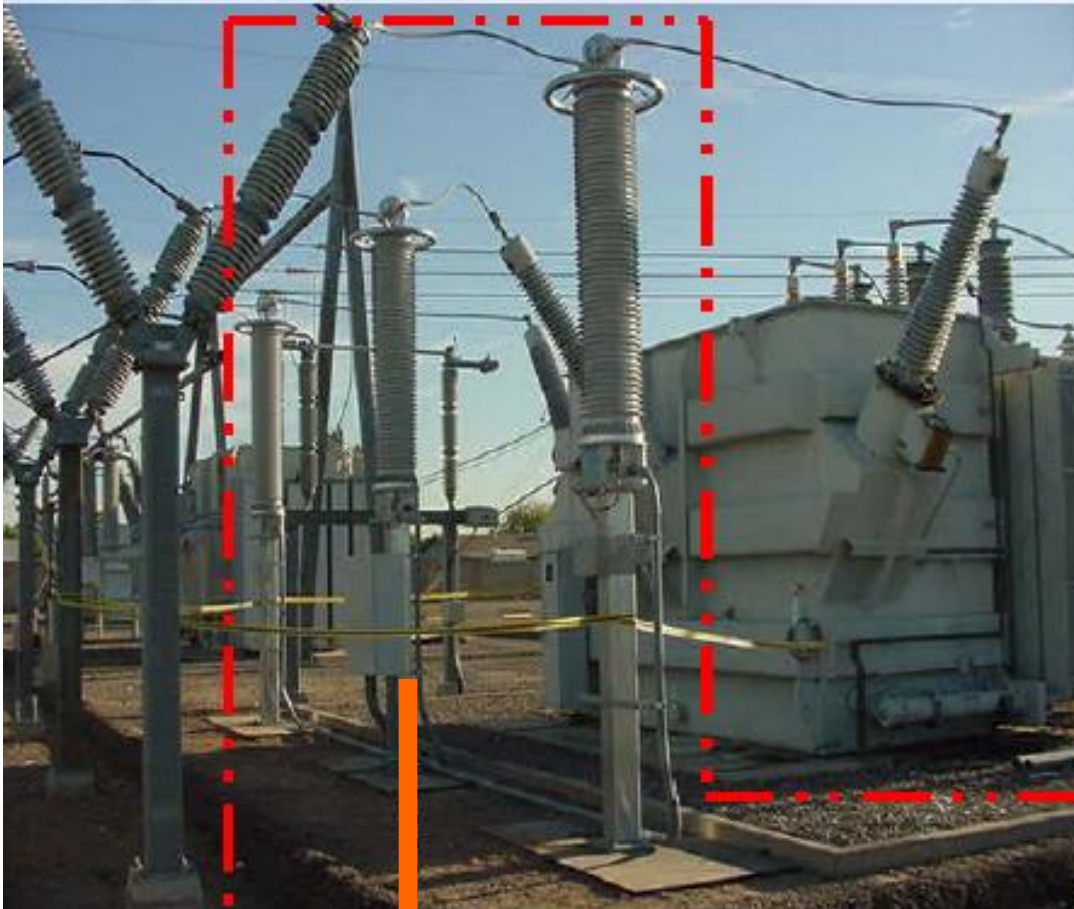
“Standard Requirements for Optical Voltage and Current Sensor Systems”

- A voltage or current sensor system using an optical effect for measuring voltage or current. The optical sensor system typically consists of three major parts:
 - ü Optical Transformers: These are high-voltage structures containing the optical sensing heads and line-to-ground insulation, typically mounted in the substation yard.
 - ü Sensor Electronics: This is an electronics or opto-electronics system responsible to communicate with the optical sensing heads, interpret the measurement, and convert it to a useful physical form for interface to secondary devices such as relays and energy meters.
 - ü Cabling System: This includes fiber-optic (and optionally electrical) cabling system connecting Optical Transformers to Sensor Electronics.

Conceptual Operation of Optical Instrument Transformers Installation



The Pieces



Control Room



Fiber-optic Cabling

Optical Instrument Transformers – Combined CT and VT



- q **Optical Instrument transformers have been developed over the past 10 years**
- q **Original specifications developed to meet IEC 0.2S standards**
 - **0.2% Accuracy class, S for “Special Application”**
 - **Global market for inter tie metering systems**
 - **Use of 1 Amp nominal meter currents**
- q **Commercial application of this technology for revenue metering and protection is now in use in Europe, UK, USA, South America, and in Quebec**

q High accuracy over wide dynamic range

- **Conforms to IEC 0.2S and ANSI/IEEE 0.15S**
- **User programmable ratios**

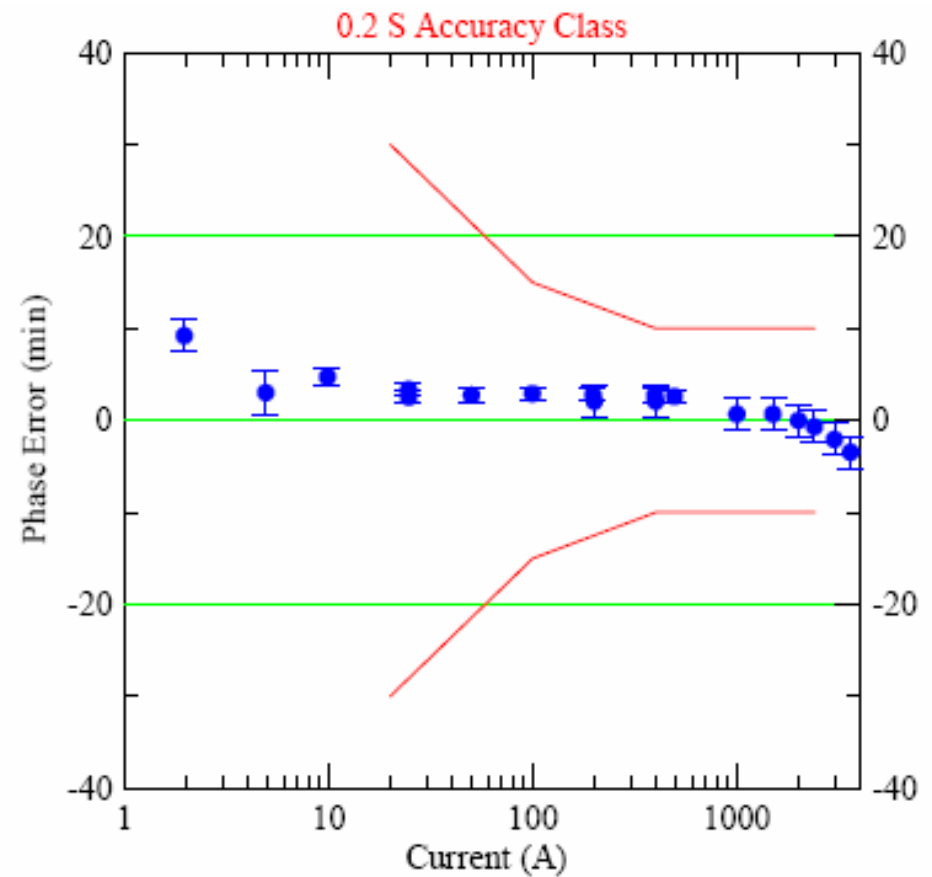
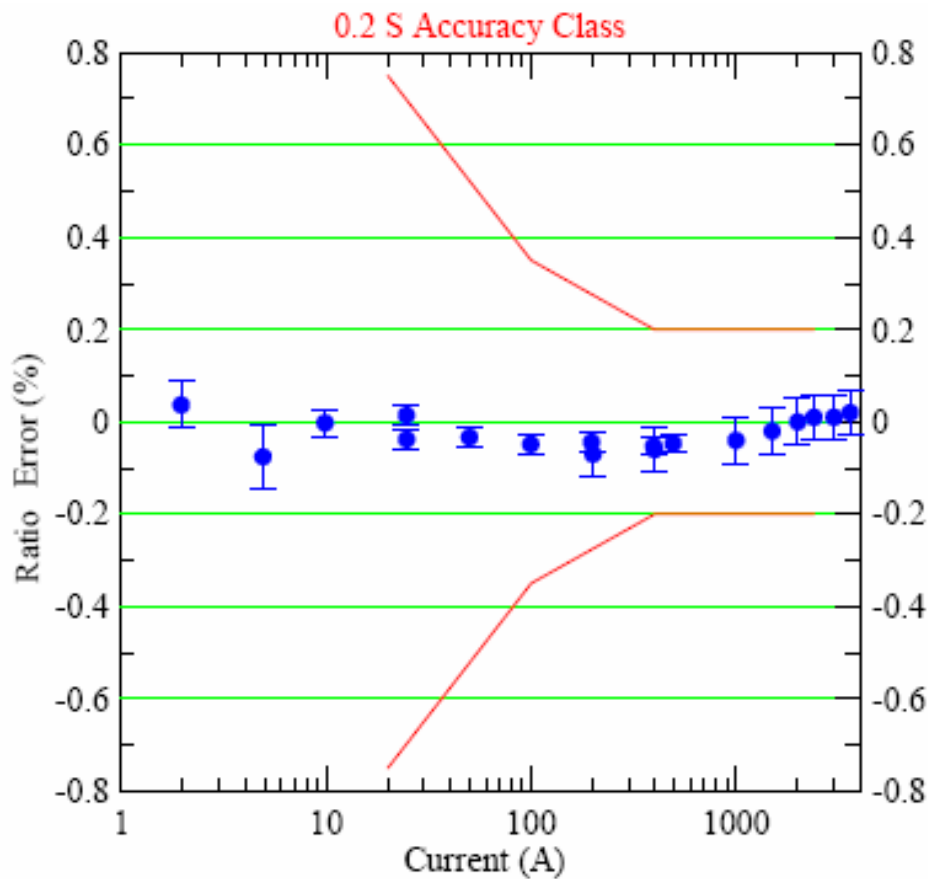
q Electrical isolation between power circuit and metering circuit via fibre optic components

- **Smaller “package” allows for use in constrained spaces**
- **Weight is 10% of conventional Instrument Transformers**

Comparison of IEC and ANSI CT Accuracy Standards

Standard	+/- Percentage Current (Ratio) Error at Percentage of Rated Current Shown Below						Rating Factor
	1%	5%	10%	20%	100%	120%	
IEC 0.2S	0.75	0.35		0.2	0.2	0.2	
ANSI 0.15S	0.3* (proposed)	0.15			0.15		0.15
ANSI 0.15		0.3			0.15		0.15
ANSI 0.3			0.6		0.3		0.3
ANSI 0.6			1.2		0.6		0.6

Optical Current Transformer – Linear Accuracy Over Wide Dynamic Range



q Existing IEC Standards

- **60044-7 Instrument Transformers – Part 7:
Electronics Voltage Transformers**
- **60044-8 Instrument Transformers – Part 8:
Electronics Current Transformers**

q New CAN/CSA Standards scheduled for publication in Q3 2006

- **CAN/CSA-C60044-7 Instrument Transformers – Part 7:
Electronics Voltage Transformers**
- **CAN/CSA-C60044-8 Instrument Transformers – Part 8:
Electronics Current Transformers**

q NxtPhase has been working with Measurement Canada to secure approval for this technology for revenue metering in Canada since 2000



Provisional Specifications

Category: ELECTRICITY	Specification: PS-E-13	Page: 1 of 5
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	Supersedes:	

Provisional Specifications for the Approval of Electronic Current Transformers

1.0 Scope

This specification applies to electronic current transformers which are intended to be used in revenue metering.

2.0 Authority

This specification is issued pursuant to subsection 12 (1) of the *Electricity and Gas Inspection Regulations*.

q IESO Market Rule 4.1.1.3 states:

4.1.1.3 have *instrument transformers* whose current transformers and voltage transformers meet or exceed the 0.3% accuracy class of ANSI standard C57.13;

q Wholesale Revenue Metering Standard – Hardware 6.10.1 and 6.10.2 states:

6.10.1 Current Transformers

Current transformers shall conform to the ANSI C57.13 (latest revision) for 0.3 metering accuracy class or the Canadian Standards Association CAN 3-C13-M83 for 0.3 metering accuracy class.

6.10.2 Voltage Transformers

Voltage transformers shall conform to the ANSI C57.13 (latest revision) for 0.3 metering accuracy class or the Canadian Standards Association CAN 3-C13-M83 for 0.3 metering accuracy class.

q ANSI Standard C57.13

- Currently does not reference optical instrument transformers

q Project designers and MSPs have contacted IESO's Wholesale Metering Group

- Interest in being able to use optical Instrument Transformers for new Ontario wholesale metering installations
- Benefits include
 - ü Accuracy over wide dynamic range
 - ü Reduced space requirements
 - ü Improved site safety

q MC approval process

q Implications for Wholesale Revenue Metering Standard – Hardware

- Non ANSI 57.13 Instrument Transformers
- Development of commissioning procedures for electronic instrument transformers
 - ü Ratio control given programmable features
 - ü Security seal issues
- Conforming Meter issues
 - ü Impact of 1 A vs. 5 A meter
 - ü Meter accuracy issues given 1 A maximum operating current
 - ü Existing definition of “MC Test Points” based on 5 A meter
 - ü Minimum pulse resolution references +/- 0.05% of full load kW
 - May require use of specific subset of conforming meters with Optical Instrument transformers

q Implications for Wholesale Revenue Metering Standard – Hardware

- **Instrument Transformer Ratio Specification**
 - ü Primary Tap – 10% issue
- **Development of commissioning procedures for electronic instrument transformers**
 - ü Ratio control given programmable features
 - ü Security seal issues
- **Conforming Meter issues**
 - ü Impact of 1 A vs. 5 A meter
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q Settlement procedure issues

- VEE process
 - ü I2h values are secondary units – very small numbers given 1 A max.
- Voltage current presence check review
- SSLA
 - ü Initial Optical Instrument Transformers will be at the transmission level but SSLA Radial Line Loss still must be accommodated
- MEC review required
 - ü Review any burden issues
 - ü Independent Revenue Metering Instrument Transformers vs. Shared Use

q Settlement tool review

- MVSTAR
- MTR

q Does the RMSC see the inclusion of Optical Instrument Transformers for Revenue Metering applications in the IESO Market as a priority?

q Options for Moving Forward

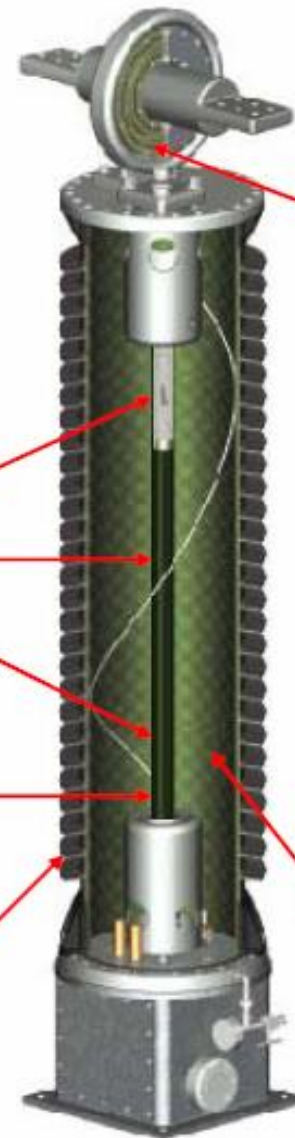
- **Wait for final MC NOA**
- **Start in advance in anticipation of MC NOA**
 - ü **Working Group of volunteer RMSC members to analyze issues**
 - ü **Provide guidance in the development of new metering requirements and procedures allow “safe use” of Optical Instrument Transformers in the Ontario Wholesale Electricity Market**

NXVCT & NXVT

VT: Multiple
Electric Field
Sensors

Internal Shielding to
Moderate Surface
Perturbation Effects

Composite Insulator



CT Head – can
have Multiple
Sets of Fiber
Sensors

Low pressure
dry nitrogen