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High Accuracy Instrument Transformers

Revenue Metering Subcommittee Meeting

May 10, 2005

Dave Wilkinson

Recent Developments

- IEEE has developed a new standard for High Accuracy Instrument Transformers
  - IEEE PC57.13.6/D3 DRAFT published Oct. 21, 2004

- It defines two new ANSI classes for Current Transformers:
  - 0.15S class maintains 0.15% accuracy from 5% rated current to 100% rated current * RF
    ("S" designation is based on IEC Convention for "Special Application")
  - 0.15 class maintains 0.3% accuracy at 5% rated current and 0.15% accuracy at 100% * RF
- Target date for IEEE final publication Dec. 31, 2005
- Manufacturers of medium and transmission class ITs offer devices built to IEEE PC57.13.6/D3 standard today

Canadian Standards Association

- CSA formed a technical working group in January, 2004 to update the CAN3-C13.M83 Instrument Transformer Standard
- Working group members include most provincial transmitters, Measurement Canada, and several Canadian IT manufacturers
- Canadian input was used to update the IEC series of IT standards in 2000 to 2002
- CSA proposed adopting the IEC IT standards with a covering section of "Canadian Deviations" that recognize North American conventions
- Canadian Deviations developed from January to May 2004 and were published to working group members for comment in July, 2004
- IESO joined the CSA working group in January, 2005
- Target date for publication of new series (CSA-C60044-x) of CSA Instrument Transformer Standards is June 30, 2006
- Measurement Canada expected to recognize the new CSA IT Standards to replace existing references to CAN3-C13.M83 within LMB-EG-07 ***"Specification for Approval of Type of Electricity Meters, Instrument Transformers and Auxiliary Devices"***

Reason for IESO Involvement

- Government of Ontario recent RFP for Renewable Energy has resulted in rapid development of new wind based generation
- Limited experience to date in Ontario with revenue metering for large scale wind farm developments
- Academic information available for "typical" wind farm installations indicates a very wide dynamic operating range
  - 75% of annual hours - aggregated output of wind farm can vary from 0 to 100% of theoretical nameplate rating * number of installed generators
  - 25% of annual hours "taking load" at minimal levels for SCADA / auxiliary heaters
- IESO working with wind farm MMPs and MSPs to encourage:
  - 0.15S class CTs with factory accuracy test results at 1% of rated current
  - Lower nominal CT ratio with higher Continuous Current Rating Factor (typically 2.0, 3.0, or even 4.0 if commercially available)
- Additional applications of 0.15S class CTs possible for legacy wholesale Generator Station installations with over-sized or improperly sized CTs

Wind Generation
Expanded CT Operating Range

- Typical Wind Farm application – 10 x 1.8 MW wind turbine generators with a single 3 element RWM at the 28 kV, 3 Phase, 4 Wire injection point
- Maximum Generator Bus output – 18 MW @ 90% PF
  - (418 Amps, assuming nominal voltage of 27.6 kV)
- Minimum load – SCADA (no heaters) – 30 kW (10 x 3 kW)
  - (0.6 Amps, assuming nominal voltage of 27.6 kV)
- Consider 0.15S Class CTs with RF of 3.0
  - Allows accurate metering from 2.0 to 600 Amps
  - MSP to archive CT manufacturer's test results at 1%, 5%, 10%, 100% and 100% *RF of rated output current for audit purposes
  - Provides evidence to support future reclassification of the CTs at this site once Measurement Canada has publicly recognized the Class 0.15S CT in LMB-EG-07

Class 0.15 S, 200:5, RF=3.0, 3 Element Metering Installation Operating Range

Instrument Transformer Characteristics:				
	Primary :	Secondary		Ratio
Potential Transformer	16,800.0	120.0	V	140
Current Transformer	200.0	5.0	A	40
Thermal Rating Factor	3.0			
Assumed Power Factor: (for all cases)	0.9			

		IEEE CLASS 0.15S EXTENDED ACCURACY RANGE		MEASUREMENT CANADA APPROVED OPERATING RANGE					
% of Rated PT Voltage	1 Phase Voltage								RF
95.0%	15,960.0								
3 Phase Voltage:	27,643.5								
% of CT Rated Current:		1.0%	5.0%	10.0%	25.0%	50.0%	75.0%	100.0%	300.0%
Equivalent Primary Current [A]:		2.0	10.0	20.0	50.0	100.0	150.0	200.0	600.0
Equivalent Primary Demand Load [kW]:		86.2	430.9	861.8	2,154.6	4,309.2	6,463.8	8,618.4	25,855.2

Next Steps

- IESO has recommended the following addition in red to the current draft of the Canadian Deviations for "***CSA –C60044-1 Instrument Transformers – Part 1: Current Transformers***"

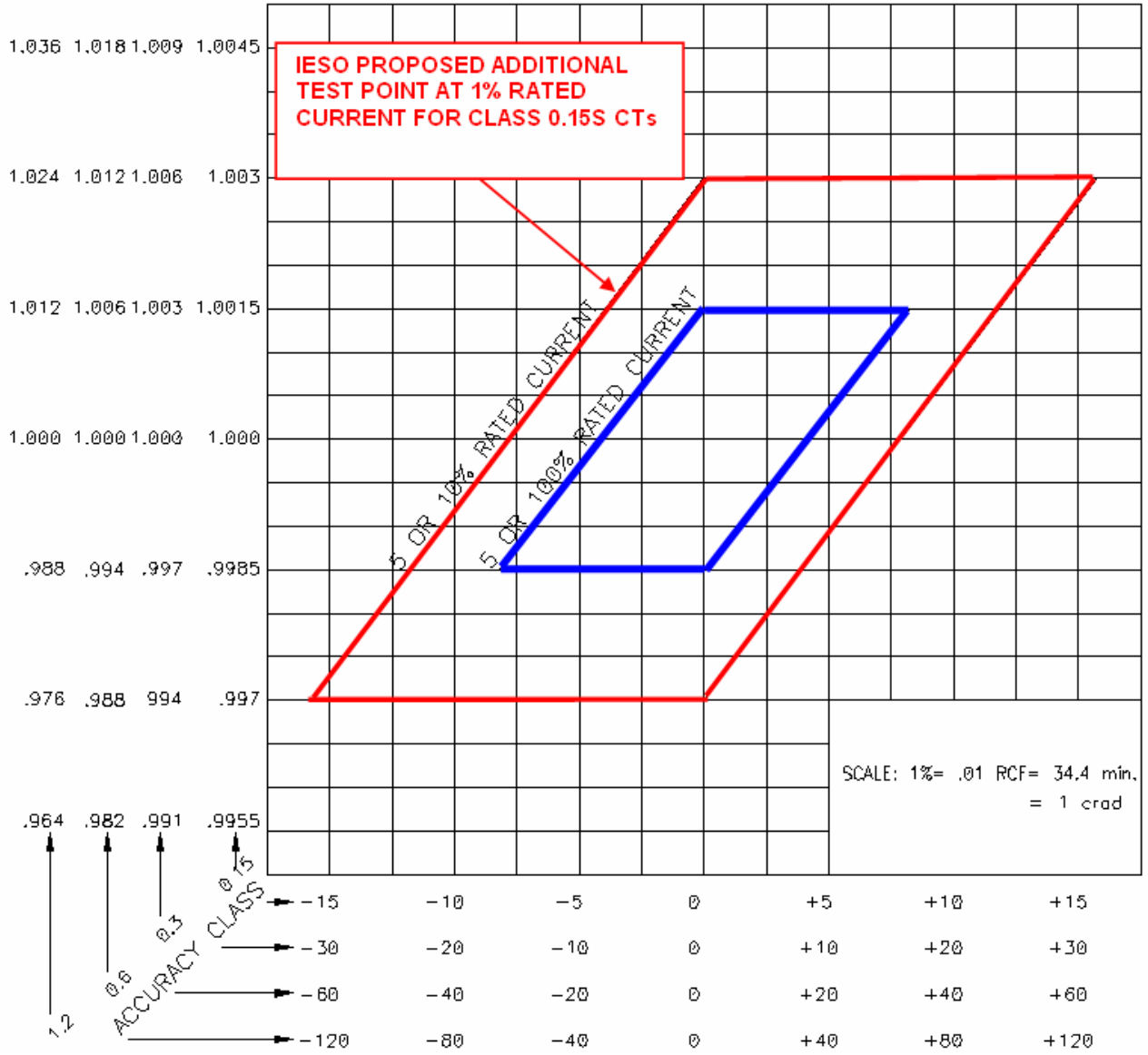
Table I
Accuracy Classes and Corresponding Limits of Transformer Correction Factors for Measuring Current Transformers (1)

Measuring Accuracy Classes	Limits of Transformer Correction Factor								Limits of Power Factor (Lag) of Metered Power Load
	100% Rated Current (2)		10% Rated Current		5% Rated Current		1% Rated Current		
0.15	0.9985	1.0015	-	-	0.997	1.003	**0.994**	**1.006**	0.6-1
0.15S	0.9985	1.0015	-	-	0.9985	1.0015	**0.997**	**1.003**	0.6-1
0.3	0.997	1.003	0.994	1.006	-	-	-	-	0.6-1
0.6	0.994	1.006	0.988	1.012	-	-	-	-	0.6-1
1.2	0.988	1.012	0.976	1.024	-	-	-	-	0.6-1

Note 1 : See Figure A

Note 2: These limits also apply at the maximum continuous current rating factor (RF)

Limits of Accuracy Classes for Measuring Current Transformers



Consistency with Conforming Meters' Approved Current Range

- Movement by Measurement Canada towards an approved lower limit of 1% of nominal CT secondary current (0.05 A) for 0.15S class CTs would result in a "consistent and approved operating current range" for a wholesale metering installation using these CTs
- IESO Conforming Main Meters are presently approved for operation down to 1% of nominal 5.0 A CT current
  - Measurement Canada Notice of Approval documents for both ION 8x00 series meters and Q1000 meter state an approved nameplate operating current range of 0.05 A to 20.0 A
- All existing IESO Conforming Meters (Mains and Alternates) have published starting currents of less than or equal to 0.005 A (5 mA)

High Accuracy Instrument Transformers

Questions ?