AESO FUNCTIONAL SPECIFICATION

FortisAlberta Kananaskis Area Reliability Project

Functional Specification

(Project Number 2023)

Issued to

AltaLink Management Ltd. (as the **legal owner** of a **transmission facility**) and

to

FortisAlberta Inc. (as the **market participant**)

APEGA
Permit-to-Practice
P-8200

21/9/18

September 18, 2018

Version V2

	Name and Title	Signature	Date
Author	Henry Ng, P. Eng.	Henry Ng	Sept 18, 2018
Checked – Manager, Project Engineering	Changling Luo, P. Eng.		Sep 18, 2018
Approved – Manager, Project & System Access Studies	Maz Mazadi, P. Eng.	Mazadi	Sep 20, 2018
Approved – Director, Transmission Engineering & Standards	Dan Shield, P. Eng.		21/9/18

Functional Specification Revision History

Revision	Description of Revision	By	Date
V1D1	• For Internal Review	Henry Ng	2018-05-01
V1D2	• For External Review	Henry Ng	2018-05-04
V1	• For Issuance	Henry Ng	2018-05-31
V2	Revision with the following updates: • Requested new DTS changed to 7.7MW • Required minimum size of the transformer in 5.5(2) changed to 8.6 MVA	Henry Ng	2018-09-18

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1 PURPOSE

(1) The purpose of this document (the "Functional Specification") is to set out the technical specifications, requirements and approved variances related to the design, construction, development and commissioning of certain new or modified facilities (the "Project") that have been proposed for or are related to a physical facilities connection with the Alberta **interconnected electric system** (AIES). This Functional Specification is issued by the Alberta Electric System Operator (AESO) to:

(i) AltaLink Management Ltd., in its capacity as general partner of AltaLink, L.P., (AltaLink), as the **legal owner** of a **transmission facility** described in the Functional Specification.

(ii) FortisAlberta Inc., (Fortis), as the **market participant** that has submitted a request for **system access service**.

(2) This Functional Specification is issued for the Project only. The **legal owner** of a **transmission facility** and the **market participant** must comply with the Functional Specification provisions.

(3) The AESO is not responsible for any facilities designed by or for any third party, or installed on a third party's behalf, to accomplish the connection of the Project facilities.

(4) This Functional Specification includes:

(i) certain specific engineering, technical and functional requirements for the Project;

(ii) the requirements to comply with **ISO rules**, including Operating Policies & Procedures (OPPs), **reliability standards**, technical standards, and **ISO tariff** provisions, (collectively, the "Authoritative Documents");

(iii) the electrical system environment in which the connecting facilities must be designed and operated; and

(iv) any approved variances from requirements set out in any applicable AESO Authoritative Documents.

2 INTERPRETATION AND VARIANCES

(1) Subject to subsection (2), any revision or variance to any of the Functional Specification provisions by the **legal owner** of a **transmission facility** or the **market participant** is prohibited.

(2) The **legal owner** of a **transmission facility** or the **market participant** may make application, jointly or individually, in writing to the AESO requesting a variance to this Functional Specification, and the AESO may in writing approve of the variance after the AESO has completed an analysis of the implications to the AIES with respect to the requested variance.

(3) Words or phrases appearing in bold have the meanings set out in the AESO *Consolidated Authoritative Document Glossary*.

(4) The AESO has determined that the criteria described in subsection 6(4)(f) of the **ISO Rules**, *SCADA Technical and Operating Requirements* ("Section 502.8"), effective 2018-09-01, are met in the circumstances of the Project. However, pursuant to subsection 4(2) of Section 502.8, the AESO has also determined that it is appropriate to waive the requirement in Appendix 4 of Section 502.8 – *SCADA Requirements for Transmission Facilities* ("Appendix 4") that applies to a transmission line where the nominal voltage is greater than or equal to 60 kV and less than 200 kV, to provide analog SCADA to measure real and reactive power (the "Waived SCADA Requirement"). Accordingly, with the exception of the Waived SCADA Requirement, the **legal**

owner of the **transmission facility** must meet the supervisory control and data acquisition requirements set out in Appendix 4.

3 PROJECT OVERVIEW

The **market participant** has submitted a request for **system access service** to the AESO to address reliability concerns on the distribution system in the Kananaskis Area. The Project is located in the AESO transmission planning area of Seebe (Area 44).

The **market participant**'s request includes a request for a Rate DTS, *Demand Transmission Service*, contract capacity increase of 4.6 MW, from 3.1 MW to 7.7 MW at existing Mount Allan 115S substation.

The **market participant**'s request can be met by the following solution:

- Add one 138/25 kV LTC transformer at the existing Mount Allan 115S substation;
- Add two 138 kV circuit breakers;
- Add one 25 kV feeder breaker, one 25 kV bus tie breaker, and associated upgrades as required for the above transmission developments.

The scheduled in-service date (ISD) for the Project is November 1, 2019.

4 FORECAST OF FUTURE DEVELOPMENT IN THE PROJECT AREA

Proposed long term developments in the Seebe area (Area 44) are described in the AESO 2017 Long-term Transmission Plan. Please refer to the AESO's website (www.aeso.ca) for more details of the long term transmission developments in the area.

5 SCOPE OF WORK

5.1 General

(1) The **legal owner** of a **transmission facility** and the **market participant** must complete all engineering, design, land or land-use acquisition, siting, public consultation, applicable regulatory approvals and permits, material procurement, construction, commissioning, and associated permitting requirements for the Project facilities.

(2) The **legal owner** of a **transmission facility** and the **market participant** must coordinate with each other as required on all project facility design details, including protection and control, telecommunication, grounding, insulation, **point of connection**, and site layout, with proper considerations of maintenance coordination.

(3) The **legal owner** of a **transmission facility** and the **market participant** must develop joint operating procedures and any connection agreements as required such that all connecting **transmission facilities** will operate safely and reliably.

(4) The **legal owner** of a **transmission facility** and the **market participant** must deliver to the AESO all final design and as-built Project facility information and records in the format and content required by the AESO, to enable the AESO to update and maintain its transmission technical records and system models.

(5) The **legal owner** of a **transmission facility** and the **market participant** must submit the project information and records referred to in subsection (4) above, under the professional

stamp and signature of a registered professional engineer in Alberta who assumes responsibility for the preparation and accuracy of the content of the information and records.

(6) The **legal owner** of a **transmission facility** and the **market participant** must mutually agree on each party's roles and responsibilities regarding inspection of all facilities of the Project prior to energization of the facilities.

(7) The **legal owner** of a **transmission facility** and the **market participant** must ensure that all project facilities have been inspected by qualified personnel in accordance with industry standards and practices, so that the project facilities are declared to be:

(a) safe for operation; and

(b) in compliance with this Functional Specification and any Authoritative Documents for which the Project must comply

(8) No project facilities are to be energized until an energization authorization has been issued by the AESO in accordance with the **ISO rules**.

5.2 Compliance with AESO Authoritative Documents

The **legal owner** of a **transmission facility** and the **market participant** must comply with the Authoritative Documents provisions which are applicable to the Project and which requirements must be satisfied and incorporated in to the design, construction, development and operation of the connecting facilities and other connection project work, including but not limited to those provisions contained herein:

- AESO Operating Policies and Procedures
- Alberta Reliability Standards
- The AESO's Measurement System Standard Rev. 1 (dated September 18, 2007)[1]
- AESO Generation and Load Interconnection Standard (dated September 19, 2006) [2]
- **ISO rules** including:
  - Section 502.3, *Interconnected Electric System Protection Requirements* (effective September 1, 2018)
  - Section 502.4, *Automated Dispatch and Messaging System and Voice Communication Systems Requirements* (effective March 27, 2015)
  - Section 502.8, *SCADA Technical and Operating Requirements* (effective September 1, 2018)

5.3 Modelling Data Requirements

All modelling data shall be provided as per the AESO Information Document ID# 2010-001R Facility Modelling Data (issued March 23, 2017), which relates to Section 502.15 of the **ISO rules**, *Reporting Facility Modelling*.

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[1] The AESO considers this standard to remain in effect notwithstanding the statement in clause 1.5 of this standard. Efforts to revise the standard are currently underway

[2] The AESO considers this standard to remain in effect, as it pertains to load, notwithstanding the statement in clause 1.5 in the standard. Efforts to revise the standard are currently underway

5.4 Substation Equipment Specifications

All new substation equipment[3] must meet the following minimum specifications:

- Temperature rating of -40°C for all outdoor equipment.
- Equipment maximum and minimum continuous voltage ratings as indicated in Table 5
- Minimum continuous equipment current ratings as indicated in Table 1.
- Equipment maximum fault duty: 31.5 kA for 138 kV.

Table 1: Minimum Continuous Equipment Current Ratings (A)

Component note 5	**138 kV**
Main Bus Note 1	1200
Cross Bus Note 2,3	600
Equipment or line terminal Note 4	600

Notes for Table 1:

Note 1: Main bus includes all sections of ring bus scheme or single bus of simple bus or breaker and a half scheme except the portion of the bus connecting to a transformer.
Note 2: Cross bus includes diameter sections of breaker and a half or breaker and third schemes.
Note 3: Cross bus can have higher minimum current rating based on bus configuration and equipment connectivity
Note 4: Line terminal includes all equipment and conductor from the transmission line to the line breakers.
Note 5: Current rating of the equipment below 69 kV within the substation shall be determined by the **legal owner** of a **transmission facility**, in consultation with **market participants**.

5.5 Specific Scope of Work for the Legal Owner of a Transmission Facility

(1) General Requirements

- Coordinate with the **market participant** to develop necessary connection agreements and joint operating procedures.
- Ensure project safety is appropriately managed from design through energization.
- Undertake all required grounding studies, testing and mitigation as required for electrical safety.
- Complete grounding studies, testing and mitigation for electrical effects on communication systems.
- Complete insulation coordination studies and coordinate with the **market participant** as required to establish appropriate insulation levels.
- The **legal owner** of a **transmission facility** shall provide access to the telecommunication system for communication services (SCADA, Operational Voice, and Operational Data if requested by the **market participant**, as required by the AESO for the operation of the AIES.

[3] Equipment includes such items as the power transformer, circuit breaker, capacitor bank, shunt reactor, high voltage current transformer, potential transformer, bus work, air break, and switchgear.

- All site preparation, fencing, foundations, grounding, support structures, termination structures, duct work, cabling, bus work, station service, control building, protection, controls, etc. as required.

(2) Existing Mount Allan 115S Substation – See Appendices 7.2.1, 7.2.2 and 7.2.3

Substation Major Equipment Requirements

- Add one (1) new 138/25kV LTC transformer with minimum transformation capacity of 8.6 MVA[4].
- Add two (2) 138kV circuit breakers, one on the high side of existing transformer and the other on the high side of the proposed transformer.
- Add two (2) 25kV motorized disconnect switches for isolation on the secondary side of the existing and proposed transformers.
- Add one (1) 25kV feeder breaker to the proposed 25kV bus.
- Add one (1) 25kV bus tie breaker.
- Modify and relocate the existing transformer voltage regulator.
- Discontinue from use for transmission purpose the existing 6 MVA transformer T1, two faulting switches on the high side of existing transformers, associated 25 kV manual disconnect switches, and the voltage regulator bypass disconnect switch.

Protection and Control Requirements

- Complete system protection coordination studies and coordinate with the **market participant** as required to establish settings appropriate for the facility additions and AIES operations.
- Coordinate protections with adjacent substations as required to establish appropriate settings for the facility additions and operations.
- Install **under-frequency load shedding** (UFLS) relays to meet under-frequency load shedding requirements.
- Install all other required protection equipment for the safe and reliable operation at the Mount Allan 115S substation.

Telecommunication Requirements

- Install new or modify/upgrade the existing communication system as necessary to meet the Project requirements for operation, control, protection and SCADA.
- Coordinate and work cooperatively with **market participant** to install new communication system as required and establish appropriate communication interface such that tele-protection, SCADA, operational voice, operational data and mobile radio requirements are met.

SCADA Requirements

- Establish communications interface point such that SCADA data can be transmitted back to the AESO's System Coordination Centre (SCC) and Backup Coordination Centre (BUCC).

[4] The actual transformer rating is determined and selected from fleet of transformers by the legal owner of a transmission facility in consultation with the market participant.

- All new Remote Terminal Units (RTU) shall have Global Positioning System (GPS) signaling for time synchronization.
- Implement control center data mapping and verification of SCADA information for the proposed transmission facility modifications and additions and any associated changes required at other area substations as per Section 502.8 of the **ISO rules**. A complete listing of energy data requirements can be found in Appendix 7.3 of this document.

Revenue Metering Requirements

- Install revenue **meter** to meet the metering requirement to the new feeders.
- Provide the AESO the metering single line diagram to show physical revenue meter location.

5.6 Scope of Work for the Market Participant

(1) General Requirements

- Coordinate with the **legal owner** of a **transmission facility** to develop necessary connection agreements and joint operating procedures.
- Undertake all required grounding studies, testing, and mitigation to ensure the connecting transmission facilities are safe.
- Ensure connection project safety is appropriately managed from design through energization.

(2) Existing Mount Allan 115S Substation – See Appendices 7.2.2 and 7.2.3

Transmission Equipment Requirements

- Coordinate with the **legal owner** of a **transmission facility** to connect the Facility to the Mount Allan 115S substation.
- Provide a suitable visible open switch point on the 25kV side of the proposed transformer with a transmission facility switch number for "Guarantee of Isolation" purposes. The open point shall be able to accommodate a transmission facility owner lock and tag and all procedures related to the safe operation of this switch shall be included in the Join Operating Procedures.

Protection and Control Requirements

- Complete protection coordination studies and coordinate with the **legal owner** of a **transmission facility** as required to establish settings appropriate for the **market participant**'s facility additions and AIES operations.
- All load market participants are required to participate in the AIES **under-frequency load shedding** program as per OPP-804. The **market participant** shall ensure sufficient load is equipped with **under-frequency load shedding** relays armed in each frequency band to meet the program specifications, and that the scheme is installed, tested, and commissioned appropriately.
- Any frequency relays installed to protect equipment for off-nominal frequency operation must function at a transmission system voltage equal to or above 80% of the rated voltage.
- Install all the required protection and control equipment as required.

SCADA Requirements

- Establish communications interface point such that SCADA data can be transmitted back to the AESO's SCC and BUCC.
- All new Remote Terminal Units (RTU) shall have Global Positioning System (GPS) signaling for time synchronization.
- Implement control center data mapping and verification of SCADA information for the proposed transmission facility additions and modifications, and any associated changes required at other area substations as per Section 502.8 of the **ISO rules**. A complete listing of energy data requirements can be found in Appendix 7.3 of this document.

Telecommunication Requirements

- Coordinate and work cooperatively with the **legal owner** of a **transmission facility** to install new or modify/upgrade the existing communication system as required and establish appropriate communication interface such that tele-protection, SCADA, operational voice, operational data and mobile radio requirements are met.

(3) Miscellaneous

- All site preparation, fencing, foundations, grounding, support structures, termination structures, duct work, cabling, bus work, station service, control building, protection, controls, SCADA equipment, etc. as required to complete the additions and/or modifications outlined above.

6 TRANSMISSION SYSTEM OPERATING CHARACTERISTICS

The **legal owner** of a **transmission facility** and the **market participant** must ensure all facilities are capable of operating in the following electrical environment.

6.1 Short Circuit Current Levels

(1) The short circuit current levels set out in Tables 2, 3 and 4 have been developed by the AESO based on information provided by the **legal owners** of a **transmission facility,** any connecting **generating units,** and adjacent operating areas. Available fault current levels will continue to increase as generation, transmission, and system inter-ties are added to the AIES. The **legal owner** of a **transmission facility** and **market participant** must continue to review the fault levels and their equipment ratings for adequacy.

(2) Any future equipment upgrades or protection system setting changes required due to increasing fault levels are the responsibility of the **legal owner** of a **transmission facility** or the **market participant**, as applicable.

(3) The following assumptions were incorporated into the AESO short circuit current models:

(i) All expected Alberta generation is dispatched.
(ii) All transmission elements are in service.
(iii) The proposed project facility is connected as per this document.
(iv) $V_{base} = V_{bus}$, $MVA_{base} = 100$

Table 2: Summary of Short-Circuit Current Levels – 2019 WP Pre-Project

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Barrier 32S	138	142.0	6.7	0.018173+ j0.061685	5.8	0.019068+ j0.092798
Spray 33S	138	142.7	7.4	0.013199+ j0.057601	8.1	0.003554+ j0.039856
Mount Allan 115S	138	142.3	5.8	0.020851+ j0.071332	4.7	0.025746+ j0.126105

Table 3: Summary of Short-Circuit Current Levels – 2019 WP Post-Project

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Barrier 32S	138	141.8	6.7	0.018239+ j0.061534	5.8	0.019068+ j0.092798
Spray 33S	138	142.6	7.4	0.013253+ j0.057492	8.1	0.003554+ j0.039856
Mount Allan 115S	138	142.0	5.8	0.020957+ j0.071049	4.7	0.025746+ j0.126105

Table 4: Summary of Short-Circuit Current Levels – 2027 WP Post-Project

Substation Name and Number	Base Voltage (kV)	Pre-Fault Voltage (kV)	3-Φ Fault (kA)	Positive Sequence Thevenin Source Impedance (R1+jX1) (pu)	1-Φ Fault (kA)	Zero Sequence Thevenin Source Impedance (R0+jX0) (pu)
Barrier 32S	138	142.4	6.8	0.018669+ j0.060951	5.8	0.019070+ j0.092812
Spray 33S	138	143.0	7.4	0.013834+ j0.056866	8.2	0.003554+ j0.039856
Mount Allan 115S	138	142.5	5.9	0.021492+ j0.070450	4.7	0.025747+ j0.126112

6.2 Voltage Levels

Table 5 provides the normal planned operating voltage range in the area of the proposed facility.

Table 5: Planned Operating Range

Substation Name and Number	Nominal Voltage (kV)	Emergency Minimum Voltage (kV)	Desired Normal Minimum Voltage (kV)	Desired Normal Maximum Voltage (kV)	Emergency Maximum Voltage (kV)
Mount Allan 115S	138	124	135	145	150

Notes:
1. The Desired Normal Operating Minimum and Desired Normal Operating Maximum are generally associated with Category A events and system normal.
2. The Emergency Minimum Voltage and Emergency Maximum Voltage are generally associated with Category B and C events and system abnormal.
3. The facilities must be capable of continuous operation at voltages up to and including the Emergency Maximum Voltage.

6.3 Insulation Levels

(1) Table 6 provides the minimum required basic insulation levels for the **transmission facilities**. Station equipment with lower insulation levels may be used provided that protection and coordination can be maintained with judicious insulation design and use of appropriate surge arresting equipment.

(2) For 25 kV circuit breakers where there is a grounded wye transformer and surge arrestors are installed a basic insulation level of 125 kV is acceptable.

Table 6: Minimum Basic Insulation Levels (kV)

Nominal Voltage Classification (kV rms)	138	25
Station Post Insulators and Airbreaks	550	150
Circuit Breakers	650	150
Current and Potential Transformers	650	150
Transformer Windings (protected by surge arresters)	550	125

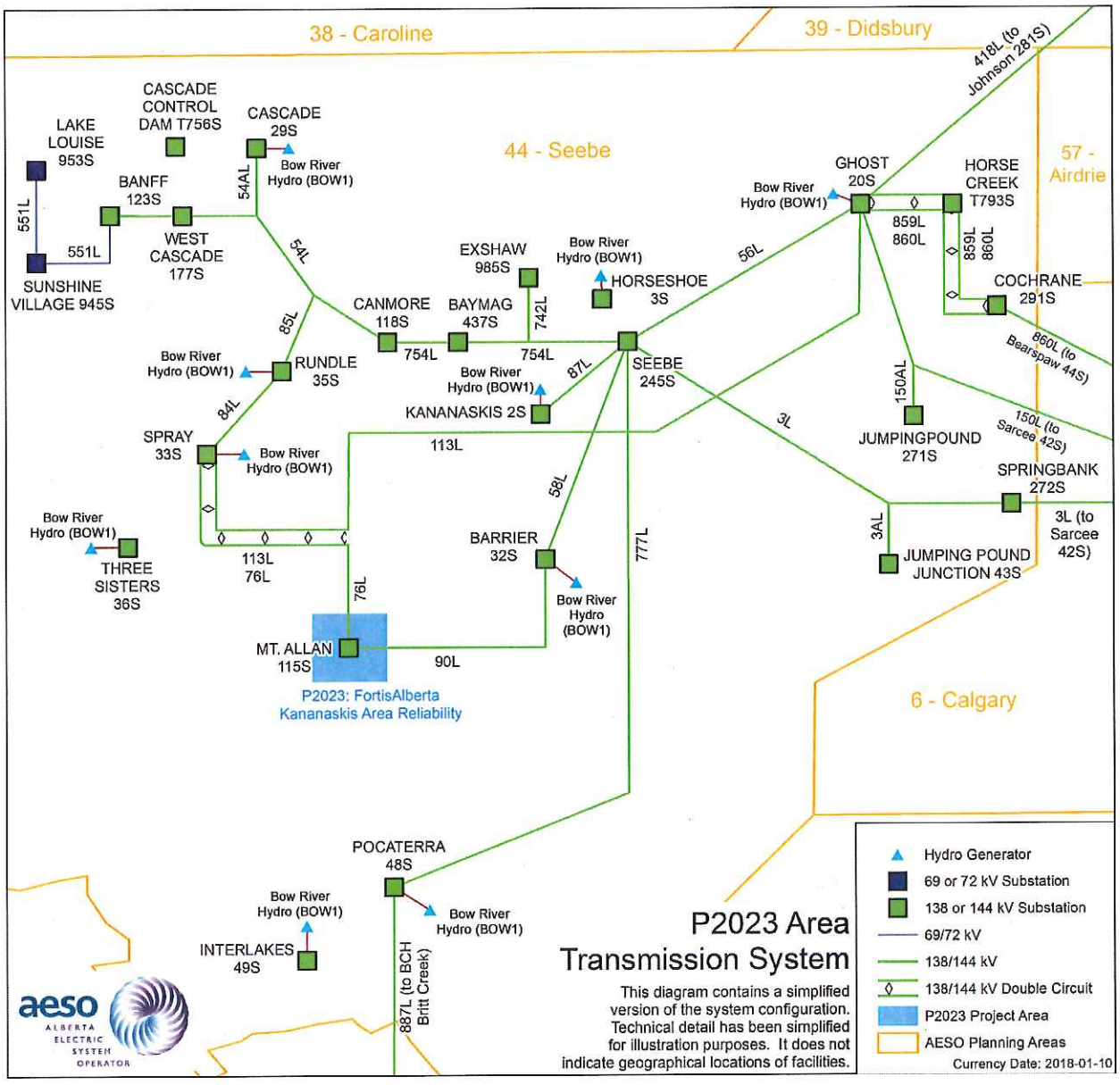
6.4 Remedial Action Scheme (RAS)

The Engineering Study Report (ESR) for this Project has indicated that no Remedial Action Scheme (RAS) or System Control Procedure (SCP) was identified for this Project based on assumptions used in the study.

Prior to the ISD of the Project, additional operations planning studies will be performed to determine and/or confirm the required mitigation measures, RAS, or procedure, by taking into account other connection and system projects, as appropriate. System conditions under additional contingency categories will also be assessed as part of operations planning studies. This will ensure that appropriate mitigation will be in place prior to the ISD of the Project. The AESO will consult with the **legal owner** of a **transmission facility** and the **market participant** before specifying revised and/or new mitigation measures.

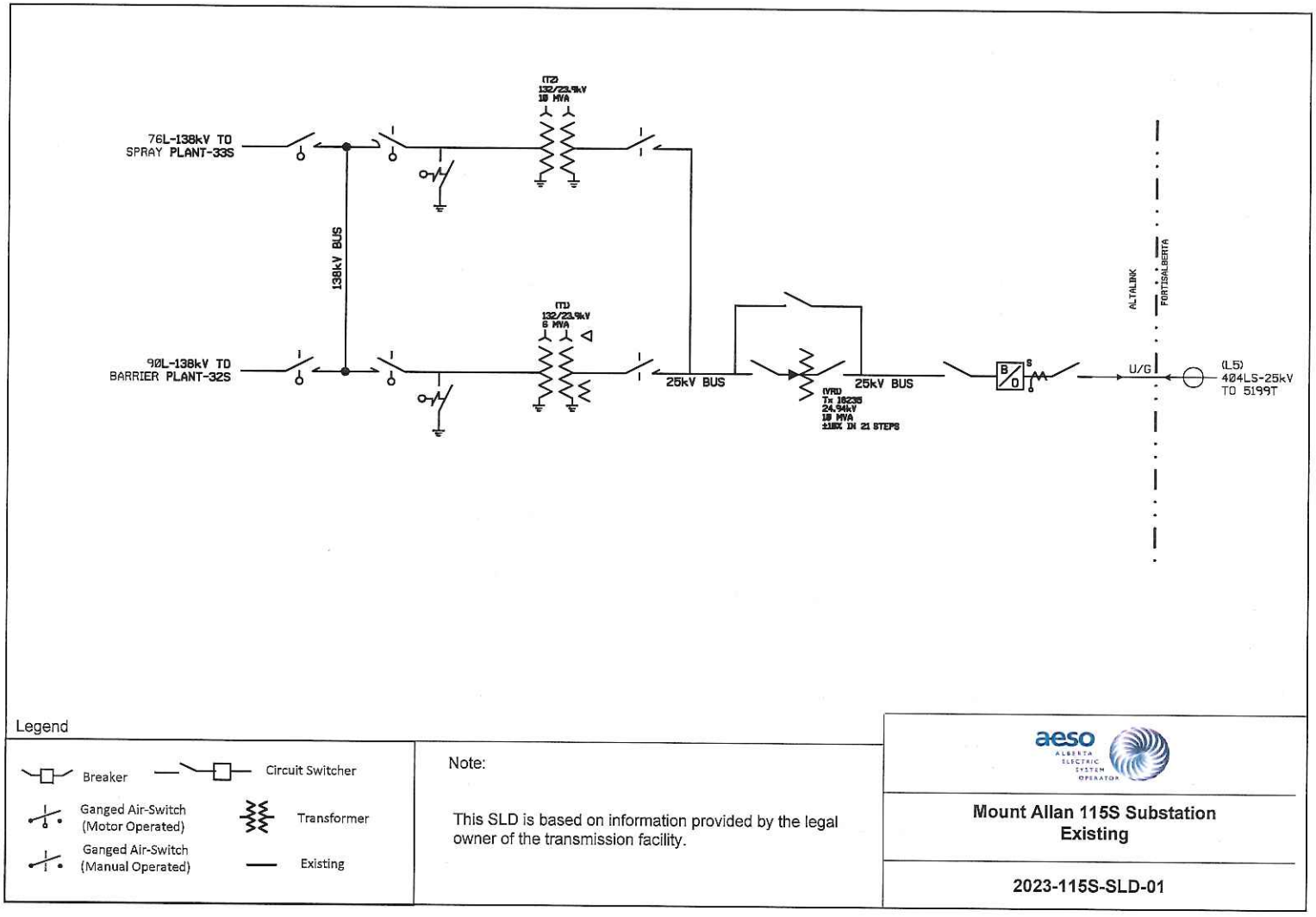
7 APPENDICES

7.1 Existing Area Transmission System and Project Area

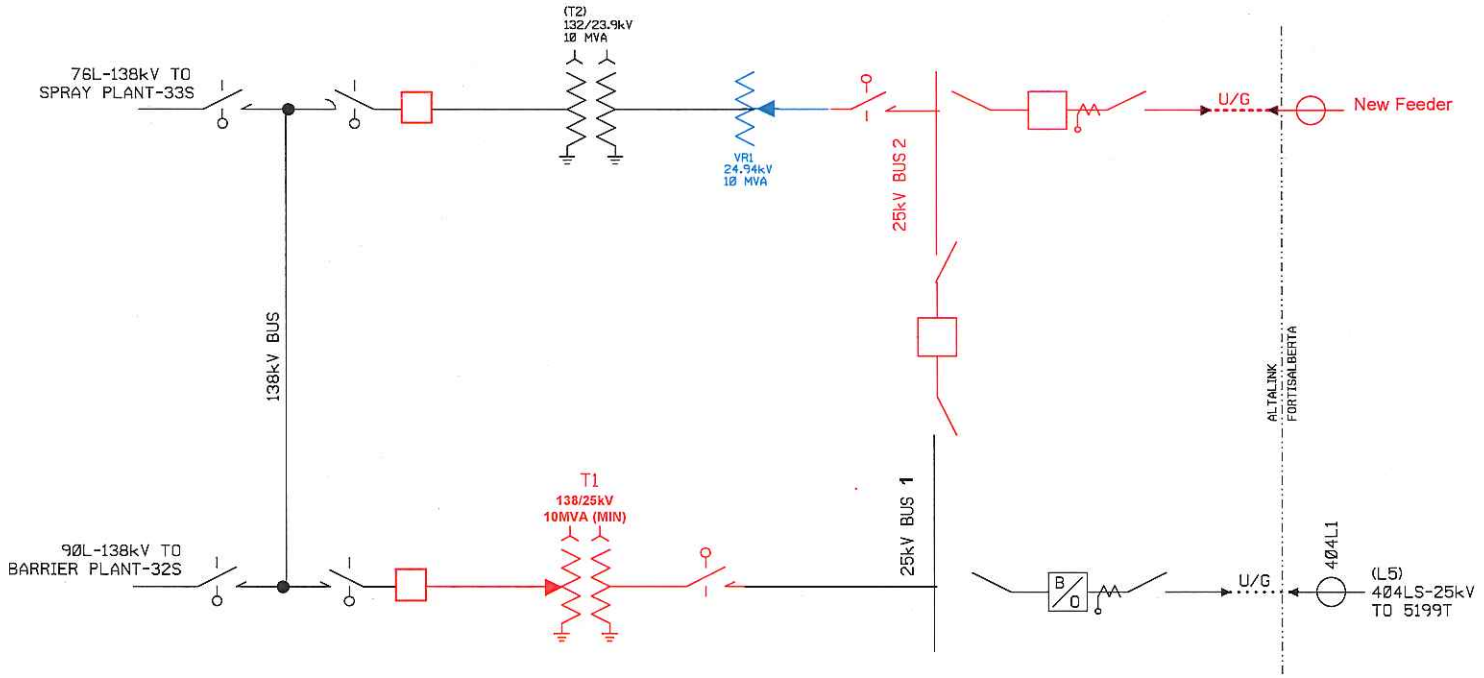


7.2 Single Line Drawings

7.2.1 MOUNT ALLAN 115S SUBSTATION – EXISTING



7.2.2 MOUNT ALLAN 115S SUBSTATION – PROPOSED DEVELOPMENT



Legend

Breaker
Circuit Switcher
Ganged Air-Switch (Motor Operated)
Transformer
Ganged Air-Switch (Manual Operated)
Existing
Proposed
Modified

Note:

This single line diagram provides an illustration of a functional arrangement that would meet the need of the proposed project. Although the TFO is required to maintain the specified functionality, the exact routing and configuration of the project proposed by the TFO in its facility application may vary slightly from this configuration based on more detailed engineering, routing and siting information obtained by the TFO in preparation of its Facility Application.

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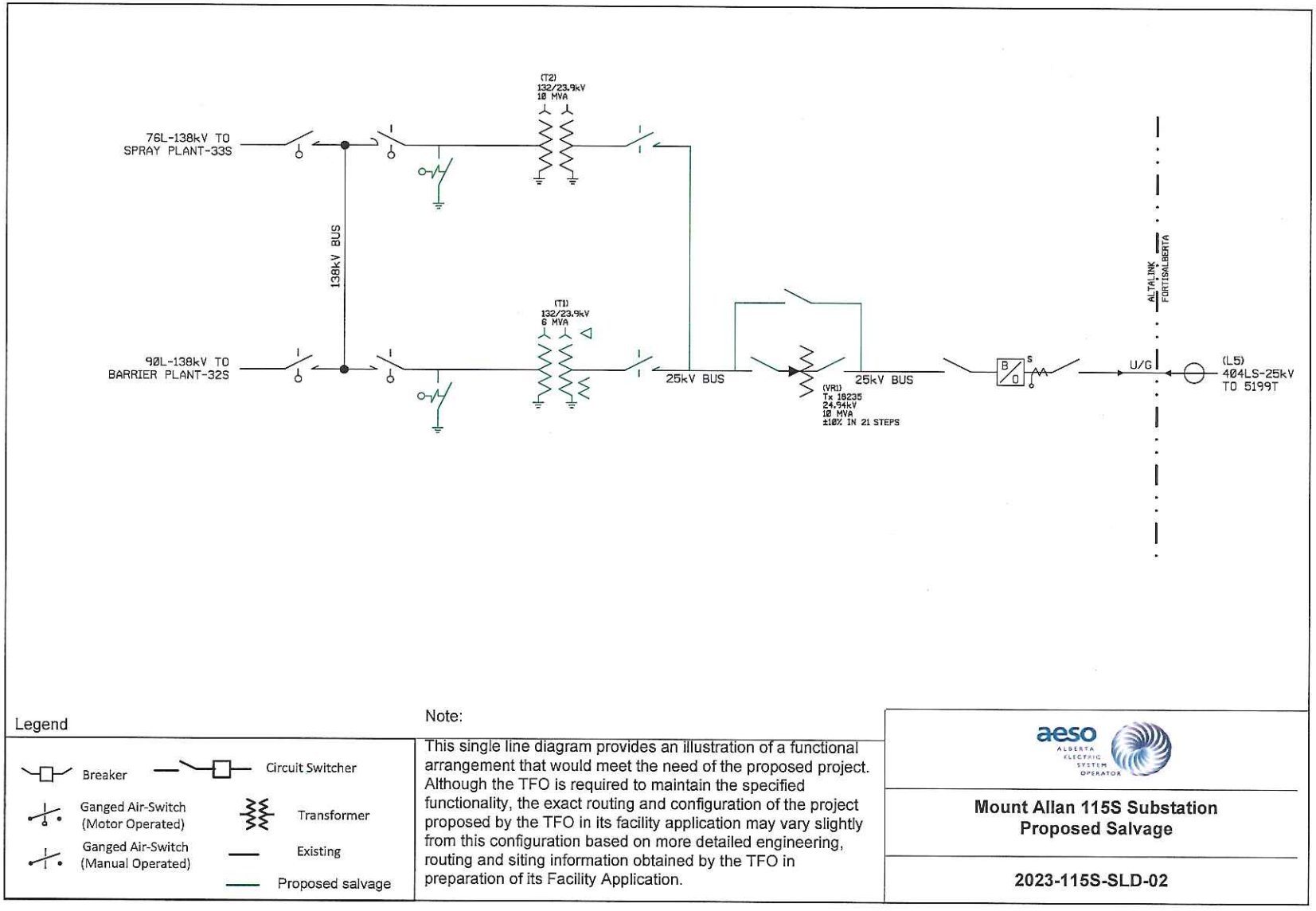
Mount Allan 115S Substation Proposed Development

2023-115S-SLD-03

7.2.2 MOUNT ALLAN 115S SUBSTATION – PROPOSED SALVAGE



Legend

- Breaker
- Circuit Switcher
- Ganged Air-Switch (Motor Operated)
- Transformer
- Ganged Air-Switch (Manual Operated)
- Existing
- Proposed salvage

Note:

This single line diagram provides an illustration of a functional arrangement that would meet the need of the proposed project. Although the TFO is required to maintain the specified functionality, the exact routing and configuration of the project proposed by the TFO in its facility application may vary slightly from this configuration based on more detailed engineering, routing and siting information obtained by the TFO in preparation of its Facility Application.

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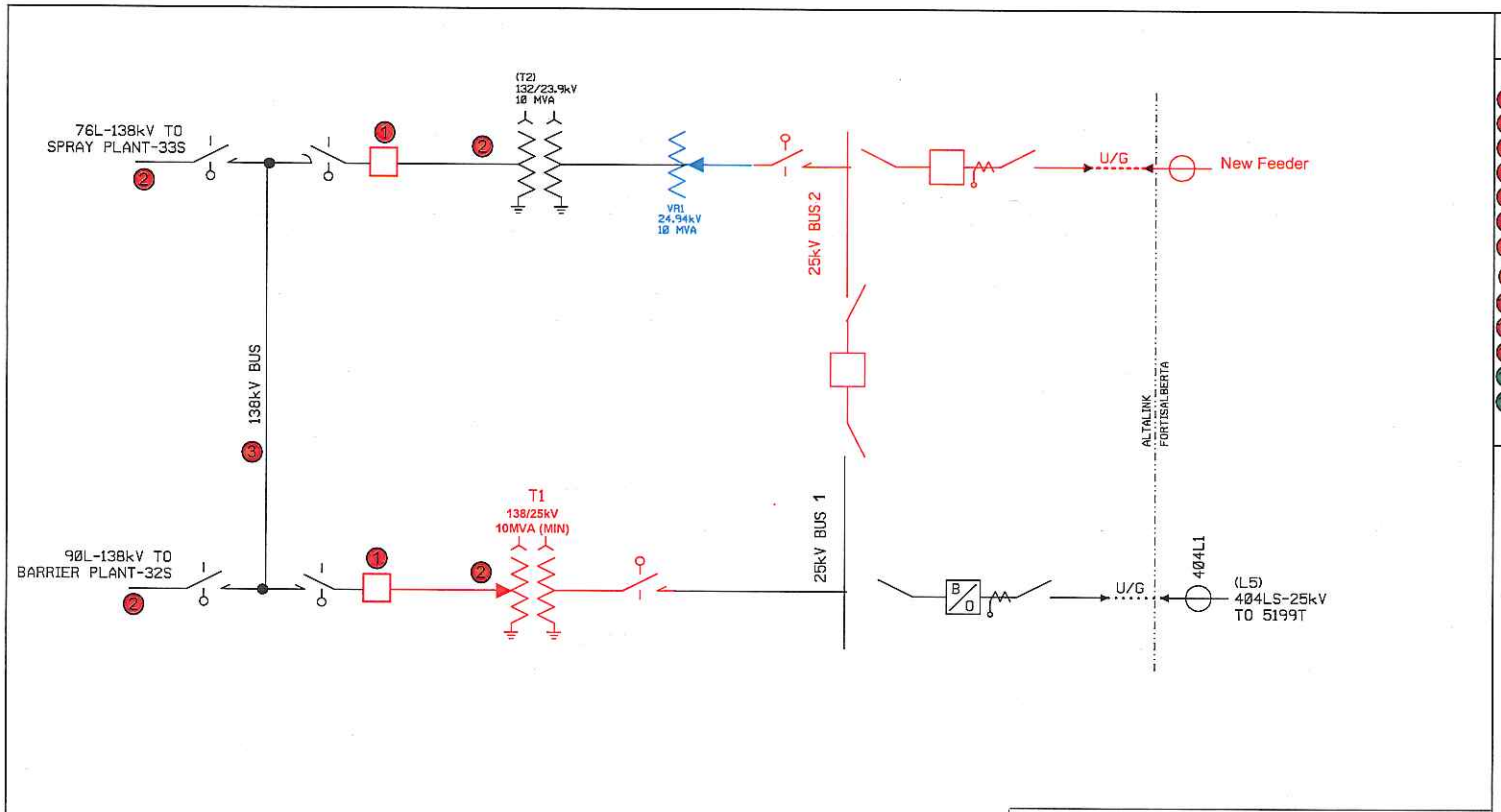
Mount Allan 115S Substation
Proposed Salvage

2023-115S-SLD-02

7.3 SCADA Point Requirements

7.3.1 Mount Allan 115S Substation



Transmission Facilities
502.8 Appendix 4

DATA TO AESO

1. Status
2. MW/Mvar Analogs
3. Voltage Analog (kV)
4. Frequency (Hz)
5. LTC Tap Position (TAP)
6. LTC Auto/Manual Status (AVR)
8. Automatic Voltage Regulation Setpoint
9. Reactive Power Resource Control Device Status
12. Reactive Power of Reactive Power Resource
13. Reactive Power Resource AVR Status
14. Reactive Power Resource Voltage Setpoint
15. IED Ganged Failure Alarm
16. RTU Failure Alarm

*Items in Green are required *Only if applicable*

Legend

- Breaker
- Circuit Switcher
- Ganged Air-Switch (Motor Operated)
- Transformer
- Ganged Air-Switch (Manual Operated)
- Existing
- Proposed
- Modified

Note:

This single line diagram provides an illustration of a functional arrangement that would meet the need of the proposed project. Although the TFO is required to maintain the specified functionality, the exact routing and configuration of the project proposed by the TFO in its facility application may vary slightly from this configuration based on more detailed engineering, routing and siting information obtained by the TFO in preparation of its Facility Application.

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Mount Allan 115S Substation
Proposed Development

2023-115S-SLD-03

7.4 SCADA Data Requirement

Facility/ Location	Device	Element	Indication	Max Latency	Notes
Mount Allan 115S	138 kV Line	76L Real Power	MW	30s	Note 3
	138 kV Line	76L Reactive Power	MVAr	30s	Note 3
	138 kV Line	90L Real Power	MW	30s	Note 3
	138 kV Line	90L Reactive Power	MVAr	30s	Note 3
	138 kV Bus	Bus 1 Voltage	kV	30s	
	138 kV Circuit Breaker (CB)	CB1 on the 138 kV side of T1	Status	30s	
	138 kV Circuit Breaker (CB)	CB2 on the 138 kV side of T2	Status	30s	
	138/25 Transformer	T1 Real Power	MW	30s	
	138/25 Transformer	T1 Reactive Power	MVAr	30s	
	132/23.9 Transformer	T2 Real Power	MW	30s	
	132/23.9 Transformer	T2 Reactive Power	MVAr	30s	
Note	**1. MW and MVAr SCADA data shall be gathered independently of the revenue metering data**				
	2. This list was prepared using the best available information. Final SCADA point will be determined based on the applicable SCADA Standard (502.8). **3. Requirement is waived per section 2(4) of this functional specification. This data will be emulated from the state estimator.**				