# Functional Specification

## P2582 Woodcroft Substation Upgrade

### AESO Project Number: P2582

**Issued to:**

*EPCOR Distribution & Transmission Inc. (EDTI TFO),* (as the **legal owner** of a **transmission facility)**, and to

*EPCOR Distribution & Transmission Inc. (EDTI DFO),* (as the **market participant**)

**Date:** May 11, 2023

**Version:** V1

**Classification:** Public

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## Functional Specification Revision History

| Revision | Description of Revision | By | Date |
|---|---|---|---|
| V1D1 | Issued for Internal Review | Jamiul Alam | Mar 15, 2023 |
| V1D2 | Issued for External Review | Jamiul Alam | Mar 23, 2023 |
| V1 | For Issuance | Jamiul Alam | May 11, 2023 |

# Contents

## 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 connection with the Alberta **interconnected electric system** (AIES) (the "Purpose"). This Functional Specification is issued by the Alberta Electric System Operator (AESO) to:

(i) EPCOR Distribution and Transmission Inc. (EDTI TFO), as the **legal owner** of a **transmission facility** described in the Functional Specification.

(ii) EPCOR Distribution and Transmission Inc. (EDTI DFO), as the **market participant** that has submitted a request for **system access service**.

(2) This Functional Specification is issued for the Purpose only. All of the parties named in Section 1(1) must comply with the Functional Specification provisions.

(3) This functional specification is being provided by the AESO in response to a **system access service** request and any applicable change proposals that were submitted by the **market participant**. The AESO makes no representations or warranties with respect to whether this Functional Specification meets the requirements of any contract or other arrangement associated with this project that has not been accounted for in the **system access service** request and subsequent change proposals, whether or not such contract or arrangement has been disclosed to the AESO by other means.

(4) 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.

(5) This Functional Specification includes:

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

(ii) the requirements to comply with **ISO rules**, including **reliability standards**, technical standards, and **ISO tariff** provisions (collectively called 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 Section 2(2), any revision or variance to any of the Functional Specification provisions by the parties named in Section 1(1) is prohibited.

(2) Any party named in Section 1(1) may make application, jointly or individually, in writing to the AESO requesting a variance to AESO Authoritative Documents, 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 AESO's *Consolidated Authoritative Document Glossary*.

# 3 PROJECT OVERVIEW

The **market participant** submitted a request for **system access service** to the AESO to reliably serve growing demand for electricity in the AESO transmission planning area of Edmonton (Area 60). The **market participant**'s request includes no change to its existing Rate DTS, *Demand Transmission Service*, contract capacity of 59 MW at the existing Woodcroft substation owned by the **legal owner** of a **transmission facility**.

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

- Upgrade the existing Woodcroft substation, including replacing three existing 72/14.4 kV 40 MVA transformers with three 72/14.4 kV 30/40/50 MVA DYg transformers.
- Add or modify associated equipment as required for the above transmission development.

The scheduled In-Service Date (ISD) is December 30, 2027. If there is a delay in the project in-service date, the **market participant** is required to engage the AESO to assess the need for an updated Functional Specification.

# 4 FORECAST OF FUTURE DEVELOPMENT IN THE PROJECT AREA

Proposed long term developments in the Edmonton area (Area 60) are described in the AESO 2022 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

The **legal owner** of a **transmission facility** and the **market participant** must:

(1) 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) coordinate with each other, as required, on all Project facility design details, including protection and control, grounding, insulation, **point of connection**, and site layout with proper consideration of maintenance coordination.

(3) develop joint operating procedures and any connection agreements, as required, such that all connecting **transmission facilities** will operate safely and reliably.

(4) 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) 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) mutually agree on each party's roles and responsibilities regarding inspection of all facilities of the Project prior to energization of the facilities.

(7) ensure prior to energization of any or all of their respective Project facilities, that the facilities to be energized have been inspected by qualified personnel, so that the 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) Do not energize any Project facilities until an energization authorization has been issued by the AESO in accordance with the **ISO rules**.

## 5.2 Compliance with AESO Authoritative Documents

Any party named in Section 1(1) must comply with the Authoritative Documents provisions which are applicable to the Project and which must be satisfied and incorporated into the design, construction, commissioning and operation of the connecting facilities and other connection Project work, including but not limited to these provisions contained herein:

- Alberta Reliability Standards
- **ISO rules** including:
  - Section 502.3, *Interconnected Electric System Protection Requirements* (effective December 11, 2019) (“Section 502.3”);
  - Section 502.4, *Automated Dispatch and Messaging System and Voice Communication System Requirements* (effective March 27, 2015) (“Section 502.4”);
  - Section 502.7, *Load Facility Technical Requirements* (effective December 11, 2019) (“Section 502.7”);
  - Section 502.8, *SCADA Technical and Operating Requirements* (effective February 18, 2021) (“Section 502.8”);
  - Section 502.10, *Revenue Metering System Technical and Operating Requirements* (effective March 18, 2021) (“Section 502.10”);
  - Section 502.15, *Reporting Facility Modelling* (effective December 11, 2019) (“Section 502.15”);

## 5.3 Modelling Data Requirements

All modelling data shall be provided as per the Information Document ID# 2010-001R Facility Modelling Data (issued on July 26, 2021), which relates to Section 502.15.

## 5.4 Substation Equipment Specifications

All new substation equipment[1] must meet the following minimum specifications:

- Temperature rating of -40ºC for all outdoor equipment.
- Equipment maximum and minimum continuous voltage ratings as indicated in Table 4.
- Minimum continuous equipment current ratings as indicated in Table 1.
- Equipment maximum fault duty: 40 kA for 72 kV.

**Table 1**: Minimum Continuous Equipment Current Ratings (A)

| **Component** note 5 | **69/72 kV** |
|---|---|
| Main Bus Note 1 | 1200 |
| Cross Bus Note 2, 3 | 600 |
| Equipment | 600 |
| Transmission Termination 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 a third schemes.
Note 3: Cross bus can have higher minimum current rating based on bus configuration and equipment connectivity.
Note 4: Transmission termination includes all connectors and conductor from the transmission line termination 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 the market participants.

## 5.5 Specific Scope of Work for the Legal Owner of a Transmission Facility [EDTI TFO]

### (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 and any mitigation for electrical effects on communication systems.
- Complete insulation coordination studies and coordinate with the **market participant,** as required, to establish appropriate insulation levels.

[1] 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.

- Complete all site preparation, including fencing, foundations, grounding, support structures, termination structures, duct work, cabling, bus work, station service, control building, protection, controls, and SCADA equipment, as required.

**(2) Existing Woodcroft Substation– See Appendices 7.2**

**Substation Equipment**

- Replace three (3) existing 72/14.4 kV 40 MVA transformers with three (3) 72/14.4 kV LTC DYg transformers with a transformation capability of 30/40/50 MVA.
- Discontinue the existing three (3) 72/14.4 kV 40 MVA transformers from use for transmission purpose.

**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.
- The **legal owner** of a **transmission facility** shall work with the **market participant** to design, modify and install necessary protection schemes to ensure safety and reliable operation.

**Telecommunication Requirements**

- Install new or modify/upgrade the existing communications system as necessary to meet the Project requirements for operation, control, protection and SCADA.
- The **legal owner** of a **transmission facility** shall provide access to the telecommunication system for communication services (SCADA) if requested by the **market participant**, as required by the AESO for the operation of the AIES.

**Revenue Metering Requirements**

- Install bi-directional **meters**, if required**,** to meet the metering requirement for the connection of the Facility.
- Provide the AESO with a metering single line diagram to show physical revenue meter location.

**SCADA Requirements**

- Update or modify existing communications interface point such that SCADA data can be transmitted back to the AESO's System Coordination Centre (SCC) and Backup Coordination Centre (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 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 7.4 of this document.

**(3) Miscellaneous**

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

### 5.6 Scope of Work for the Market Participant [EDTI DFO]

**(1) General Requirements**

- 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 Woodcroft Substation– See Appendices 7.2**

**Transmission Equipment**

- Coordinate with the **legal owner** of a **transmission facility,** as required, to connect the **market participant**'s facility to the 14.4 kV connection point.
- Complete insulation coordination studies and coordinate with the **legal owner** of a **transmission facility** as required, to establish appropriate insulation levels.

**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 the AIES operations.
- All load **market participants** are required to participate in the AIES **underfrequency load shedding** program as per PRC-006-AB-3 of Alberta Reliability Standards. The **market participant** shall ensure sufficient load is equipped with **underfrequency 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.

**Telecommunication Requirements**

- Coordinate with the **legal owner** of a **transmission facility** to install new or modify/upgrade the existing communication system as necessary.

## 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 and 3 have been derived by the AESO based on information provided by the **legal owner** of a **transmission facility,** any connecting **generating units,** and adjacent operating areas. Available short circuit current levels will continue to increase as generation, transmission, and system interties are added to the AIES. The **legal owner** of a **transmission facility** and the **market participant** must continue to review the short circuit current levels and their equipment ratings for adequacy.

(2) Any future equipment upgrades or protection system setting changes required due to increasing short circuit current 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 Facility/**transmission facility** is connected as per this document.
(iv) $V_{base} = V_{bus}$, $MVA_{base} = 100$

**Table 2a:** Summary of Short Circuit Current Level - 2023WP Pre-Project

| Substation Name and Number | Base Voltage (kV) | 3PH Fault (kA) | Positive Sequence Thevenin Source Impedances (R1+JX1) (pu) | 1PH Fault (kA) | Zero Sequence Thevenin Source Impedances (R0+JX0) (pu) |
|---|---|---|---|---|---|
| North Calder | 240 | 17.56 | 0.002967+j0.014039 | 14.82 | 0.003928+j0.022038 |
| Jasper | 240 | 18.38 | 0.003090+j0.013367 | 15.61 | 0.003263+j0.020881 |
| Bellamy | 240 | 20.98 | 0.002573+j0.011835 | 18.98 | 0.003293+j0.015685 |
| Poundmaker | 240 | 17.71 | 0.003133+j0.013881 | 14.42 | 0.003100+j0.020440 |
| Jasper | 72 | 15.69 | 0.007175+j0.055826 | 19.24 | 0.001099+j0.025281 |
| Meadowlark | 72 | 13.49 | 0.012083+j0.064150 | 10.93 | 0.069749+j0.094503 |
| Woodcroft Tx1 & Tx3 (supplied from Jasper) | 72 | 11.5 | 0.017937+j0.074175 | 9.23 | 0.102422+j0.101085 |
| Woodcroft Tx2 (supplied from Rossdale) | 72 | 16.43 | 0.020673+J0.050087 | 13.68 | 0.069942+J0.060373 |
| Poundmaker | 72 | 12.64 | 0.007518+J0.070003 | 11.45 | 0.008260+J0.092090 |
| Rossdale | 72 | 30.38 | 0.004377+j0.029067 | 39.16 | 0.001062+j0.009683 |

**Table 2b:** Summary of Short Circuit Current Level - 2023WP Post-Project

| Substation Name and Number | Base Voltage (kV) | 3PH Fault (kA) | Positive Sequence Thevenin Source Impedances (R1+JX1) (pu) | 1PH Fault (kA) | Zero Sequence Thevenin Source Impedances (R0+JX0) (pu) |
|---|---|---|---|---|---|
| North Calder | 240 | 17.56 | 0.002967+j0.014038 | 14.82 | 0.003928+j0.022038 |
| Jasper | 240 | 18.38 | 0.003090+j0.013366 | 15.61 | 0.003263+j0.020881 |
| Bellamy | 240 | 20.98 | 0.002573+j0.011835 | 18.98 | 0.003293+j0.015685 |
| Poundmaker | 240 | 17.71 | 0.003133+j0.013880 | 14.42 | 0.003100+j0.020440 |
| Jasper | 72 | 15.68 | 0.007181+j0.055821 | 19.24 | 0.001099+j0.025281 |
| Meadowlark | 72 | 13.49 | 0.012088+j0.064146 | 10.93 | 0.069749+j0.094503 |
| Woodcroft Tx1 & Tx3 (supplied from Jasper) | 72 | 11.5 | 0.017945+j0.074164 | 9.23 | 0.102422+j0.101085 |
| Woodcroft Tx2 (supplied from Rossdale) | 72 | 16.43 | 0.020674+J0.050084 | 13.68 | 0.069942+J0.060373 |
| Poundmaker | 72 | 12.64 | 0.007520+J0.070001 | 11.45 | 0.008260+J0.092090 |
| Rossdale | 72 | 30.38 | 0.004378+j0.029067 | 39.16 | 0.001062+j0.009683 |

**Table 3:** Summary of Short Circuit Current Level - 2033WP Post-Project

| Substation Name and Number | Base Voltage (kV) | 3PH Fault (kA) | Positive Sequence Thevenin Source Impedances (R1+JX1) (pu) | 1PH Fault (kA) | Zero Sequence Thevenin Source Impedances (R0+JX0) (pu) |
|---|---|---|---|---|---|
| North Calder | 240 | 17.26 | 0.003126+j0.014183 | 14.63 | 0.003917+j0.022104 |
| Jasper | 240 | 17.94 | 0.003275+j0.013583 | 15.3 | 0.003250+j0.021090 |
| Bellamy | 240 | 20.69 | 0.002684+j0.011906 | 18.9 | 0.003180+j0.015418 |
| Poundmaker | 240 | 17.33 | 0.003317+j0.014075 | 15.15 | 0.003085+j0.020590 |
| Jasper | 72 | 15.56 | 0.007448+j0.056069 | 19.09 | 0.001092+j0.025345 |
| Meadowlark | 72 | 13.4 | 0.012385+j0.064401 | 10.87 | 0.069814+j0.094629 |
| Woodcroft Tx1 & Tx3 (supplied from Jasper) | 72 | 11.42 | 0.018222+j0.074385 | 9.18 | 0.102415+j0.101149 |
| Woodcroft Tx2 (supplied from Rossdale) | 72 | 16.41 | 0.020870+J0.050317 | 13.69 | 0.069942+J0.060398 |
| Poundmaker | 72 | 12.6 | 0.007815+J0.070420 | 11.41 | 0.008349+J0.092657 |
| Rossdale | 72 | 30.24 | 0.004574+j0.029304 | 38.99 | 0.001062+j0.009708 |

## 6.2 Voltage Levels

### (1) Area Planning Voltage Range

Table 4 provides the steady state planning voltage range in the area of the proposed Facility/**transmission facility**.

**Table 4:** Steady State Voltage Range (kV) during Normal and Contingency Events

| 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) |
|---|---|---|---|---|---|
| Woodcroft | 72 | 65 | 68.5 | 75.5 | 79 |

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.
4. Planning voltage range specified in Table 4 can be used as operational voltage range in the substations unless the substations are also listed in Table 1 in ID #2010-007RS of Alberta Reliability Standard VAR-001 with customized operational voltage range. The planning and operational voltage range are applicable to any new equipment proposed in this project. Please report to the AESO if existing equipment cannot meet the range.

## 6.3 Insulation Levels

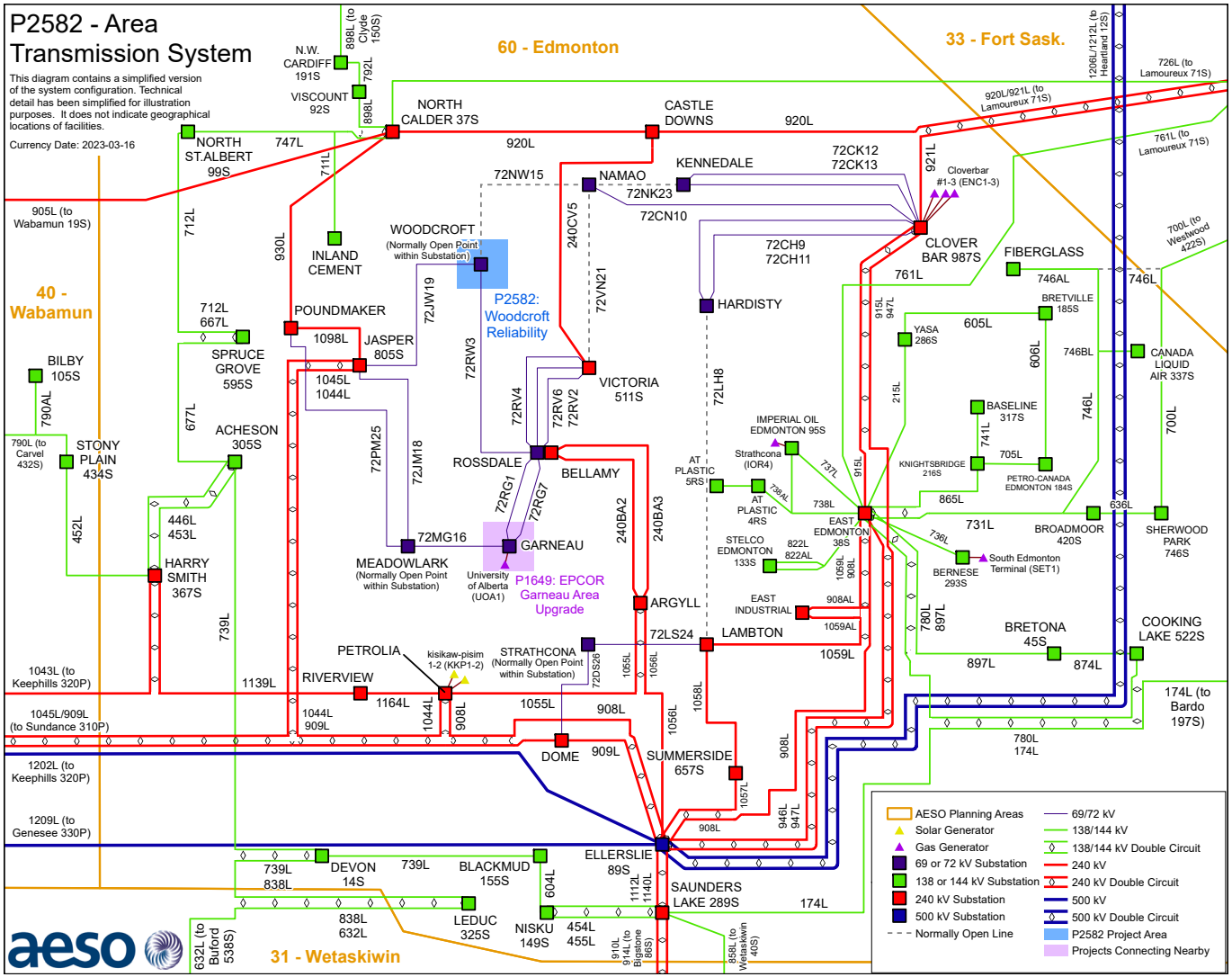
(1) Table 5 provides the minimum required basic insulation levels for the **transmission facilities**. Station equipment with lower insulation levels may be used provided that protection and coordination can be maintained with judicious insulation design and use of appropriate surge arresting equipment.

**Table 5:** Minimum Basic Impulse Levels (kV)

| Nominal Voltage Classification (kV rms) | 15 | 72 |
|---|---|---|
| Station Post Insulators and Airbreaks | 150 | 350 |
| Circuit Breakers | 150 | 350 |
| Current and Potential Transformers | 150 | 350 |
| Transformer Windings (protected by surge arresters) | 125 | 350 |

# 7 APPENDICES

## 7.1 Area Transmission System - Proposed





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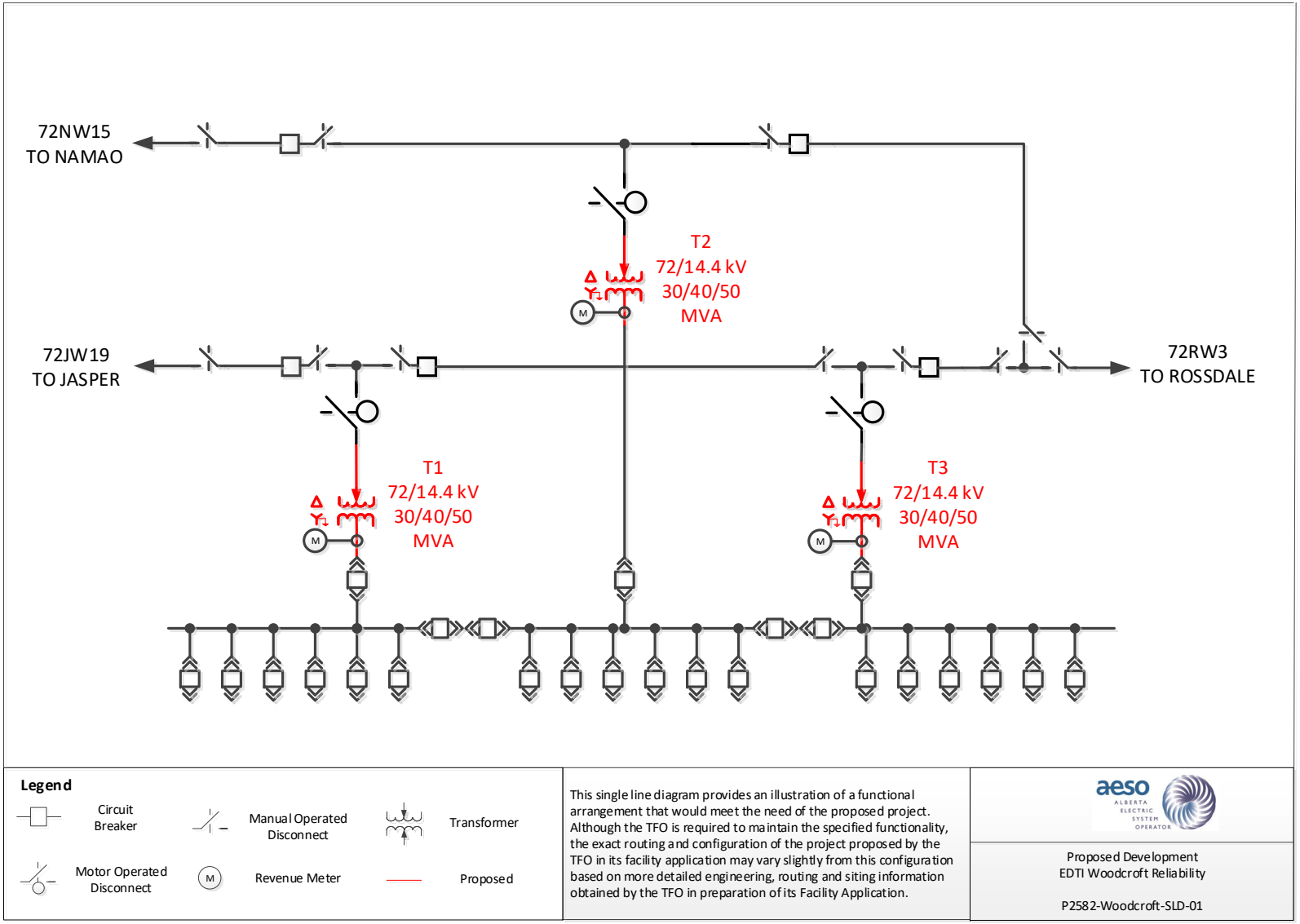
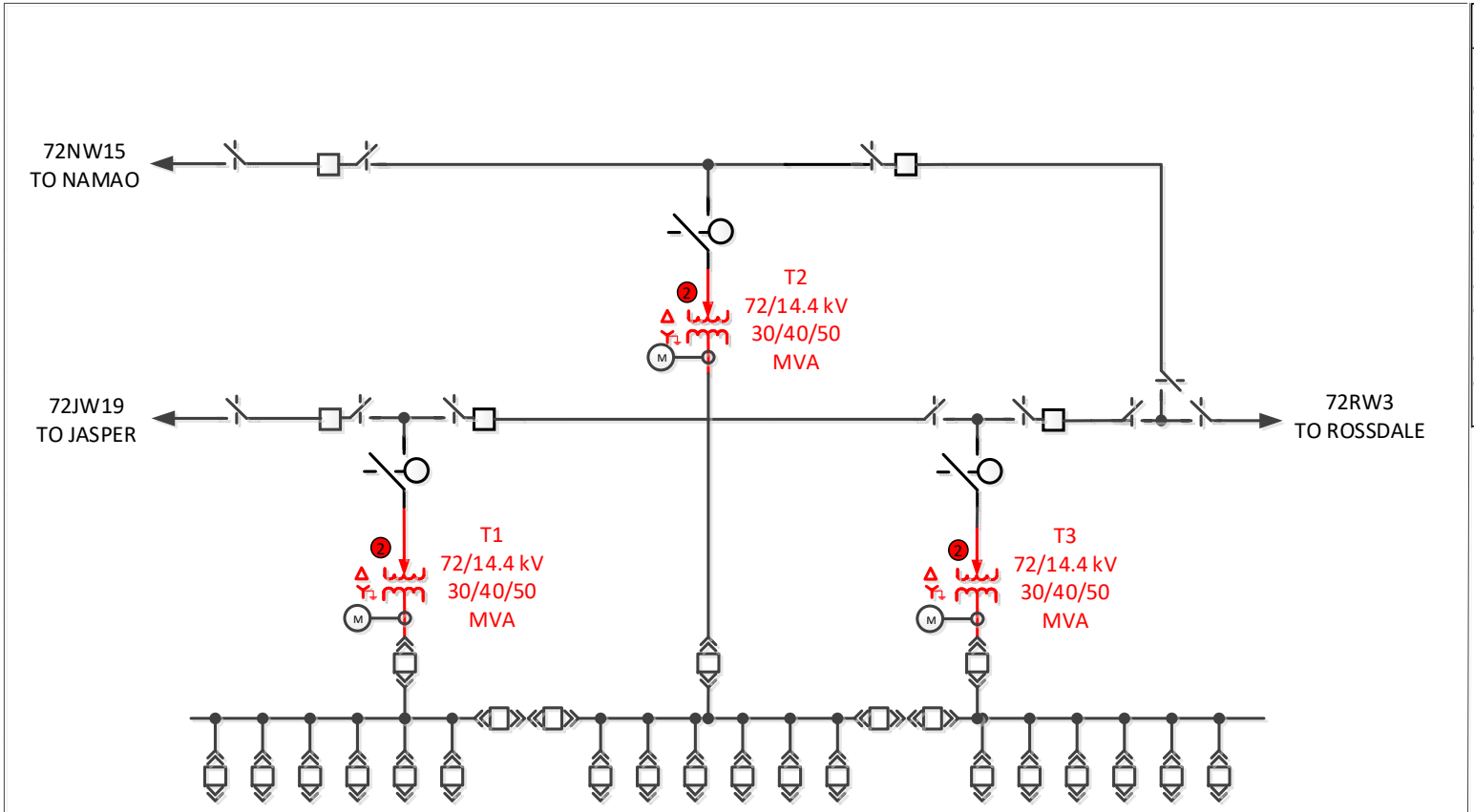
## 7.2 Single Line Drawing – Woodcroft Substation – Proposed



## 7.3 SCADA Requirements



## 7.4 SCADA Data Requirements

| Facility/Location | Device | Element | Indication | Max Latency | Notes |
|---|---|---|---|---|---|
| **P2582 Woodcroft Substation Upgrade Woodcroft** | 72/14.4 kV Transformer | Real Power at the High Side of Transmission System Step-up Transformer T1 | MW | 30s | |
| | 72/14.4 kV Transformer | Reactive Power at the High Side of Transmission System Step-up Transformer T1 | MVAr | 30s | |
| | 72/14.4 kV Transformer | Real Power at the High Side of Transmission System Step-up Transformer T2 | MW | 30s | |
| | 72/14.4 kV Transformer | Reactive Power at the High Side of Transmission System Step-up Transformer T2 | MVAr | 30s | |
| | 72/14.4 kV Transformer | Real Power at the High Side of Transmission System Step-up Transformer T3 | MW | 30s | |
| | 72/14.4 kV Transformer | Reactive Power at the High Side of Transmission System Step-up Transformer T3 | MVAr | 30s | |
| | | | | | |
| | | | | | |
| **Note** | **1. MW and MVAr SCADA data shall be gathered independently of the revenue metering data** | | | | |
| | **2. An external GPS based signal shall be utilized to provide 1ms time stamped event accuracy** | | | | |
| | **3. Additional SCADA measurements may be required for resources to provide ancillary services** | | | | |