ISO Rule Section 502.11 (Substation) Workgroup Meeting – Proposed Agenda

Meeting Date: January 21, 2016 from 10:00 am to 3:00 pm
Meeting Place: AESO Boardroom 2538P, 25th floor of Calgary Place building (330 5th Ave SW, Calgary)

Agenda Item	Time	Presenter
1. Welcome Revisit Nov 19, 2015 meeting minutes as per [AESO] comments Comments and finalization of Dec 17, 2015 meeting minutes	10:00 – 10:30	[AESO]
2. Action items from Dec 17, 2015 meeting: • Send substation design parameters respecting Snow, Icing and Wind Limits to the AESO. These parameters may be included in the associated Information Document for 502.11.		All
3. Discussions on what will be included in the substation rule 502.11 • Power transformers • Shunt reactors and shunt capacitors • Instrument Transformers (CTs and PTs) • Other	10:30 – 12:00	All
4. Lunch break	12:00 – 1:00	
5. Continuation of rule discussions	1:00 – 2:00	All
6. Summary presentation from [AESO] on • what WG has come up since August 2015 • next steps	2:00 – 3:00	[AESO]

1. Power transformers

As the most expensive equipment in most substations, power transformers have an average life span of 25-35 years in normal operation. Rules on power transformers must be for the purpose of promoting reliable operation of the system, and prolonging/maintaining the useful life to support a cost effective system.

The following points will be discussed:

- All transformers should be designed for an in service operating life that is comparable to other electrical apparatus in the same substation
- Single phase vs. three phase – Should we require single phase transformers for circumstances such as
    - The GSU units at very large base load power plants (>800 MW or other values)
    - 500/240 kV autotransformers with >800 MVA (or other value)

- Over Voltage Protection
    - All power transformer terminals shall be equipped with surge arresters with adequate protective margins

- All surge arresters should be installed as close as possible to the transformer bushings

- Transformer rating and cooling
  - Should we specify how transformers rating is determined for normal condition?
  - Should we specify overloading capability for large power transformers (like >1000 MVA)? The AESO has been specifying 30-minutes and 3.5-hours overloading capability for large transformers with >1,000 MVA
  - Should we require 55^{o}C rise (instead of 55/65^{o}C or 65^{o}C) for certain sized transformers?
  - Should we require FCBN for all 240/138 and 500/240 kV autotransformers?

- Tap changer
  - Should we require OLTC on any power transformers (except GSUs and 500 kV transformers)?
  - Should we preclude the use of DETC for certain transformers?
  - Should we require LTC be always placed at the primary winding (or the wye winding)?
  - Range – should we require minimum number of steps and the range, or power factor range?

- Transformer impedance and losses
  - Should we require a transformer loss study be conducted for all 500 kV or other voltage level transformers?
  - Should we specify a range of impedance?
  - Should we require that no-load loss, load loss and auxiliary loss must be all considered when conducting loss studies?
  - Should we mention IEEE Standard C57.120 as the transformer loss evaluation method?

- Short circuit withstand
  - Should we specify that "transformers shall withstand, without damage, the mechanical and thermal stresses by external faults"
  - Should we specify 2 seconds short circuit duration?

- Parallel operation
  - Under what conditions do we allow parallel operation of transformers in a substation?

- Geomagnetical disturbance and geomagnetically induced current
  - Do we need any special requirements for geomagnetical disturbance?

- Any other points by WG members

2. Shunt Reactors and Shunt Capacitors

The following are proposed to be discussed. WG members may have additional points.

Shunt capacitor bank

- Under what condition do we require a shunt capacitor to be connected to a diameter between buses?
- Shunt capacitor banks must be solidly grounded with the neutral grounded at a single point
- For multiple parallel capacitor banks which are switched back-to-back, each bank shall have a circuit breaker
- H-coupled capacitor banks must have unbalance protection, both alarm and trip function

- Should we require that a TRV study be done for each project having capacitor bank(s) to determine the use of series reactors or other schemes (such as pre-insertion resistors) to limit the switching transient overvoltage and resonance?
- Any other points from WG members

Shunt reactor bank

- For line connected shunt reactors – Should we prescribe minimum compensation level?
- Should we limit the construction types of reactors to either gapped core type or magnetically shielded air core having fixed impedance?
- Should we require reactor to have constant impedance up to, say, 1.5 times the rated voltage?
- Under what condition do we require a shunt reactor to be connected to a bus or a tertiary winding?
- For line connected shunt reactors – Auto reclosing of a transmission line with line shunt reactors is prohibited unless it can be assured that the fault is in the line section
- For line connected shunt reactors – Shunt reactors must be either solidly grounded or grounded through a neutral reactor
- For line connected shunt reactors – Under what condition do we require a four legged reactor (if not four legged reactor, a separate neutral reactor)?
- For tertiary winding connected reactors – There must be a circuit breaker connected
- Any other points from WG members

3. Instrument Transformers

Do we have any other technical requirements than the ones already specified in the current 502.3 rule as follows?

ISO Rule 502.3 – Interconnected Electric System Protection Requirements

Instrument Transformers

9(1) The **legal owner** of a **generating unit**, the **legal owner** of an **aggregated generating facility** and the **legal owner** of a **transmission facility** must ensure the facility uses protection class voltage and current transformers.

(2) Each **protection system** must have separate current cores and utilize separate secondary voltage transformer windings.

Voltage Transformers

10(1) Voltage transformers for a facility must be wire wound, capacitive or optical voltage transformers, and any other form of transformer is prohibited.

(2) For two hundred and forty (240) kV or higher voltage facilities, **protection system** devices that require voltage transformer inputs to provide protection functions must be connected to voltage transformers that are directly connected to the protected element.

(3) For one hundred and forty four (144) kV or lower voltage facilities that utilize simple bus design, the use of common bus voltage transformers is acceptable.

Fuse Failure Alarm for Voltage Transformers

11 A voltage transformer used for protective purposes, including synchronism checking, must have a loss of potential alarm.

Current Transformers

12(1) A current transformer used in a **protection system** must be either magnetic or optical, and must not be the limiting element in the transmission facility's rating.

(2) The maximum available current transformer ratio must be sized for the ultimate fault level of the facility as set out in the functional specification.
(3) A current transformer used in a **protection system** must meet the two point five (2.5L) low internal secondary impedance accuracy requirement as set out in *CAN/CSA-C60044-1:07, Instrument transformer – Part 1: Current transformers, Table 1B*, or an equivalent accuracy requirement at its maximum possible ratio, regardless of the ratio actually being utilized.

Breaker Failure Protection
35(7) For applications where free standing current transformers are used with live-tank breakers it is acceptable to have a breaker fail operation for faults located between the breaker and the current transformer.