Location: AESO BP Location, Meeting Room 6006, 6th floor of the BP Centre located at 240 – 4th Ave SW Calgary, AB T2P 2H8
Date: September 24, 2019
Time: 9:00 a.m. to 3:00 p.m.

Attendees:

Company
Alberta Electric System Operator ("AESO")
Alberta Newsprint Company ("Alberta Newsprint")
AltaLink Management Ltd. ("AltaLink")
ATCO Electric Ltd. ("ATCO Electric")
Capital Power Corporation ("Capital Power")
Cenovus Energy Inc. ("Cenovus")
CNOOC International Ltd. ("CNOOC")
Consumers Coalition of Alberta represented by BEMA Enterprises Ltd. ("CCA")
Depal Consulting Limited ("Depal") representing Inter Pipeline Ltd.
EPCOR Distribution & Transmission Inc. ("EDTI")
ENMAX Power Corporation ("EPC")
Maxim Power Corporation ("Maxim")
Suncor Energy Inc. ("Suncor")
TransAlta Corporation ("TransAlta")

Consultation Session Overview and Introductions

- The AESO welcomed Stakeholders to the session, reviewed safety procedures, reviewed the agenda, and provided an overview of the current consultation session.
- The AESO explained what is expected of Stakeholders in each consultation session, mainly to ask questions, provide feedback, and assured market participants that their views are not binding; stating that comments received are purely being used for consultation purposes. Further, the AESO provided instructions for asking questions in person and through the webinar, and requested that market participants ensure that one person speaks at a time into the webinar microphone as there were issues with hearing everyone's input at the last session.
- The AESO advised everyone that the session is being recorded to aid in minute taking and that before being finalized the minutes will be circulated to attendees for comments. Further the AESO noted that the webinar recording will be deleted after the minutes are finalized and that the AESO noted that personal information is collected in accordance with the *Freedom of Information and Protection of Privacy Act*.
- All attendees introduced themselves.

Overview of September 2019 Stakeholder Sessions

- The AESO provided an overview of the September 2019 Stakeholder Sessions. The AESO noted that the September 10, 2019 Stakeholder Consultation Session ended at subsection 9(5) of the proposed new Section 502.11, so this session will pick up from that spot and continue to the last subsection of the rule. For each subsection, the AESO explained that it will provide its rationale and open up the floor for questions and comments.
- Throughout the session, the AESO let attendees know that it is willing to listen and see if there are requirements that need to be amended or removed.

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Insulation Requirements (continued)

- The AESO reviewed the subsection 9(5) and its preferred rationale.
- There was a discussion on the insulation material:
  - Capital Power asked if the AESO has a preference on insulator material to use. For example, glass versus porcelain versus polymer.
  - The AESO noted it will leave that up to the market participant; however, the AESO's only requirement is that market participants give consideration to contamination.

Terminal Components

- The AESO explained the proposed requirement for terminal components: that the terminal component connecting either a bulk transmission line or a transformer cannot limit the ampacity rating of the facility, whether it the bulk transmission line or the transformer. The AESO noted that this should fall under good design practice. The AESO also explained its rationale that there have been problems at older substations when terminal components are the limiting component. The transmission lines may have been built to a capacity beyond what was immediately required, and may have been built larger to minimize losses on the grid and equipment that was rated less than the actual transmission line. The AESO noted that it has been involved in many situations where it was required to upgrade bits and pieces of substations to get the full capacity out, for example jumpers and current transformers ("CT"). The AESO noted that upgrading equipment can become a big undertaking because there may not be the space available and it may be hard to shut down the associated transmission line. The AESO also commented that subsection 10 is geared towards basic static and emergency ratings; that there is no mention of dynamic line ratings; and that if the AESO were interested in pursuing dynamic line ratings it would be a standalone project.
- There was a discussion about whether or not the requirement was appropriate for radially-connected substations:
  - Capital Power mentioned that this topic has come up on two substations that Capital Power owns in Alberta, which are both radially connected to the Alberta interconnected electric system ("AIES"). Capital Power noted that AltaLink has transmission lines that are limited by CTs, and that it would not be compliant with the requirement. Capital Power gave the example of a transmission line that is rated for 400 or 500 MVA, but that is limited by a CT to 200 MVA.
  - ATCO Electric asked Capital Power if it is speaking about radially-connected transmission lines and noted that the rule is about bulk transmission lines. ATCO Electric further noted that if Capital Power's connection was an in-and-out connection configuration, then their CTs could limit the ability of that transmission line to flow power; however, since it is a radially-connected transmission line, this is not how to interpret this rule.
  - Capital Power noted that it understood the comment; however, asked how the AESO plans to manage the situation since Capital Power's CT don't have to comply with Section 502.3 of the ISO rules, Interconnected Electric System Protection Requirements ("Section 502.3"), but AltaLink will have to report non-compliance to the AESO.
  - The AESO answered that currently, the proposed new Section 502.11 is not in place, so there are no compliance issues with the proposed new Section 502.11. However, for Section 502.3, the AESO expects facility owners to report the most limiting factor on its transmission lines, which may be CTs.
  - Capital Power further noted that it is not just concerned with CTs, that if a radially-connected substation becomes a substation connected via an in-and-out connection configuration, a redesign would be needed as nothing in the design specifies how to have power flow through the substation, so Capital Power would probably need an exemption. Capital Power also noted that there is no rule that requires its substations to be ready to expand in the future or become a network substation.
  - The AESO responded that it understood Capital Power's concerns and that there had been lots of discussion about the topic at past meetings. The AESO stated its position that if the AESO identifies that a particular substation needs to be expanded, then the substation may be required to meet the full requirement and that the AESO can identify this in the project functional specification, whether it is the generator or load substation. However, if the substation remains radially

connected, then Capital Power has a valid point and that the requirement may not be necessary for radially-connected substations, but it will be for networked facilities.
    - EPC commented further to the AESO's response, saying that with a radially-connected transmission line, if it does become a networked transmission line later, the scope modifications and cost will need to be decided at an earlier stage, which would get covered by other mechanisms.
    - The AESO confirmed this would be covered in the ISO tariff, but the need for it must be developed in the early stages of the project, much like the AESO does with its transmission projects. Once the need is determined, the AESO works with the market participant to identify and apply the ISO tariff to figure out how much it will cost.
    - EPC asked why radial transmission lines would have a greater capacity than the facility it is connecting if the plan is to never make use of the extra capacity of the transmission line.
    - The AESO noted that the problem may be transmission line minimum ratings. There is a practical lower rating limit for standard 138 kV and 240 kV transmission circuits. The AESO also noted that transmission line capacity is dealt with in Section 502.2 of the ISO rules, Bulk Transmission Lines ("Section 502.2") and is a bit outside of the scope of the proposed new Section 502.11.

Bus Arrangement

- The AESO presented subsection 11(1), which includes a definition of substation elements used through subsection 11 of the proposed new Section 502.11, specifically that it included different types of transformers, reactive resources, and bulk transmission line terminations. The AESO also noted that it does not plan to define the term formally in the AESO's *Consolidated Authoritative Document Glossary* ("CADG") because it is only used in the proposed new Section 502.11. The AESO explained its rationale for choosing this definition.
- There was a discussion about the size limits chosen for some transformer types in the substation element definition:
    - EPC asked why the definition of substation element included a size limit of 100 MVA or higher for load transformers and does not specify a size limit for generating unit step-up transformers ("GSUs").
    - The AESO explained that 100 MVA or higher was chosen for load transformers because a transformer at this capacity is considered a large transformer that generally impacts the system to a greater degree than transformers that are less than 100 MVA. It did not specify a size for GSUs because the AESO's intent was to identify GSUs as being important facilities. The AESO encouraged attendees to see how the definition is used throughout subsection 11, and if there are still concerns, the concerns can be discussed.
- The AESO presented subsection 11(2), which describes substation element isolation requirements during planned maintenance events. There were no comments from market participants for this subsection.
- The AESO presented subsections 11(3), 11(4), and 11(10), which specify substation element isolation requirements during circuit breaker failure events.
- To help explain the requirements proposed in subsection 11(3), the AESO drew a diagram of a simple 138 kV bus with 4 substation elements connected to it, and noted that, if there were more substation elements added, then isolation equipment, like a bus-tie breaker, would be needed to meet the requirement.
- There were no comments from market participants on subsection 11(3).
- To explain subsection 11(4), the AESO drew a diagram of a 240 kV substation, with 2 transformers, and 2 transmission lines connected to it. The AESO drew an example of a design that would result in the simultaneous tripping of two bulk transmission lines as a result of a breaker failure, and, therefore, would not meet the 11(4) requirement. The AESO also drew an example of a design that would result in one bulk transmission line going out of service when there is a breaker failure, and one that would meet the 11(4) requirement.
- There were no comments from market participants on subsection 11(4).

- The AESO explained subsection 11(10), which requires that no more than 2 substation elements are tripped, including GSUs, as a result of this requirement.
- There was a general comment from ATCO Electric about the “breaker-and-a-half design” drawn by the AESO:
  - ATCO Electric noted the AESO diagrams illustrate the Alberta definition of a breaker-and-a-half design whereby transformers are placed on the main buses, which is not the pure breaker-and-a-half design. ATCO Electric noted that this has been done this way historically to save a breaker, so as a result, now anytime a bus gets taken out of service, a transformer is lost. ATCO Electric further explained that this is an example of where the ISO rules developed by the AESO are specific to Alberta and that the idea is to come up with a facility that is best fit for the Alberta grid, economic environment, and the regulatory environment. ATCO Electric also explained that the workgroup was trying to think of ways to come up with substation rule requirements such that the solutions are economical and practical.
  - The AESO agreed with ATCO Electric’s comment, that the missing breaker is in front of transformer, and this is an Alberta specific design. The AESO further explained that if it thinks the substation will expand to have 138 kV, 240 kV, and 500 kV voltages and related future transformers, quite often the AESO will require market participants to leave space for a future breaker for the future transformer. The AESO noted that the consequence of adding an additional transformer to a bus that does not have room for a breaker is that, if a bus goes out of service, 3 buses and 2 transformers are lost.
  - The AESO also noted that, for most of the 240 kV-backbone transmission system substations, the AESO does not have plans to upgrade to three voltage levels and it does save money on bus-tie or system transformer breakers. So far the only substation that is a part of the AIES that has 3 voltage levels is the Livock substation; however, in the future, there will likely be more substations with 3 voltage levels.
- There was a discussion about generator requirements in the proposed new Section 502.11:
  - Capital Power asked if the reliability of the transmission line connecting a wind aggregated generating facility (“AGF”) to the rest of the AIES should be determined by the owner of the generator since it impacts the generator’s reliability.
  - The AESO explained, regarding a large wind project, it would work with a market participant to decide on a project-by-project basis what the appropriate connection is. The AESO further explained that the requirement is intended to ensure that an element can be taken out for service for maintenance without dropping a transmission line or losing service to an area.
  - The AESO gave the example of a situation where there were 3 diameters, also referred to as bus bays, in place in an area where a market participant was requesting a connection to a wind AGF. The AESO noted that it would consider the benefits and drawbacks of adding a bus-tie breaker on a project-by-project basis and that there is probably value if there are already 3 transmission lines.
- There was a discussion around who pays for the added breakers, the participant or the system:
  - EPC wanted to confirm its understanding that the cost of bus-tie breakers, if reliability is needed, will be borne by the system.
  - The AESO said that it likely will not be borne by the system, but the participant. The AESO explained that it will review, on a project-by-project basis, the need for the facilities and apply the ISO tariff regarding who pays, and that it is not committing to the system paying for the bus-tie breaker.
- The AESO then presented subsection 11(5) and 11(6) on slide 41, and also referred to slide 25. The AESO explained that subsections 11(5) and 11(6) limit the number of substation elements that can be connected to a ring bus to 6. The AESO noted that substations with connections to more than 6 substation elements will be expected to add a third diameter in a two-bus arrangement. The AESO noted its rationale, that ring buses with more than 6 system elements have presented operating challenges to the AESO, noting in particular, when elements are taken out for maintenance and something else trips.
- The AESO further explained that, in terms of number of transformers or transmission lines that make up the 6 elements, it does not have specific requirements. The AESO noted that some US utilities also

limit the number of transformer terminations and transmission lines. The AESO commented that it is not proposing to a limit on the number of transformers or transmission lines.

- There was a discussion to clarify this requirement:
  - EPC asked if there is any requirement on number of elements connected on a ring segment. EPC explained that it has multiple substation elements, specifically multiple transformers connected to the same node, between ring breakers at some of its substations.
  - The AESO noted that this would not meet the proposed new Section 502.11.
  - EPC agreed with this point.
- The AESO then presented subsection 11(7) and 11(9) that relate to the AESO's requirement to provide information on the ultimate substation design requirements and the TFO's requirement to design the high voltage bus such that the ultimate design can be realized without relocating any existing substation elements except a termination connecting a bulk transmission line. The AESO explained its rationale that this ensures initial and long term costs are considered when determining its initial design.
- There were no comments from market participants on subsections 11(7) and 11(9).
- The AESO then presented subsection 11(8), the high voltage bus minimum current capabilities, which are found in Table 6 of the proposed new Section 502.11.
- The AESO also presented a summary of the main points made by attendees regarding Table 6 at the September 10, 2019 Stakeholder Consultation Session, which includes a question regarding why the AESO is asking for more capacity than what the facility immediately requires, and that the AESO heard feedback that minimum continuous current ratings may not be enough for certain 500 kV buses.
- There was a discussion on the 500 kV substation component requirements in Table 6:
  - Capital Power asked the AESO if Table 6 is stating that, for a 500 kV transmission line terminal, the equipment, between the 500 kV bus and the 500/138 kV load transformer, is required to be rated at 3000 amperes ("A"). Capital Power noted that it is concerned about the short piece of line to their generators, which are operated at much less than 3000 A, further noting that one of the lines operates at 1000 A. Capital Power asked if there could be an exclusion for smaller generators.
  - ATCO Electric explained that 500 kV transmission lines are built with a thermal capacity of 2600 MVA, which equates to 3000 A and gave the example of Fort McMurray West. When the 500 kV transmission lines are built, they are built to meet the ultimate capacity. ATCO Electric then provided some further examples of transmission lines rated at 3000 A.
  - The AESO explained that, if it identifies that there may be future expansion then the requirements outlined in Table 6 would apply. The AESO further explained that the requirement would be dealt with in the project functional specification and that, on large 500 kV projects, apart from this requirement, there are hundreds of components in a substation and the AESO needs to be satisfied that all components are appropriately rated.
- There was a discussion about whether or not subsection 10(1) conflicted with subsection 11(8):
  - EPC noted that subsection 10(1) appears to contradict subsection 11(8), because subsection 10(1) states that the line terminal cannot be the limiting factor, while subsection 11(8) provides minimum values the substation terminals must meet, such as 600 A for 138 kV transmission line terminals.
  - EPC also asked why the line terminal and the transmission line ratings do not match noting that the minimum current rating is set at 600 A while the transmission line is 1200 A. EPC asked if, at a minimum, the minimum transmission line terminal rating requirement could match the line rating requirement. EPC noted that, in its view, the transmission line and its terminal is the same element. EPC further noted that it always has a disconnector on the transmission line first, and then it connects to the main bus.
  - The AESO explained that subsection 10(1) deals with specific equipment whereas subsection 11(8) deals with the bus. The AESO also explained that the rating values are absolute minimums. Nothing stops a market participant from going higher if there is a need for higher line capacity.
  - In response to EPC's comment regarding the 138 kV transmission line and the terminal being the same thing, the AESO responded that, depending on whether or not the bus configuration is a

single bus, there may be line breakers, CTs, risers, or jumpers, and then the 138 kV transmission line would connect to a bus.

- The AESO further explained that in its view, EPC is asking why 600 A is specified for the cross bus for 138 kV facilities, and that, with simple buses there isn't a cross bus. The AESO noted that in the simple bus arrangement, there is a line terminal which is rated at 600 A, and a main bus which is rated at 1200 A. The AESO further noted that the 1200 A accounts for the fact that there may be multiple transmission line currents flowing on one single bus.
- The AESO commented that it understood EPC's concern and that it would review EPC's request. Specifically, that there are two different requirements on the same topic.
- ATCO Electric commented that 600 A could be interpreted to be the minimum rating, and if the line is rated higher, then subsection 10(1) applies.

Alternating Current Station Service Supply System

- The AESO presented the Alternating Current ("AC") station service supply system requirements, which includes a requirement for major substations to have dual independent AC station service supply sources, and the rationale for this requirement.
- The AESO asked market participants if this is common practice on all substations, and a discussion on the topic followed:
  - AltaLink responded that it is common practice on major substations, and smaller substations would have a single supply source.
  - EPC noted it has a standard to install two major station service transformers ("SST") regardless of if it is a major or standard service station. EPC has two SSTs with a breaker on the primary side, and an Automatic Transfer Switch ("ATS") on the secondary side.
- There was a discussion about the inclusion of circuit switchers in the subsection 12(2) requirement:
  - Capital Power asked if the AESO considers a circuit switcher reasonable equipment to protect SSTs and if it allows circuit switchers in new installations. Capital Power explained that a circuit switcher functions like a breaker, but it is not a true breaker it is a "cheap breaker" and does not meet Institute of Electrical and Electronics Engineers ("IEEE") standard. Capital Power noted it is surprised the AESO accepts this kind of equipment as it really is not up to the same reliability and performance as a circuit breaker. Capital Power further explained that a circuit switcher can be a variety of products and wanted to know if there were specific requirements for the circuit switchers. Capital Power asked if, for example, the circuit switcher has to be rated to 40 kA.
  - Maxim noted that its understanding is that breakers are the ones that really interrupt the fault; circuit switchers don't have as much fault interrupting capability that a circuit breaker does. Maxim also commented that circuit switchers are usually used to switch loads and load currents, not fault currents.
  - The AESO responded that it would be acceptable to use a circuit switcher and that the circuit switcher should be rated for the fault levels it is exposed to. The AESO explained that the requirement relates to transformer terminations, so a circuit switcher may be acceptable because a reclosing mechanism is not required. The AESO further explained, in terms of interrupting capability, some circuit switchers can handle short-circuit current levels of 40 kA or higher, but it is hard for them to do so. The AESO noted that a circuit breaker will be required if circuit switcher is not sufficient to meet the expected short-circuit current levels.
- There was a discussion about the subsection 12(2) requirement that the SST requires a capacity of 3 MVA or more:
  - ATCO Electric noted that this requirement is related to SST, predominantly where TFOs operate and whereby power potential transformers ("PT") are not large enough to operate. ATCO Electric also provided its understanding that the reason the proposed capacity requirement for the SST is 3 MVA is because 3 MVA is the smallest size available for a 240 kV SST. ATCO Electric noted that, in a breaker-and-a-half bus arrangement, a 240 kV 3 MVA SST cannot be hung on a bus without a breaker or switcher. ATCO Electric also noted that, in situations where there is also a system transformer, a fault in a SST can take all of them down.

- ATCO Electric noted that subsection 12(2) requires a fault interrupting device for SSTs. ATCO Electric further noted that the main goal for substation owners is to find something that both complies with subsection 12(2) and accomplishes the intended purpose of isolating the SST without interrupting the rest of the facility.

- There was a discussion about the AESO requirement that equipment is able to handle short-circuit current level, which is often stated in the project functional specification:
  - The AESO explained that the initial and ultimate substation short-circuit current levels will be provided in the project functional specification. The AESO will manage the grid such that substation short-circuit current levels do not exceed the levels provided.
  - Capital Power agreed; however, noted that the proposed new Section 502.11 now states that a 240 kV circuit breaker has to have a minimum interrupting rating of 40 kA. Capital Power asked if this is a standard practice.
  - The AESO explained that the proposed new Section 502.11 obligates the AESO to provide the substation short-circuit current levels in the project functional specification, but it does not hardcode the actual value. However, 40 kA is typically the value provided by the AESO in the project functional specification for 240 kV breakers for their duty-cycle requirement.
- There was a comment about the difference between the level of reliability of isolation equipment for SSTs and other 240 kV equipment:
  - Capital Power asked why the station service requirements are any different than other 240 kV equipment since SSTs have the same amount of full current and the SSTs can affect the reliability of the substation. Capital Power also noted that a less expensive circuit switcher can also be bought if it has no reclosing capability.
- There was a discussion about whether subsection 12(2) is already covered under subsection 11(10):
  - AltaLink explained that the subsection 12(2) requirement is not necessary because subsection 11(10) states that, for major substations, more than 2 system elements cannot be taken out for any outage. AltaLink recommends that subsection 12(2) be removed because it is covered in subsection 11(10). AltaLink noted that if an SST is added to a substation it also needs to be added to the bus protection.
  - The AESO responded that if the requirement is covered under subsection 11(10), it could be removed. The AESO agreed to review this and decide. However, it noted that an information document ("ID") could provide further information.
  - AltaLink further explained that there are ways to design the substation such that all equipment is properly protected. AltaLink noted that the substation can be designed in such a manner that a circuit breaker may not be needed to isolate the SST. AltaLink added that the requirement for a SST breaker means the substation owner needs to pull in all the sensors and relays; however, if the requirements are based on the reliability required, then the substation owner probably doesn't need to put in all the sensors and relays because there are other options.
  - The AESO noted that if there is a breaker, there is the expectation to isolate and coordinate with the protection systems. The AESO further noted that it will take this away for further review to determine if subsection 12(2) is really needed. The AESO commented that because an SST with 3 MVA is rare, it can effectively be dealt with in the project functional specification.
- There was a discussion about the prevalence of major substations:
  - The AESO asked AltaLink how many major substations would have SSTs that are greater than 3 MVA.
  - AltaLink explained that its HVDC substation is the only substation it has that is that large.
  - The AESO explained that it is not a widespread application; however, it will take away AltaLink's recommendations. The AESO also noted that if there is another HVDC substation needed, the AESO will look at the design in greater detail and could optimize it.

Direct Current Station Service Supply System

- The AESO presented the direct current ("DC") station service supply system requirements and rationale for the requirement, specifically noting that the AESO proposed requirement is that major substations are required to have two independent battery banks and that all other substations have

one battery bank, each capable of supplying all connected DC loads for 8 hours after the AC station supply is disconnected. The AESO also noted that, as the substation develops, the market participant is expected to stay ahead of the curve to meet these requirements. The AESO further explained that it is up to the market participant to decide when to upgrade batteries to meet the substation DC load requirement.

- There was an error found on Slide 45:
  - Capital Power pointed out the requirement in the slide deck is incorrect, notably that it says "a minimum of 24 hours or less charging time".
  - The AESO agreed and noted it is written correctly in the rule, that the requirement is that charging time should be less than 24 hours.
- There was a discussion about the battery types that would meet the subsection 13(1) requirement that *IEEE Standard 485 – IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications* be used to size the battery or an industry standard that the ISO approves:
  - EPC asked if a market participant would want to use something different than lead-acid batteries, would they need the AESO's approval. EPC used the nickel-cadmium battery as an example that met the IEEE standard.
  - The AESO responded that the AESO does need to approve the use of batteries that are not lead-acid because it wants visibility of new technology. The AESO explained that if a market participant wants to use a different battery type, they should approach the AESO, explain the standard they are using, how it is equivalent in reliability, and how it meets the AESO's minimum requirements, and the AESO would listen.
  - ATCO Electric explained that subsection 13(1) speaks to battery sizing and that market participants can use the lead-acid battery sizing calculations to determine the amp-hour requirement for their battery bank. ATCO Electric further explained that, when a substation owner picks a different battery technology, it has to have same amp-hour capacity as a lead-acid battery bank and that IEEE Standard 485 is the only standard out there for battery banks.
  - AltaLink noted that for substations, it is less about the actual amp-hour and more about the actual voltage profile because the IEEE standard is based on the voltage of the equipment. AltaLink further noted that amp-hour is secondary as it depends on the voltage of the battery output.
  - ATCO Electric spoke to amp-hour as this is how batteries are sized, but AltaLink is correct.
  - The AESO explained that it plans to put information regarding battery sizing in an ID, including an indication that the next IEEE standard 1106 for nickel-cadmium is the AESO approved standard. The AESO further explained that, for lithium ion battery banks, the AESO understands that IEEE is making a standard and the AESO will adjust the ID if a new standard is published. The AESO also explained that the reason for subsection 13(1) is that it wants one consistent methodology to approaching battery sizing.
- There was a discussion about the battery sizing:
  - The CCA asked if the battery is sized to maintain power to the protection and control equipment only, and not to other functions, such as cooling, heating, and lighting.
  - The AESO responded yes to this question.
  - Maxim asked, regarding 8 hours of discharge time, what the AESO envisions for duty cycle for the connected load, such as the number of circuit breakers open and closed and operations. Maxim noted there is a separate standard for stationary batteries.
  - AltaLink explained that, at the workgroup sessions, it was recommended practice to choose duty cycle, and IEEE Standard 485 is the only guideline. AltaLink noted that the market participant can pick from plausible events for the substation.
  - The AESO explained that subsection 13(1) is written so that if a market participant cannot meet IEEE Standard 485, then it just needs to discuss it with the AESO. The AESO noted that it sounds like there are options in the IEEE Standard 485, and given that the AESO has simply referenced the standard, the TFOs can choose from the options. The AESO also noted that the blackstart plan will be based on 8 hours of operability.
- The AESO then presented and explained its rationale for subsection 13(4), which speaks to the requirements of battery rectifiers.

- There was a discussion about the requirement that the rectifier for the battery charger is capable of continuously supplying all direct current loads in normal operation:
  - AltaLink asked the AESO a series of questions including: clarification if the requirement is intended to ensure that it can supply load in normal operation and handle switching events if all batteries are gone; if so, it asked the AESO why batteries are needed at all. AltaLink noted that if the battery is disconnected, the charger cannot typically handle all switching events.
  - ATCO Electric noted the sizing of the rectifier is a function of the batteries being charged and that with a flooded cell it is between 20-50%. ATCO Electric further noted that the battery charger cannot be larger than that because the physics of the battery limit charger capacity, so this criterion can't be put in a rule.
  - The AESO explained that its intention was not to go beyond current practice, so it would review the proposed requirement for battery chargers to take full load when battery is disconnected.
- The AESO asked the attendees their opinion on the full-wave requirement in subsection 13(4) and if the attendees see the need to specify that the rectifier must be full-wave.
  - AltaLink responded that there is no need to require that the rectifier be full-wave because is it current practice. AltaLink also noted that, in the worst case, the market participant would damage their own battery or equipment.
- The AESO presented subsection 13(5), which includes the required characteristics of the independent battery banks for major substations.
  - Capital Power asked if one battery charger was sufficient for 2 battery banks.
  - The AESO responded that subsection 12(1) includes requirements on AC station service supply system sources and that some of these requirements would drive the chargers. The AESO gave the example of standby generators, which are independent chargers.
  - The CCA commented that a recharge time after a blackout of 24 hours seems long and that 12 hours seems reasonable.
  - The AESO responded to the CCA that the chargers have to be independent and that 24 hours applies if batteries are completely flat. The market participant can use the full 24 hours to charge as it sees appropriate.
  - AltaLink noted that subsection 13(5) states that the maximum recharge time is 24 hours. AltaLink also asked where the 24 hour limit comes from and if it was referring to the situation where there are 2 battery banks. AltaLink also noted that 4 hours likely provides enough time to be able to switch to AC service and have it back.
  - The AESO confirmed that AltaLink is saying that 4 hours is a reasonable time to get staff out to fix the failed charger.

Transformer

- The AESO presented the subsection 14 requirements and its rationale for choosing those requirements. The AESO explained that it specifies the minimum rating of transformer to meet the needs of a customer or the transmission system and lets the TFOs manage their fleets appropriately. The AESO also explained that it usually only specifies emergency ratings for system transformers, which have a rated voltage of 500 kV or 240 kV. The AESO also noted that, in the past, the AESO has asked for 0.5-hour to 3.5-hour emergency ratings to get through specified contingency but it is fairly rare. The AESO explained that it specifies the transformer ratings in the project functional specification and subsection 14 requires market participants to use a recognized standard to ensure the transformer can operate at its required rating.
- There was a discussion about the relationship between FAC-008, *Facility Ratings* ("FAC-008") and subsection 14:
  - AltaLink noted that FAC-008 includes bulk electric system ("BES") requirements, which includes transformers with ratings above 100 kV. AltaLink asked if subsection 14 will be similarly applied to BES transformers or to load transformers as well.
  - ATCO Electric noted that if an emergency rating above normal rating is never specified in the functional specification and transformers were not tested, then TFOs are not required to report the emergency ratings under FAC-008 clause R3421. ATCO Electric further noted that, if this were the

case, emergency ratings are the same as normal nameplate ratings. The concern is loss of life in case of overloading.
    - The AESO explained that after the facility is built, but before energization, FAC-008 would kick in and the substation owner would need to provide ratings. The AESO further explained that the FAC-008 obligation refers to what the substation owner needs to submit regarding facility ratings. The AESO also noted that, for most transformers, the AESO requires only normal ratings. For major transformers, emergency ratings for 0.5 hours and 3.5 hours to address the specific contingency may be required. The AESO also noted that questions regarding FAC-008 should be submitted through the RFI process.
- There was a question about when a market participant would know if its project would require a transformer with overloading.
    - Maxim noted that transformers are long lead items and asked when it would know a transformer with emergency ratings was needed.
    - The AESO responded that it would likely be for system projects and that it would give adequate time.
- There was a discussion about the load cycle testing requirement outlined in subsection 14(2):
    - Capital Power asked a number of questions about the load cycle testing requirement, including what kind of test the AESO is referring to when it talks about a load cycle test; what are some sample overload ratings; and if the AESO expects the rest of the substations to handle that overflow situation. Capital Power noted that it was under the assumption that the transformer has to be tested and that its nameplate should specify the hours and capability. Capital Power also asked if GSUs would be exempt from this requirement.
    - The AESO responded that it does not intend to specify emergency ratings for GSUs. The AESO explained that emergency ratings would have been analyzed at the beginning of the project to determine if a transformer emergency rating would be required.
    - The AESO explained that, in the past, it has specified emergency ratings for transformers with a load cycle, and that it specified time durations the market participant must be able to load the transformer to that emergency levels in the first 0.5 hours and the next 3.5 hours, with an initial loading of 70%, the transformer must be able to produce 10% of capacity for 3.5 hours.
    - The CCA noted that overloading transformers impacts the transformer life and asked the AESO if it wants to do this testing on a new transformer at the factory.
    - ATCO Electric concurred that overload testing a new transformer at the factory is not good practice. ATCO Electric also explained that transformer testing can include a heat run to the nameplate rating; however, beyond that, overload testing takes life away from the transformer.
    - EDTI agreed overload testing in factory should not be a mandatory requirement.
    - The AESO responded that it likely would not want to overload a transformer at the factory and acknowledged that the opinions heard from the attendees were that testing to emergency rating had more risk than benefit. The AESO also noted that it would give consideration to modifying subsection 14(2). The AESO further noted that relying on manufacturer's transformer specification should be adequate enough.
- The AESO presented its proposed requirement and rationale regarding on-load tap changing ("OLTC") and asked if there are any concerns with the AESO pointing this requirement in a project functional specification.
- There was a discussion about the OLTC requirements and transformers with reverse capability.
    - ATCO Electric commented that the market is changing into bi-directional power flow with generation coming from distribution network and that OLTC transformers are for one-way power flow from the transmission network to the distribution network. ATCO Electric further commented that if this power flow turns around, this tap-changer model doesn't apply because controls are not set up to handle it; however, this is mostly a comment to just keep an eye on it for the future.
    - Capital Power noted that when it looks to connect a new generation project to the AIES, it often runs into problems connecting existing load substations with transformers that were bought without reversing power capability. Capital Power further noted that it is a small cost to consider purchasing

transformers with reverse power capabilities and that generation development is very hard to predict.
    - The AESO noted that it appreciated the feedback and that there are initiatives underway at the AESO regarding distributed energy resources. The AESO responded that it will do its best to set up the transmission system to accommodate reversed flow it sees coming. The AESO noted that the vast majority of OLTC regulate on the high-side of the transformer right now. Generators mostly have off load tap changer transformers.
- There was a discussion about the impact on the OLTC on sparing.
    - The CCA commented that the OLTC difference on transformers will cause sparing issues and that standardization would be better. The CCA also noted that it would like to see standardized transformers because spares can be shared across province. This will save sparing costs.
    - ATCO Electric noted that they have a number of tap changer options depending on what part of the province the transformer is being installed in. ATCO Electric also noted that it won't change sparing strategy as long as there is decent flexibility in the rule.
    - EDTI noted that sparing would require AUC direction and asked the AESO if it is planning on including transformer spares in its tariff.
    - The AESO responded that each TFO manages their sparing and there isn't a provincial fleet of spares that is shared. The AESO also noted that it doubts that it will engage in TFO sparing. The AESO also asked if TFOs can speak to fleet management regarding standardization of the transformer.
- There was a discussion about the location of the OLTC on the transformer.
    - EPC asked if the AESO would be specifying where OLTC is located: the high side or low side.
    - The AESO responded that it is not specifying which side the tap changer must be on and noted that it is common practice and cheaper to install in on the high side.
    - Maxim commented that the tap changer voltage range of +/-10% is the maximum system operating voltage is 155 kV. Maxim asked if this was normal or would the AESO want to the transformers to be operated higher.
    - AltaLink commented that capability has nothing to do with where the transformers are run.
    - ATCO Electric noted that the transformer high-side voltage typically doesn't move, so if it is operated at 146 kV, the nameplate will show 152 kV. The low-side voltage is going to be regulated between +/-10%.
- The AESO explained subsection 14(9), the loss evaluation requirement, and its rationale for the requirement. The AESO further explained that it is proposing to specify when loss evaluation is required by the market participant.
- There was a discussion about the loss evaluation requirement.
    - AltaLink asked if the AESO is going to have internal criteria for what level this will occur at.
    - The AESO explained it has not thought about it; however, the practice in the past was to specify for system transformers, which have a rated capacity of 400 MVA or higher. The AESO also mentioned that it has specified in a couple projects that loss evaluation was required and asked AltaLink when it has performed loss evaluations in the past.
    - AltaLink responded, saying that it does loss evaluation on all of their transformers. AltaLink also recommended that loss evaluation is required for all system-connected transformers because this is where loss will come from.
    - The AESO asked if the threshold is set at 100 kV for system transformers, would that work.
    - AltaLink responded that it would.
    - The AESO noted that it will have to establish something internally and put it in a rule.
- There was a discussion about subsections 14(10), 14(11), and 14(12), specifically that the facility owner must determine the impedance value of transformers, except for transformers with a secondary nominal voltage greater than 100kV, and step-up transformer for a generating unit or an aggregated generating unit facility, or an energy storage facility that has a rated capacity of 400 MVA or higher, which will be specified by the AESO in the project functional specification:

- Capital Power asked why the AESO wants to include GSUs and why the threshold for inclusion is 400 MVA. Capital Power noted that 200 MVA is generally the owner's responsibility and that, at 400 MVA, the power factor is different than most wind AGFs.
- AltaLink agreed with Capital Power because system transformers are specified where they get the most faults. AltaLink also noted that for GSUs, the AESO might want to be involved in any generation up to a certain size and that a 200 MVA is still a pretty big unit. AltaLink also asked the attendees if they can name a GSU that is greater than 400 MVA. AltaLink noted that Sundance would be around 450 MVA.
- Maxim commented that it is helpful to get these values well in advance of the project functional specification.
- The AESO noted that it would work with participants. The AESO agreed that 400 MVA is a high threshold and will discuss with planners to see if to should be lowered. The AESO also noted that for large energy storage facilities impedance will need to be specified.
- The AESO noted that projects are sometimes on critical timelines and the AESO tries not to cause delays.

Circuit Breaker or Circuit Switcher

- The AESO presented the circuit breaker and circuit switcher requirements laid out in subsection 15 and the rationale behind it.
- There was a discussion about the subsection 15(4) requirement that circuit breakers on bulk transmission lines with nominal voltage of 200 kV or higher be capable of single pole operation:
  - Capital Power noted that single pole operation may be TFO common practice but it is not for wind farms. Capital Power further noted that market participant substations have no need for single pole operation and that it would like to see some wording in subsection 15(4) that excludes generators.
  - The AESO confirmed that subsection 15(4) states "unless the ISO specifies otherwise in the functional specification".
  - AltaLink commented that once the applicability of the rule is determined, then this may be applied to the system substations only.
  - The CCA asked if the AESO would ever deny generators an exemption to 15(4) and, if so, why not write it into the rule. The CCA also asked if there are 240 kV substations on the system right now that do not have single pole operation. The CCA asked where, in the foreseeable future, single pole functionality would not be needed and asked, if there is a transmission line that, for the next 10-20 years doesn't need single pole functionality, would the AESO automatically remove the requirement in the project functional specification. The CCA also asked if the requirement results in any cost implication to the transmission system.
  - The AESO, responding to the CCA, said that the majority of 240 kV are single pole operation capable but not all are implemented. The AESO said that historically it is a greater benefit in some places than others. The AESO also noted that the benefit can change over time. The AESO also responded that it believes AESO past practice was to require the capability for single pole operation; and that the AESO has gone back to market participants and asked for it to be installed. The AESO further noted that it has always asked for single pole capability on generation in recent years as it is beneficial to have the capability. In addition, the AESO responded that requiring single pole operation capability will not have cost implications to the transmission system.
  - AltaLink commented that the way the single pole operation requirement is worded today would limit the "stranded" capabilities because the way the requirement was presented in project functional specifications before was that all the breakers needed to meet that capability. In this case, the proposed new Section 502.11 requirement is specifically stating transmission line breakers. AltaLink further commented that it helps this way to mandate that all breakers have to have single pole operation.
  - Capital Power confirmed that this rule would not apply to transformer protection circuit breakers. It further commented that it is common in the US for the upstream circuit breaker to implement the auto-reclose for wind farm connections. Capital Power added that usually a 3-phase auto-reclose helps speed up restoration during outage without having to re-energize the line. Capital Power

noted that the main point is auto-reclosing. There is an advantage to having it on a radial line as well.
    - AltaLink explained that the conversation is now back to a radial setup and that if the breaker is de-energizing it is more restoration than reclose now because there aren't two lines – single pole is usually only required when there are multiple sources. AltaLink suggested this could be a clarification that could be in the rule. It also suggested that radially-connected substations that have aggregated generation above a certain limit may also be brought into scope, but there is still no need for the breaker requirement because the substation does not have more than 2 lines.
    - The AESO noted that technically it can be done. The AESO wants to control restoration and the default in Section 502.3 is to have the reclose capability and to let operators decide on how to reclose. The AESO also noted that this is current AESO practice, but if there was a particular situation where a deviation is requested, it can be discussed.
- There was a discussion about the single pole operation requirement outlined in Section 502.3:
    - The AESO explained that, in Section 502.3, the AESO would most likely want to sustain reclosing logic between the terminals if a market participant's substation is tapped to the transmission system. The AESO also noted that the market participant substation may trip, but the AESO will want to maintain its functionality. The AESO explained that if there is a dedicated radial to a substation, it does not see a need for the substation to meet this requirement.
    - The CCA asked if there was anything in Section 502.3 that requires a market participant to enable single pole operation and asked if it was up to the TFO.
    - The AESO noted that Section 502.3 would kick in. It also noted that, if the AESO sees that, it can hardcode it and not require it.
    - AltaLink explained that, depending on how to control it, it is more beneficial to open at zero crossing and that this is just outlining capability, just enabling capability for those systems.
- There was a question about the ability of circuit switchers to meet fault clearing time requirements:
    - The CCA asked if 230 kV circuit switchers will meet the required fault clearing time.
    - The AESO explained they have very specific requirements in the circuit breaker section in terms of interrupting time, and they must meet the minimum requirement as laid out in the interrupting time table whether a switcher or breaker is used. The AESO planners will run stability studies based on a maximum clearing time, and that would be partially based on breaker operating time. If the AESO went with a different number it would have to do a separate analysis regarding stability in and around the area, so if there is an additional breaker in the substation for these transformers, it would have to clear in the same time period.
- There was a discussion on the cycle time requirements outlined in Table 7 of subsection 15(3):
    - ATCO Electric explained that, given its circuit breakers operating voltages, it procures breakers that are 300 kV and it has used that type of breaker since the late 1970s.
    - Capital Power commented that its first impression is that the circuit breaker cycle time is the time it takes, after the trip signal is received by circuit breaker, for the circuit breaker to operate. Capital Power noted that 240 kV circuit breakers, as a standard for all vendors, have 3 cycle and that, for 300 kV circuit breakers, it is different - some are 2 cycle and some are 3 cycle. Capital Power also noted that a 2.5 cycle is not common, so if Capital Power had to buy a 2.5 cycle breaker, it would end up with a 2 cycle circuit breaker, which will significantly increase costs if implemented. Capital Power explained that compared to a 3 cycle circuit breaker, a 2 cycle circuit breaker needs more foundation, more structure, more wiring, and would require different operators. Capital Power also asked the AESO if it is changing the cycle time because it has a problem with protection coordination.
    - AltaLink noted that it has 230 kV breakers, but for its systems running at 260 kV, it uses 300 kV breakers. AltaLink also noted that it deployed 2.5 cycle circuit breakers, so it is incorrect to say there are only 2 or 3 cycle breakers. AltaLink commented that it has a 2.5 cycle breaker on which it performed testing and coordination and it operates fine.
    - ATCO Electric commented that the issue is total clearing time, which includes the protection operation and the breaker, and that subsection 15(3) is just looking at one element independently. ATCO Electric further commented that the AESO should identify total clearing time at near and far

end of the circuit breaker cycle time, and that the proponent should come up with a solution that meets the total clearing time independent of the actual breaker nameplate.

- EPC suggested using 3 cycles for 138 kV and 240 kV circuit breakers in subsection 15(3) based on industry availability and that if the AESO requires less in certain locations, it can be specified.
- AltaLink added that, instead of putting in a minimum requirement of 3 cycles, the AESO will need to know total clearing times from the beginning in order to give a margin.
- The CCA asked what the consequences were of going with 3 cycle circuit breakers and if there are jurisdictions that require 3 cycle circuit breakers. The CCA also noted that the price premium is the issue. The CCA also asked if subsection 15(3) could only be applicable for circuit breakers that affect the AESO and if the AESO could let generators decide their circuit breaker cycle times since it is their equipment that would be at risk. The CCA also asked if clearing times vary from place to place in the province, for example, one place needs 2.5 but everywhere else 3 is fine then why not require 2.5 for one region or substation.
- The AESO responded that there are places in the province where clearing times are extremely important because there are stability issues. The AESO asked market participants to move to 2 cycle circuit breakers a couple years ago and got pushback because one of the major manufacturers would have been excluded. The AESO noted that, as a result, it agreed to 2.5 cycle circuit breakers. The AESO further noted that it is now hearing that 3 cycle circuit breakers is a better place for a standard. The AESO explained that, from a system perspective, it is the total clearing time not the breaker operating time that matters; however, it tried to hardcode the clearing time into Section 502.3, and got a lot of pushback.
- AltaLink asked what was the minimum clearing time for 240 kV rather than looking at the exceptions and noted that a 3 cycle minimum has more to do with equipment.
- ATCO Electric explained that system design is paint by numbers, so when the rule requirements are set, like subsection 7(6) surge arrestors, we cannot shoot the arrow and draw a bullseye around where it lands and that becomes a prescriptive rule.
- Capital Power added that total clearing time can be another area.
- Maxim noted that that nailing everything together is tough because there is no system operating standard. Maxim assumed this value will be in the project functional specification.
- The AESO explained that it is aiming for something that is readily available and that can be competitively procured. The AESO also explained that when it runs into transmission system stability issues, it can change the protection systems to have faster total clearing times instead of adding transmission lines.
- ATCO Electric explained that anyone with the standards would meet this, noting that some foreign manufacturers may not meet the standards as they tend to build for their domestic market.
- The AESO noted that in the first round of stakeholder engagement, there was extensive discussion on clearing time and it was decided that the proposed new Section 502.11 would focus on individual equipment capabilities; that the proposed new Section 502.11 wasn't the appropriate place to discuss total clearing times. The AESO mentioned that this requirement was discussed internally with its engineers that perform stability studies, and it found that its engineers are quite happy with 2 cycles, can live with 2.5 cycles, and have concerns with 3 cycles.
- The CCA asked the AESO if its engineers are uncomfortable with 3 cycle circuit breakers everywhere or just in some areas. The CCA also noted that this is the dilemma between standardization and fit-for-purpose engineering.
- The AESO responded that the engineers were uncomfortable with 2 and 2.5 cycle on the bulk transmission systems, and that there are localized areas where 2 and 2.5 are not desperately required. The AESO noted that CCA's point was well taken.
- AltaLink commented that the AESO engineers may be worried about 3 cycles because they don't have a margin elsewhere. AltaLink asked what total clearing time the engineers are comfortable with and what the minimum clearing time is that is acceptable for the whole province. AltaLink commented that the AESO can set minimum requirements for equipment operation, that protection has its own limit, and then if specific areas don't meet the minimum, then change it. AltaLink also asked where clearing times would go if not in Section 502.11 as the clearing times originate in the substation.

- The CCA asked if the rule could be adjusted to say that the market participant has to use the limits unless it can demonstrate it is meeting the clearing time requirements.
- ATCO Electric noted that, as a large fleet operator of breakers, if the AESO sets the cycle time requirement higher, it may choose to buy the breakers with lower cycle times to achieve cost savings through standardizations. ATCO Electric noted that standardization is an effective way to defend its spending.
- EPC noted that standard clearing times can be published if needed.
- The AESO commented that it does have standardized clearing times that planners use and noted that it has a lot to think about.

Disconnect or Isolation Switches

- The AESO presented the subsection 16 requirements and its rationale for requiring disconnect and insulation switches: to be tested in accordance with the IEEE C37 or IEC 62271 standards; and to have ice breaking capability.
- The AESO asked if there were any comments from attendees.
  - ATCO Electric commented that the requirement is a very low bar to clear, and that it would be surprised if anyone has trouble with the requirement.

Shunt Capacitors and Shunt Reactors

- The AESO presented its subsection 17 and 18 requirements for shunt capacitors and shunt reactors and rationale behind those requirements.
- There was a discussion about breaker and switcher use with shunt capacitor banks.
  - The CCA asked if there were cases where there is no breaker or switcher for a capacitor bank.
  - ENMAX responded that it had breakers or switchers for all its capacitor banks and that, where it has switchers, it is switching them out with circuit breakers because of reliability issues.
  - ATCO Electric responded that shunt reactors are sometimes part of a transmission line and that it does not have a circuit breaker that switches the reactor; however, it is still breaker controlled because the line cannot be operated without the reactor. ATCO Electric stated that this is a functional specification requirement, which supersedes the rule.
- There were questions about subsection 18(2), which requires the legal owner to review to switching transients:
  - ATCO Electric noted that neutral reactors can limit ground return current and recovery voltage, and asked who does the studies. ATCO Electric also asked if there was any element where the AESO would run studies in advance in order to given the legal owner more guidance. ATCO Electric noted that this requirement puts a lot on the legal owner to understand risk and consequence.
  - ATCO Electric commented that it would expand on the requirement to identify why the legal owner would need to do studies to trigger legal owners as to what type of expertise it needs to engage to properly study.
  - The AESO responded that its intention was for the legal owner to perform the studies and that the AESO does not intend to undertake studies.
- There were general discussion about the subsection 18 requirements:
  - The CCA asked several questions; namely, if there were any cost implications, if the requirement was a change, why it is in the rule if it is what everyone does, and what value does the requirement add.
  - ATCO Electric added that the assumption is that, for anyone venturing into Alberta from a different jurisdiction that they should know what to do.
  - The AESO responded that the requirement represents a minimum standard design practice to manage transient. The AESO noted that it brought up the purpose of the proposed new Section 502.11 at the March 18 stakeholder session, which is to establish minimum substation requirements.

Not Included – Site Remediation Requirements

- The AESO then presented its rationale for not including site remediation requirements in the proposed new Section 502.11; namely, that it believes there are adequate requirements in other legislation, regulations and AUC rules, so it does not need to be mentioned in the proposed new Section 502.11. The AESO noted that the information regarding where the requirements are found could potentially be added in an ID, if everyone sees the benefit.
- There was one comment on this:
  - The CCA noted that it is ok not to include it, but that it has seen some exceptionally expensive oil containment provisions in some substations which have driven the cost up a lot. The CCA further noted that it does not always understand why that is, because sometimes it is nothing and sometimes it is a lot; however, it is not asking the AESO to help, it is just saying there is a need to figure out a way to deal with it.

Additional Discussion

- The attendees asked to discuss several proposed new Section 502.11 subsections that were discussed at the September 10 meeting:
- There was a discussion about subsection 6, which contains the grounding requirements.
  - Capital Power asked if there was any way to include in the rule, that grounding shield wire is required at both ends.
  - ATCO Electric responded that the ground grid studies will drive that, noting that a multi-grounded shield wire and a ground grid work in tandem and that it deals with the concept of current division. ATCO Electric added that a substation ground grid has a much lower resistance than that of the transmission line; so that is modelled in the grounding studies.
  - Capital Power explained that it had an instance where the TFO refused to ground the shield wire in Capital Power's substation because it wanted to isolate its ground grid. Capital Power noted that there were big issues, and that the shield wire, which is also the optical ground wire ("OPGW") is the only communication for SCADA and protection, so instead the shield wire is grounded outside of the first substation and the OPGW runs down that structure and converts to fiber cable underground. It runs in the ground for 30 metres into the substation, which creates a lot of problems.
  - AltaLink commented on grounding and how it has changed over time. AltaLink further commented that a singular transmission line ground has zero to little effect on the ground grid and that the idea of connecting it is typically for direct stroke protection. AltaLink noted that it is irrelevant if it helps the grounding grid or not, it is mostly for workers on how they deal with issues out on the line, and that putting this in a rule is irrelevant.
  - The AESO is not proposing to add the requested requirement in the rule because it has been back and forth at different facilities regarding whether the shield wire should get tied into the substation or not. The AESO suggested that market participants may need to work through this detail with the adjacent facility.
  - The CCA commented that grounding the shield wire to the substation grid transfers the ground potential rise ("GPR") outside the substation and that in the substation there is a grid, outside there is not. The CCA noted that grids around the poles are sized for this GPR and it is not sure there would not be appropriate compliant grounding.
  - AltaLink responded that there are no "GPR rules" regardless of being in a substation or outside and that the requirement is for the substations to have safe touch and step. AltaLink explained that lines, historically, have never and probably will never have safe step and touch.
  - The AESO asked AltaLink if it is safe to say that when running studies, if the facility owner choses to connect the shield wire, the facility owner would address this topic at that time.
  - AltaLink responded that it includes the shield wire in its model.

- There was a discussion on subsection 7, which contains the lightning and surge protection requirements:
  - ATCO Electric commented that subsection 7 is about insulation coordination which carries into subsection 9. ATCO Electric noted that the concept is to protect equipment from transient events and asked what the proper level of insulation and surge protection is. ATCO Electric further commented that the proposed new Section 502.11 calls out common practice, which includes investing heavily in surge arrestors, especially for a transformer. ATCO Electric noted that insurance underwriters will not give insurance if the facility does not have lightning protection.
  - ATCO Electric noted that transmission lines are different and that when the workgroup discussed subsection 7(6), transmission line surge arrester requirements, the discussion was around protecting circuit breakers. ATCO Electric commented that it did not agree with the current wording of subsection 7(6), and that it had asked that surge arresters be required to be installed at transmission line entrances unless a transient study suggests they are not needed. ATCO Electric explained that if a facility owner is prepared to do the work, it should be able to do design and accept the risk while maintaining compliance to the reliability standards of the province. ATCO Electric also noted that the addition of surge arrestors may not decrease the risk to assets, but will increase the cost to facility.
  - The AESO responded that there was lots of back and forth on this requirement and that it had the impression that ATCO Electric was going to change its practice.
  - ATCO Electric explained that it is not discussing this internally at this time, but it is constantly reviewing its approaches to insulation coordination. ATCO Electric further explained that it does not have failure events related to it, so it is business as usual.
- There was a discussion about current limiting reactors:
  - The CCA asked if current limiting reactors are being installed to limit current in substations.
  - EPC responded that the only place it has installed grounding reactors is on the distribution system.
  - The AESO responded that the distribution system limits phase-to-phase or phase-to-ground, and at transmission levels may change locations. The AESO noted that it is approaching 35 kA in some parts of the province.
  - AltaLink commented that there is very little equipment that will see the ultimate fault current levels unless the circuit fault occurs on the equipment. AltaLink asked the AESO how far it was going to go on its bus design because AltaLink may exceed the ultimate fault current level, may have to replace equipment in excess of 35 kA and that it will need to go into the fault study results to provide other numbers.
  - The AESO will need to review facilities specifically and come up with a solution.
- There was a discussion about whether or not there would be an ID:
  - EPC asked if there will be an ID posted along with the proposed new rule.
  - The AESO responded that there would be if it thought there is information that needs to be in an ID, but that the ID should not be relied on.
- There was a discussion about major substations versus other substations.
  - The CCA commented that if a substation gets classified as a major substation, there is substantial cost and asked what criteria is used to determine what is a major substation. The CCA added that it has no issue with taking land.
  - The AESO responded that it will identify major substations and other substations. The AESO also responded that, when major substations were presented earlier, incremental costs were discussed, and that the AESO is in the best position to identify what the future of the province looks like. The AESO does not need it to be built upfront. As long as the substation owner is aware that the substation will become a major substation, it can allow space for future growth as well a provision for a second power supply.
  - AltaLink noted that if it knows that a substation is going to become major substation there is a lot that goes into an initial design to accommodate the substation becoming a major substation, not just land.

- ATCO Electric made additional comments about substation preventative maintenance:
  - ATCO Electric added that there has not been a discussion about preventative maintenance cycles. ATCO Electric explained that today's equipment is much less maintenance intensive than 20 years ago and that the industry has come a long way with reliability. It is about contingency need for system reliability.

NEXT STEPS

- The AESO presented outstanding requested information from September 10, 2019 Stakeholder Consultation Session and new requested information from the September 24, 2019 Stakeholder Consultation Session in an Action Item List format, which is shown below, and asked TFOs to please send all of these requests to the ISO rules inbox. The AESO noted that it had received EPC's feedback.

Proposed New Section 502.11 Action Item List

	Stakeholder Name	Action Item	Date of Request	Date Received
1.	ENMAX	Outage caused by equipment failure	September 10, 2019	Requested by: October 8, 2019
2.	ATCO	Outage caused by equipment failure (sent to CEA)	September 24, 2019	Requested by: October 8, 2019
3.	AltaLink	Outage caused by equipment failure (sent to CEA)	September 24, 2019	Requested by: October 8, 2019
4.	ENMAX	BIL/BSL levels for GIS equipment	September 10, 2019	September 12, 2019
5.	EDTI	BIL/BSL levels for GIS equipment	September 10, 2019	Requested by: October 8, 2019

- The AESO thanked everyone for coming and explained its next steps were to take back all that it had heard and figure out what to do next. The AESO further explained that the more immediate next step is to finalize the meeting minutes to send out to attendees for comments. Once it receives comments, it will issue final meeting minutes, post them on the AESO website, and put a notice in the AESO's Stakeholder newsletter. The AESO added that, in terms of information that it is requesting from TFOs, please send it to the AESO within a reasonable timeframe. It added that if more time is needed, the TFOs should just let the AESO know.
- End at 2:38PM

POST-MEETING NOTE

In order to align with the AESO's new Stakeholder Engagement Framework and standardize the AESO's approach to gathering Stakeholder feedback, the AESO will no longer be soliciting Stakeholder feedback solely at Stakeholder consultation sessions. All information the AESO solicits from Stakeholders will be communicated via the AESO's proposed new Section 502.11 Stakeholder engagement webpage, so all Stakeholders, including those in attendance at the Stakeholder consultation sessions will be aware of the requested information. As a result, the AESO is not requesting Stakeholder feedback to the Action List above at this time.