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

Meeting Date: March 31, 2016 from 10:00 am to 3:00 pm
Meeting Place: AESO Boardroom 2538, 25th floor of Calgary Place building (330 5th Ave SW, Calgary)

Agenda Item	Time	Presenter
1. Welcome	10:00	[AESO]
2. Action items from Feb 18 meeting: • Transformer overloading capability: Appropriate wording in the substation rule respecting overloading capability of transformers • Transformer loss evaluation methodology: BCH method vs. IEEE standard • ARS CIP-002-AB and NERC CIP-014: Definition of critical facilities • Any further comments on [CANA] presentation on the minimum technical requirements for transmission substations of USA and Canadian utilities	10:00 – 11:00	All
3. Review of previous WG agreements based on AESO internal discussions: • Consideration of contamination in insulation requirement • Bus ampacity requirement for 240 kV bus	11:00 – 12:00	All
4. Lunch break	12:00 – 1:00	
5. Discussions on the following topics • Shunt reactors and shunt capacitors • Instrument Transformers (CTs and PTs)	1:00 – 2:00	[AESO] / All
6. Summary presentation from [AESO] on • what WG has come up with since August 2015 • next steps	2:00 – 3:00	[AESO]

1. Action items from February 18 meeting

Action: Transformer overloading capability – appropriate wording in the substation rule respecting overloading capability of transformers

Update:

At the February 18 meeting, it was generally agreed that the 502.11 rule should not explicitly set the minimum overloading capability for each and every power transformer in the future.

Subsequent discussions occurred with some WG members on the necessity of including some generic wording respecting the overload ratings of transformers, if either the AESO requires in a project's Functional Spec, or the TFO has to do it to comply with ISO reliability standards, such as the upcoming FAC-008.

The following text represents proposed wording regarding transformer overload rating requirement:

Any ratings beyond the nameplate rating, if requested by the ISO in a Functional Specification with a specified load cycle, shall be recorded and provided to the ISO.

Any load cycle test to meet above requirement or other requirements from the ISO shall be performed in accordance with Clause 10 of IEEE Standard C57.119. The test report shall include, to the maximum extent possible, all information as specified in Section 4.4 of IEEE Standard C57.91.

Action: The AESO is to review the difference between BC Hydro's loss methodology and the IEEE C57.120 standard

Update:

The difference between the different methodologies appears to be how the costs in $/kW of the losses (No-load loss, Load loss, Auxiliary loss) are arrived at, based on either levelized cost or marginal cost concept.

While the AESO would not like to mandate a specific loss evaluation methodology, but views that the levelized cost concept appears to be more suitable method. If the AESO requires loss comparison to be made on certain transformers, the AESO is obligated to provide the necessary parameters. WE need discussions on what information the AESO is required to provide.

Action: The AESO is to review NERC's definition on CIP (5 source line terminations?), and determine if the WG needs to review the "Type 1" substation definition

Update:

The NERC CIP-014-2 – Physical Security – has the following definition on CIP facilities:

4. Applicability:

4.1. Functional Entities:

4.1.1 *Transmission Owner that owns a Transmission station or Transmission substation that meets any of the following criteria:*

4.1.1.1 *Transmission Facilities operated at 500 kV or higher. For the purpose of this criterion, the collector bus for a generation plant is not considered a Transmission Facility, but is part of the generation interconnection Facility.*

4.1.1.2 *Transmission Facilities that are operating between 200 kV and 499 kV at a single station or substation, where the station or substation is connected at 200 kV or higher voltages to three or more other Transmission stations or substations and has an "aggregate weighted value" exceeding 3000 according to the table below. The "aggregate weighted value" for a single station or substation is determined by summing the "weight value per line" shown in the table below for each incoming and each outgoing BES Transmission Line that is connected to another Transmission station or substation. For the purpose of this criterion, the collector bus for a generation plant is not considered a Transmission Facility, but is part of the generation interconnection Facility.*

Voltage Value of a Line	***Weight Value per Line***
less than 200 kV (not applicable)	*(not applicable)*
200 kV to 299 kV	*700*
300 kV to 499 kV	*1300*
500 kV and above	*0*

__4.1.1.3__ Transmission Facilities at a single station or substation location that are identified by its Reliability Coordinator, Planning Coordinator, or Transmission Planner as critical to the derivation of Interconnection Reliability Operating Limits (IROLs) and their associated contingencies.

__4.1.1.4__ Transmission Facilities identified as essential to meeting Nuclear Plant Interface Requirements.

__4.1.2__ Transmission Operator.

2. Review of previous WG agreements based on AESO internal discussions

- Consideration of contamination in insulation requirement

Looking up previous meeting minutes, we didn't talk about contamination in insulation coordination. Contamination is a factor that must be considered in insulation coordination studies in setting creepage distance for insulators in areas with pollution, along with many other factors such as altitude correction factor, etc.

We just need to include the contamination factor in the minutes.

- Bus ampacity requirement for 240 kV cross bus

At the December 17 meeting, we came up with the following minimum bus ampacity values:

Component	138/144 kV	240/260 kV	500 kV
Main bus	1,200	3,000	4,000
Cross Bus	600	2,000	3,000
Feeder or Line terminal	600	2,000	3,000

An internal review suggests to increase the "Cross Bus" ampacity from 2000A to 3000A, for handling load growth and future expansions.

We need to talk further about the cost implication of this change.

3. Shunt Reactors and Shunt Capacitors

WG members are encourages to bring any additional points to the meeting.

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

4. 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.