

# ISO Rule 502.11 (Substations)

Industry Workgroup Meeting

August 27, 2015

 AESO

# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

## Applicability

- ISO
- Legal owner of a transmission facility
- Those legal owners of generating units who own substations
- Other (BTF)?



## Questions

- Should customer owned substations be included? If so, same voltage as for the legal owner of transmission facility?
- Should 69/72 kV facilities be included?
- Should we include HVDC substations?



# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

## Definition of a Transmission Substation

- At least one voltage level  $\geq 100$  kV
- Connects to at least one transmission circuit



## Question

- Should we define a Major Substation?
  - Voltage  $\geq 240$  kV;
  - Total terminations  $\geq 6$ ; and
  - Transformation capacity  $\geq 400$  MVAor
  - HVDC converter station with voltage  $\geq 100$  kVor
  - Connect to external jurisdictions
- A Major Substation will have more stringent requirement



# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

## General Requirements

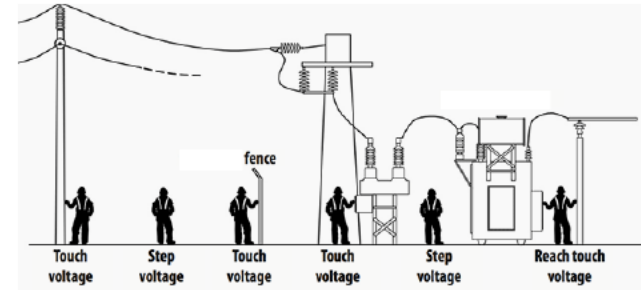
- Siting Selection
  - Access roads
  - Minimize line termination crossings
  - Difference between T & D costs because of location must be considered
- Life expectancy
  - 40/50/60/80 years depending voltage, capacity, operation, etc.
  - Emergency rating should not impact life expectancy
- Reliability and Availability
  - Meet N-1 criterion and other ARS standards
  - No cascading failure allowed



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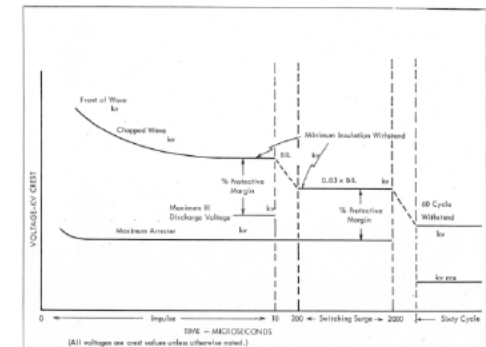
## General Requirements (cont'd)

- Safety
  - OH&S code
  - Electrical code (AEUC)
- Insulation Coordination and Grounding
  - AIES is an effectively grounded network
  - BIL and BSL levels



## Questions

- Interconnecting ground grids of back-to-back substations
- Should 69 kV and 25 kV BIL be included?
- Should 260 kV be treated as a voltage class having MCOV and BIL/BSL?





# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

## General Requirements (cont'd)

- Station Power Supply
  - Battery
  - Emergency generator
  - Distribution source nearby
- Control Building
  - Protective relay system panels
  - Communication facilities
  - AC/DC panel boards / Battery rooms



## Questions

- Should we allow Station Service PT?
- Should we require separate trenches?
- Should we specify battery capacity and gen size, redundancy and discharge hours?



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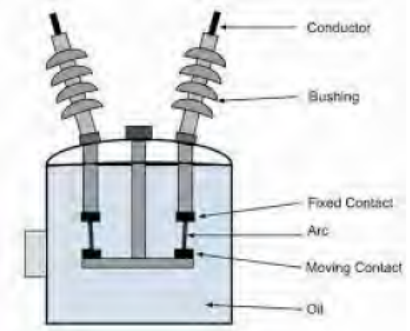
## Major Equipment – Circuit Breakers

- Short circuit current duty cycle
- Breaker operating time (cycles)
- SPT&R capability
- Sync-check functionality
- Point-on-wave functionality requirement



## Questions

- Should we require economic studies on GIS switchgear if GIS is proposed?
- Should we require a breaker installed at every line termination? Every SS transformer at  $\geq 240$  kV bus?
- Should we specify maintenance requirements?
- Should we require metal clad switchgear to be arc flash resistant?



# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

## Power Transformers (include PST & Shunt Reactors)

- Capacity rating and methodology
- On-load tap-changer requirement
- Operating voltage range

## Questions

- Emergency capacity requirement? How?
- Full capacity below nominal voltage?
- Oil containment requirement?
- Should we require specifications for loss evaluation?
- Special purpose transformers?





# What to be Included in ISO Rule 502.11 – Preliminary Thoughts

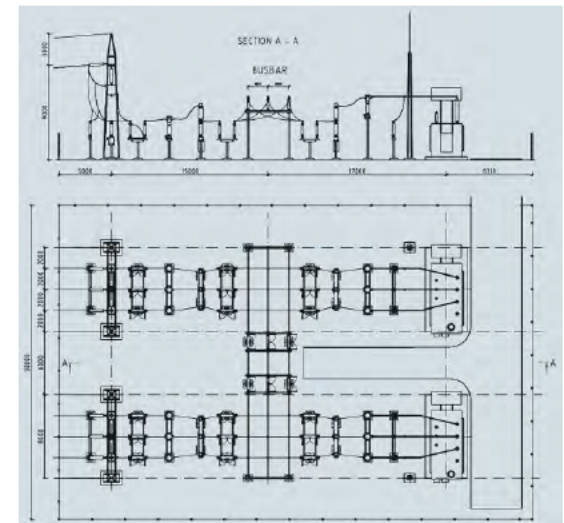
## Bus Design

- Bus layout and configuration
  - 500/240 kV
  - 138/144 kV
- Bus ampacity rating



## Questions

- Should we “prescribe” bus configurations especially for Major Substations?
- Should we require tie breaker(s) for two or more line terminations?
- Limit the number of terminations in a ring-bus?
- How will future expandability be addressed?
- Should AESO specify ultimate configuration for key substations?



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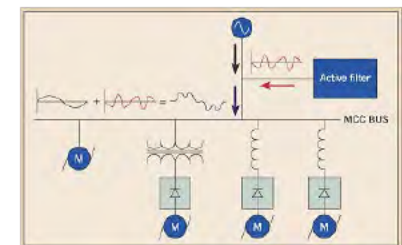
## Other Substation Equipment

- CTs and PTs
- Communication equipment
- Relaying & metering
- Fire protection requirement
- Fences and gates



## Other Issues

- Service and operating conditions
- Harmonic limits
- Physical security

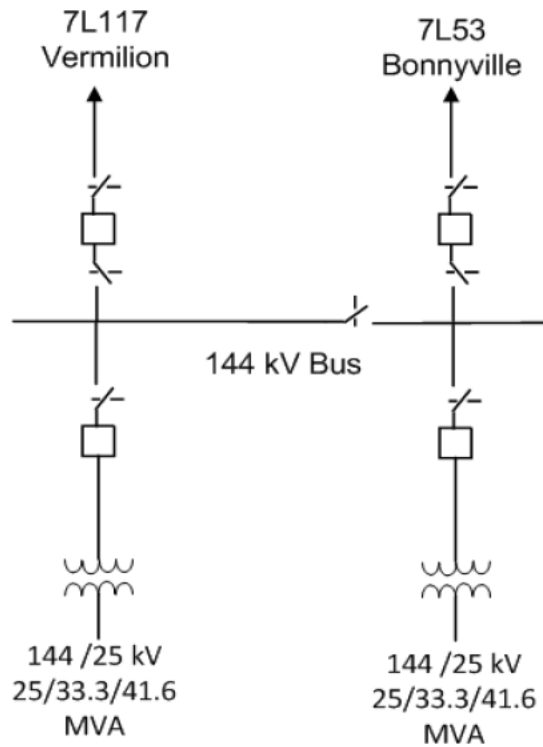


Should we include the following items in 502.11?

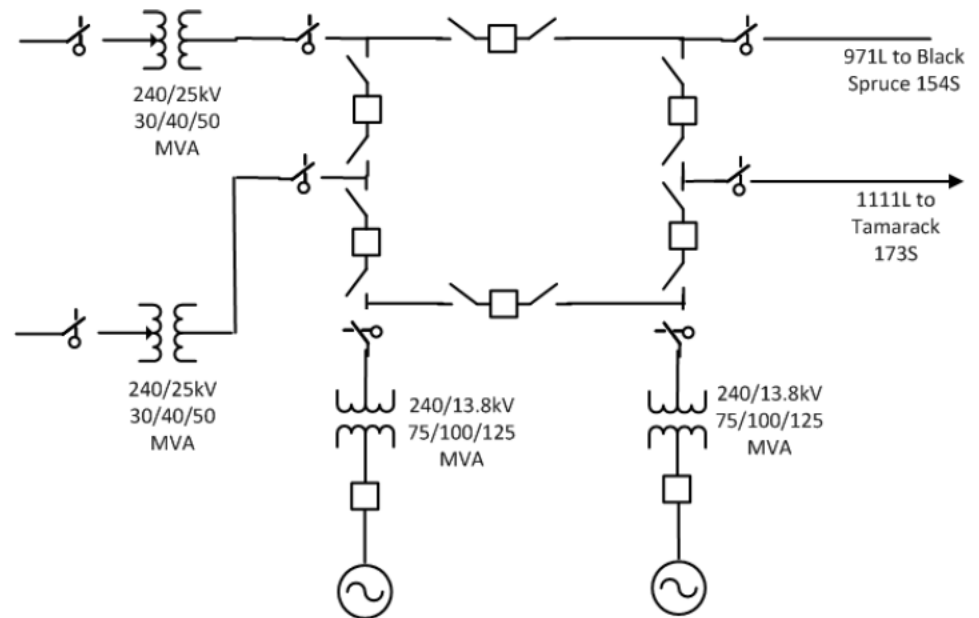
- Maximum harmonic levels (THD)
- Minimum total clearing time for faults
- IEC 61850 standard (communications)
- Spare equipment
- Conductor clearance (for future expandability)

**Thank you**

**aeso**  
ALBERTA  
ELECTRIC  
SYSTEM  
OPERATOR



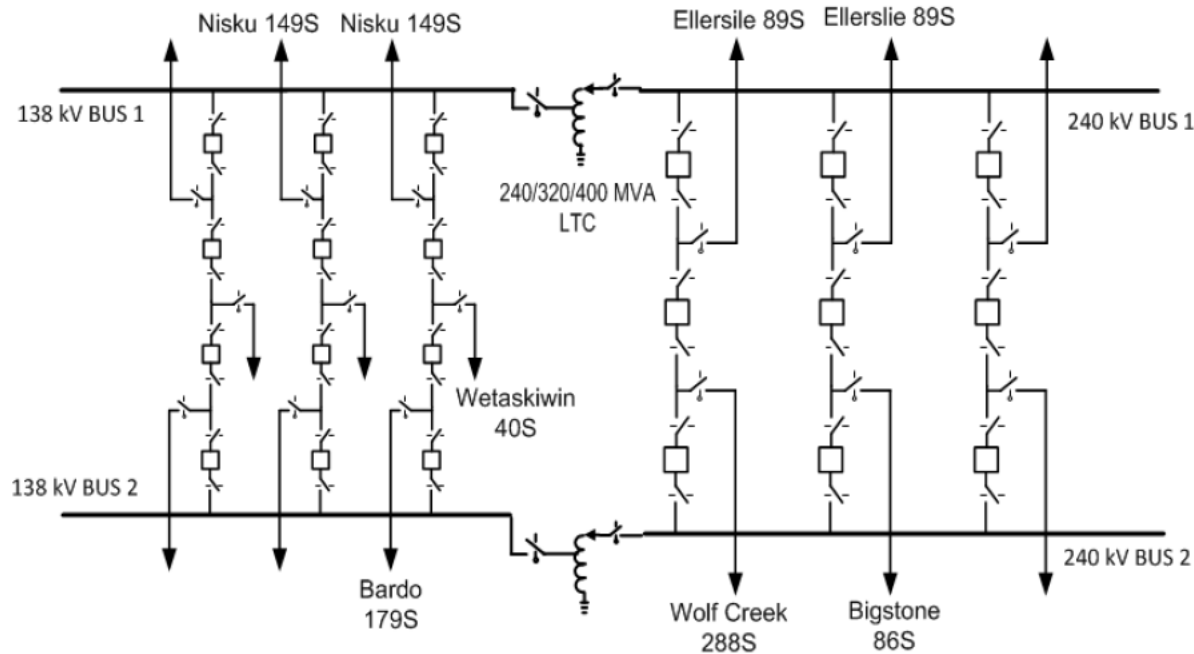
## Simple Bus



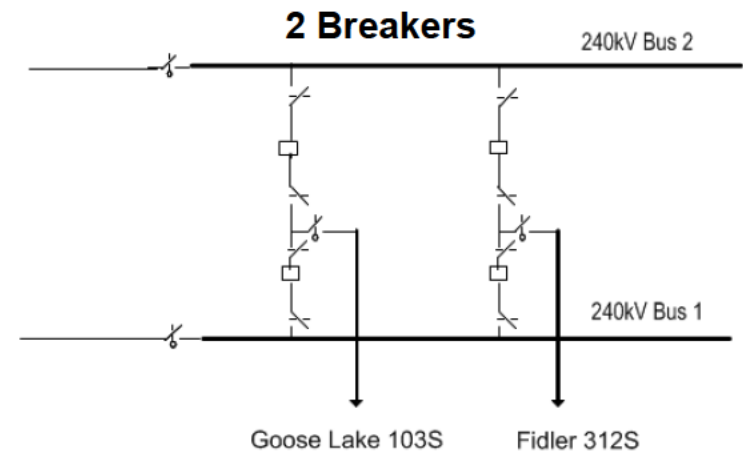
## Ring Bus



# Typical Single Line Diagrams



**1 1/2 Breakers**  
**1 1/3 Breakers**



# Typical Single Line Diagrams

**Gas Insulated  
Switchgear**

