NorthWestern® Energy

Delivering a Bright Future

PROJECT #401

LARGE GENERATION
INTERCONNECTION FACILITIES STUDY
RESTUDY

MAY 24, 2024

ELECTRIC TRANSMISSION PLANNING

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Introduction

NorthWestern Energy (NWE) has prepared this Facilities Study (FAC) to provide the following information:

- Identify: The electrical switching configuration of the equipment, including, without limitation, transformer, switchgear, meters, and other station equipment.
- Specify and estimate: The cost of the equipment, engineering, procurement and construction work (including overheads) needed to implement the conclusions of the System Impact Study report.
    - The nature and estimated cost of the Transmission Provider's Interconnection facilities and Network Upgrades necessary to accomplish the interconnection.
    - An estimate of the time required to complete the construction and installation of such facilities.

This FAC Restudy has been prepared in response to SIS Restudy #3 dated March 15, 2024 and supersedes previously issued FAC reports.

Description of Project

The Interconnection Customer (Customer) has proposed interconnecting a wind facility to the 100 kV bus at NWE's existing Roundup City substation. The interconnection request is for a total output of 70 MW at the Point of Interconnection (POI). The Generating Facility is Project Number 401 in NWE's interconnection queue. The requested Commercial Operation Date (COD) is November 15, 2023.

The Interconnection Customer has requested NRIS service.

The mitigation (including cost responsibility) for any transmission/distribution violations is defined as part of the Facility Study Report associated with this request. NWE is responsible for maintaining acceptable system reliability, and must be certain that system reliability is maintained with the addition of the proposed load increase. NWE's Business Practices identify the acceptable tolerance levels.

Interconnection Data

The interconnection information used in these studies includes:

Project

- **Interconnection Queue Position:** 401
- **Requested Output at Point of Interconnection:** 70 MW
- **Rated Size** 84 MW @ 1.0 pf, nameplate
- **Interconnection Service Requested:** NRIS
- **Requested Commercial Operation Date:** November 15, 2023

Point of Interconnection

- **Description of Location:** Roundup City substation
- **Location:** 46°26'24.56"N, 108°33'46.26"W
- **Nominal Voltage:** 100 kV

Equipment

- **Turbine Information:**
  - Number of Turbines: 14
  - Manufacturer: Vestas
  - Make/Model: V162-6.0
  - Turbine Type: Type 4
  - Nameplate Turbine Rating: 7.0 MVA, 6.0 MW
- **GSU Transformers:**
  - Number of Transformers: 14
  - Size: 7 MVA
  - Voltage: 0.72/34.5 kV
  - Winding Connection: Wye-Gnd/Delta (Low/High)
  - Impedance: 9.9 %, 19.2 X/R
  - Fixed or OLTC: Fixed
- **Main Transformers at POI:**
  - Number of Transformers: 1
  - Size: 66/88/110 MVA transformers
  - Voltage: 34.5/100 kV
  - Winding Connections: Wye-Gnd/Wye-Gnd (Low/High)
  - Impedance: 8 %; 35 X/R
  - Fixed or OLTC: Fixed
- **Storage:**
  - None

Point of Change of Ownership:

The change in ownership will occur at the POI substation dead-end structure as detailed below.

Conductor

- NWE will own/maintain the substation dead-end structure and all equipment on the substation side of the structure. Customer will provide and own the conductor, shoe, and insulator on the project side of the substation dead-end structure.
- Responsibility for installation of Customer connections and terminations of the lead line to the substation dead-end structure will be determined during construction in order to ensure that the Customer and contractors recognize and adhere to NWE guidelines and policies and accommodate substation construction and operational requirements.

Communications

- The Customer will provide, own and install OPGW and associated hardware, on the generator lead transmission line to their side of the POI substation dead-end structure. The Customer will also dead-end, train down, and attach OPGW to the POI substation dead-end tower with a 50 ft long coil of OPGW cable on each run at the base of the dead-end structure.
- NWE will supply the armor cans, splice cases and splice tray (along with labor) to splice each OPGW to each ADSS cable in the NWE POI substation yard.
- Responsibility for installation of Customer OPGW connections and terminations to the substation dead-end structure will be determined during construction in order to ensure that the customer and contractors recognize and adhere to NWE guidelines and policies and accommodate substation construction and operational requirements.

Customer Requested Commercial Operation Date: November 15, 2023

Disclaimer

NWE cannot guarantee that future analysis (i.e. Transmission Service or Operational studies) will not identify additional problems or system constraints that require mitigation or reduce operation. There are currently Transmission Service Requests (TSRs) in the NWE transmission service queue that may impact the study results for this Project. Should one of these queued TSRs become designated/granted, future analysis of this project could have different mitigation when applying for transmission service. Neither ERIS nor NRIS interconnection product conveys or implies any type of transmission service. If there is a change in the generator interconnection queue, a restudy of this Project may be required.

System Impact Study Results Overview

Steady State Power Flow Analysis

The study showed that the addition of the Generating Facility at full output to NWE's transmission system as an NRIS project causes/contributes to the following thermal violations.

- Overloads on Crooked Falls – Wayne Pump tap – North Raynesford Cenex Pump tap – Spion Kop Wind tap 100 kV line
  - Loss of Great Falls 230 kV Switchyard – Highwood Switchyard – Spion Kop Switchyard 230 kV line
  - Opening of Great Falls 230 Switchyard – Highwood Switchyard, Highwood Switchyard – Spion Kop Switchyard, or Spion Kop Switchyard – Judith Gap Auto 230 kV lines sections without a fault
  - Breaker failures that remove the above elements
- Overloads on Spion Kop Wind tap – Raynesford Pump tap – Stanford Auto, Stanford Auto – Benchland, Benchland – Utica Pump tap – Utica Rural – Front Range Cenex Pump tap – Judith Gap Auto 100 kV lines
  - A 230 kV breaker failure at Great Falls 230 kV Switchyard
- Overloads on Harlowton – Judith Gap tap – Judith Gap Auto 100 kV line
  - Opening of Judith Gap Auto – Project 360 230 kV line section without a fault
  - Loss of Broadview Switchyard 230/100 bank '1' or '2'
  - Breaker failures that remove the above elements
- Overloads on Painted Robe – Broadview Switchyard 100 kV line
  - Loss of Roundup City – Broadview Switchyard 100 kV line
  - Loss of Broadview Switchyard – Project 333 230 kV line
  - Loss of Project 333 – Judith Gap South 230 kV line
  - Opening of Roundup City – Roundup Pump tap 100 kV line section without a fault
  - Breaker failures that remove the above elements
- Overloads on Painted Robe – Harlowton 100 kV line
  - Loss of Broadview Switchyard 230/100 kV bank '1'or '2'
  - Breaker failures that remove the above elements
- Overloads on Broadview Switchyard 230/100 kV bank '2'
  - Loss of Project 333 – Judith Gap South 230 kV line
  - Loss of Broadview Switchyard – Project 333 230 kV line
  - Loss of Broadview Switchyard 230/100 kV bank 1' (after Broadview rebuild)
  - Breaker failures that remove the above elements

Discussion

- The following transmission upgrades are required prior to NRIS interconnection. The transmission upgrades are broken into two groups: New Network Upgrades and Contingent Facilities.

New Network Upgrades:

- Upgrade Painted Robe – Broadview Switchyard 100 kV line
- Rebuild Broadview Switchyard substation to accomplish the following:
  - Breaker and a half configuration of the 100 kV bus
  - Independent protection so that the 230/100 kV banks can fault independently leaving the other parallel bank in service
- Uprate Broadview Switchyard 230/100 kV bank '2' to 100 MVA minimum. This is a planned network upgrade.

Contingent Facilities:

Project 335:

- Upgrade Crooked Falls – Wayne Pump tap – North Raynesford Cenex Pump tap – Spion Kop Wind tap 100 kV line
- Upgrade Benchland – Stanford Auto 100 kV line
- Upgrade Harlowton – Judith Gap Tap – Judith Gap Auto 100 kV line

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- Upgrade Spion Kop Wind tap – Raynesford Pump tap – Stanford Auto 100 kV line
- Upgrade Benchland – Utica Pump tap – Utica Rural – Front Range tap – Judith Gap Auto 100 kV 100 kV line

Fault Duty Analysis

A typical breaker interrupt rating is 40,000 amps. The fault current observed at the POI was approximately 3,530 amps. The addition of the Generating Facility did not cause any breakers in the local area to exceed their interrupt rating. The Generating Facility can interconnect without needing to replace or upgrade any existing breakers.

Short Circuit Ratio (SCR) Analysis

Table 1 shows the SCR at the POI for an N-0 and N-1 (strongest source out-of-service) condition for this Project. It is recommended that the Customer work with their generator manufacturer to ensure that the system they are procuring is capable of operating in a potentially "weak" system. As part of the construction sequence, an electromagnetic transient (EMT) study will be performed to verify the Project does not have any negative impact on the rest of the system. The EMT study will be performed by contract engineering services once we have received a deposit and received updated data based on the actual equipment being procured by the Customer.

Table 1: SCR at the POI

System Condition	Without 401's Contingent Facilities or Required Mitigation	With 401's Contingent Facilities	With 401's Contingent Facilities & New Required Mitigation
N-0	7.40	7.43	7.59
N-1	1.67	1.73	4.20

Transient Stability Analysis

The study showed that the addition of the Generating Facility at full output to NWE's transmission system as an NRIS project causes the simulation to diverge, causes frequency and voltage oscillations in the Roundup City area that do not show positive dampening within 30 seconds of the studied event (TPL-001-WECC-CRT-3.2 WR1.1.6), or causes the voltage at BES load serving buses in the Roundup City area to dip below 70 % of pre-contingent voltage for more than 30 cycles following fault clearing and voltage recovery above 80 % (TPL-001-WECC-CRT-3.2 WR1.1.4). These transient stability violations occur under contingencies at Broadview Switchyard that remove the Broadview Switchyard 230/100 kV banks. The rebuild at Broadview Switchyard identified in the Steady State Power Flow Analysis section mitigates these transient stability violations and will be required prior to a NRIS interconnection.

Power Voltage Analysis

For every contingency analyzed, it was found that there is adequate reactive margin with the addition of the Generating Facility.

Conclusions

The results of the Facility Study indicate that the addition of the Generating Facility as an NRIS project will cause new thermal violations and exacerbate existing thermal violations to multiple elements described in the Steady State Power Flow Analysis section. The Generating Facility's connection as an NRIS project also causes transient stability violations under multiple contingencies at Broadview Switchyard as described in the Transient Stability Analysis section.

The Generating Facility may be subject to re-study should any senior queued projects change their status. The Customer will be responsible for mitigating any thermal overloads or voltage violations that may be identified in further System Impact Studies or Transmission Service Request studies.

Study Assumptions

The following are study assumptions for this Project:

- The Customer's request for interconnection service in and of itself does not convey transmission service.
- The Customer will construct and own the any facilities required between the Point of Interconnection and the Project.
- The Customer will be required to reduce generation output or adjust power as necessary to maintain area voltages within the limits.
- The generator was modeled to have operational characteristics at full nameplate output of 0.90 leading to 0.90 lagging power factor ranges measured at the high side of the generator substation. Studied scheduled voltage (p.u.) = 1.00 at the Point of Interconnection.
    - The Generating Facility cannot meet NWE's power factor requirement given the current performance specifications provided by the Customer. The Customer must inform NWE how they intend to meet the power factor requirement prior to construction.
- NWE must approve the main transformer connection configuration prior to construction.

- The Customer will be required to have a breaker on the project side of the Point of Change of Ownership.
- This report is based on information available at the time of the study

Required Modifications

The Generating Facility and collector/step up substation are to be located north of Roundup, Montana. The POI is the Roundup City 100 kV bus. The Generating Facility and POI substation will be connected with a Customer designed, built and owned 100 kV generation tie line, approximately 19 miles in length.

Based on the conclusions presented above, the following Generating Facility modifications, system modifications and Contingent Facilities will be required for the requested interconnection.

Generating Facility Modifications

The Generating Facility is to be connected to the POI substation with a 100 kV generation tie line.

- The Generating Facility will be required to provide one (1) 24 count fiber optic cables, either single mode OPGW fiber optic cables or ADSS fiber optic cables. The purpose of these fiber facilities are to provide a primary and back up path for communications supporting line relaying and SCADA RTU communications from the Collector substation RTU to NWE's Tie Point RTU in the POI substation. It is assumed this will be provided by OPGW on the generator tie line. The Customer is responsible for installation, testing, and splicing this cable.
- NWE requires the Generating Facility main transformer configuration to be approved by NWE.
- The Customer will be required to have a main breaker on the project side of the Change of Ownership.
- The Generating Facility will be required to bring the new generation tie line into the POI substation. Design exhibits showing proper clearances will be required if there are any crossings of NWE power lines. A path for the lines entering the POI substation that is satisfactory to all parties involved will have to be defined by the Developer. The Customer will work with NWE's right of way representatives as encroachment documents will be needed if the Generating Facility tie line crosses over any part of existing line easements.

System Modifications (POI)

This Project is requesting a 70 MW interconnection to the existing 100 kV bus at the Roundup City substation.

Substation Modifications:

The following will be required:

- New substation pad and fencing approximately 100 ft by 60 ft
- One (1) 100 kV breaker
- Four (4) 100 kV air break switches
- Three (3) single phase 100 kV PT/CT combination metering units
- Protective relaying

Transmission Lines Modifications:

None Identified

Communications Modifications:
Communications estimate includes termination and joint testing with the Customer's representative of the Customer supplied and installed OPGW or ADSS fiber optic cable on the generation tie line from their collector/GSU substation to the Roundup City substation. These costs are included in the TPIF estimate section for Communications.

The Communications estimate also includes providing network communications to the Generation Point of Receipt (GPOR/high side) meter located in the Roundup City substation. These costs are included in the Network estimate section for Communications.

Metering Modifications:
NWE, as the Transmission Provider, shall install metering equipment at the POI prior to any operation of a Large Generating Facility and shall own, operate, test and maintain such metering equipment. Power flows to and from the Large Generating Facility shall be measured at the POI. Any additional metering that is required to accommodate allocating an interconnection project into multiple phases, multiple interconnection projects behind a single POI or any other market arrangements, shall be installed behind the POI by the Customer and its cost, operation, testing and maintenance shall be the responsibility of the Customer. The Customer will be responsible for any and all allocations behind the POI meter generated by such additional metering, and shall provide information of the allocations as requested by the Transmission Provider.

Modifications include installation of a 100 kV metering unit consisting of three (3) single phase 100 kV PT/CT combination metering units and associated equipment at the POI substation. Only high side metering is required.

EMS Data Modifications:
Update energy management system data bases and displays to incorporate the new POI substation and generating facility operational signals.

Additional System Modifications

In addition to the POI modifications, the following additional system modifications have been identified for NRIS service request to remove limitations in the system that arise from the addition of the 70 MW of wind generation.

Substation Modifications:
The following are additional substation modifications:

- Upgrade Painted Robe jumpers and strain bus to achieve 1200 amp ratings
- Broadview Switchyard 230 kV and 100 kV bus rebuild
- Uprate Broadview Switchyard 230/100 kV bank '2' to 100 MVA. The correction of this issue is required before this Project can come on line. At this time, correction is being planned and is expected to be completed in 2024.

Transmission Lines Modifications:
The Broadview Switchyard – Painted Robe 100 kV line requires a re-conductor and full rebuild. This line segment is roughly 13 miles with very minimal poles able to remain.

Communications Modifications:
Fiber splicing and materials for Painted Robe – Broadview Switchyard 100 kV line re-conductor.

Metering Modifications:
None Identified

EMS Data Modifications:
None Identified

Contingent Facilities

The Steady State Power Flow Analysis has identified the upgrades below as necessary prior to the operation of the proposed Generating Facility as an NRIS project. These upgrades have been previously identified by senior queue interconnection projects and are also required by this Project. As a result, they are identified as GIA Network Upgrades in Table 3. Should any of these projects change status, elements of this cost estimate will need to be reviewed and revised. The full cost of GIA Network Upgrades has been shown in Table 3 to provide a worst case estimate of potential Project costs

Required by Project 335:

- Upgrade Crooked Falls – Wayne Pump tap – North Raynesford Cenex Pump tap – Spion Kop Wind tap 100 kV line
- Upgrade Benchland – Stanford Auto 100 kV line
- Upgrade Harlowton – Judith Gap Tap – Judith Gap Auto 100 kV line

Required by Project 347:

- Upgrade Spion Kop Wind tap – Raynesford Pump tap – Stanford Auto 100 kV line
- Upgrade Benchland – Utica Pump tap – Utica Rural – Front Range tap – Judith Gap Auto 100 kV line

Substation & Relay Facilities

The following is a detailed summary of the Substation Facilities needed to interconnect the Customer Project with the NWE system. This summary includes, but is not limited to: MVA, voltage, current, BIL level, MCOV and interrupt ratings of equipment as applicable, and associated grounding requirements. The general minimum specifications for NWE Transmission and Substation equipment are listed in on Appendix 6: NWE Standard Equipment Requirements. NWE reserves the right to modify its design at the time of construction or adjust for conditions that have changed or were unknown at the time of this facilities study.

Roundup City Substation:

The equipment and associated requirements identified for Roundup City substation have been assigned as Interconnection Customer Interconnection Facilities, Transmission Provider Interconnection Facilities or Network Upgrades in the sections below.

Interconnection Customer Interconnection Facilities

None Identified

Transmission Provider Interconnection Facilities

The equipment and associated requirements listed below are Transmission Provider Interconnection Facilities.

- One (1) 100 kV breaker
- Four (4) 100 kV air break switches
- Three (3) 100 kV single phase 100 kV CT/PT combination metering units

The primary equipment and bus work support structures listed below are Transmission Provider Interconnection Facilities.

- Two (2) H-frames
- Three (3) 100 kV bus support towers
- Three (3) 100 kV single phase CT/PT support towers and mounting brackets

Substation civil site work, access roads, fencing and associated requirements listed below are Transmission Provider Interconnection Facilities.

- 6,000 ft^2 substation pad development
- 200 ft site fencing

Transmission Provider Interconnection Facilities include the foundations, structural steel, bus work, conduit and ground mat associated with the equipment identified above.

NWE will design, procure, install and own all equipment and associated infrastructure.

Construction of Transmission Provider Interconnection Facilities will be performed internally by NWE or by NWE Contractor.

Network Upgrades

None Identified

Distribution Upgrades

None Identified

Roundup City Relay:

Protective relaying equipment and associated requirements identified at Roundup City have been assigned as Interconnection Customer Interconnection Facilities, Transmission Provider Interconnection Facilities or Network Upgrades in the sections below.

Interconnection Customer Interconnection Facilities

Interconnection Customer Interconnection Facilities associated with protective relaying will include, but are not limited to, the following items:

Synchronizing:
Interconnection Customer is responsible for synchronizing onto NWE's system.

Coordination of Protection:
Interconnection Customer shall coordinate protective relay settings with NWE.

Inspection Requirements for Existing or New Facilities:
Facilities classified as Bulk Electric System are to meet NERC/WECC requirements for inspection and maintenance.

System Protection:
Interconnection Customer shall provide a Tie Power Circuit Breaker (PCB) and an auxiliary 'a'switch from their GSU transformer high side breaker for indication to NWE's Tie Point RTU.

Transmission Provider Interconnection Facilities

The equipment and associated requirements listed below have been identified as Transmission Provider Interconnection Facilities equipment.

Protective Relaying
The interconnect line will be protected by a new relay panel using dual SEL-411L relays. The new breaker will be incorporated into the existing bank/bus differential scheme in the substation.

SCADA Remote Terminal Unit (RTU)
The existing substation SCADA RTU will be modified as needed.

Tie Point Remote Terminal Unit RTU
A new SEL-3530 RTAC tie point RTU will be installed.

Voltage Transformer Junction Box
A new VT J-box will be installed for the metering units.

Transmission Provider Interconnection Facilities include relay control panels and control wiring associated with the protective relaying, RTU's and metering capabilities identified above.

NWE will design, procure, own and operate all equipment and associated infrastructure.

Construction of Transmission Provider Interconnection Facilities will performed internally by NWE or by NWE Contractor.

Network Upgrades

None Identified

Distribution Upgrades

None Identified

Broadview Switchyard:

The equipment and associated requirements identified for Broadview Switchyard have been assigned as Interconnection Customer Interconnection Facilities, Transmission Provider Interconnect Facilities, or Network Upgrades in the sections below.

Network Upgrades

The equipment and associated requirements listed below have been identified as Network Upgrades.

- Two (2) 230 kV breakers
- Nine (9) 100 kV breakers
- Six (6) single phase 100 kV PT's
- Six (6) 230 kV ABSWs
- 22 – 100 kV ABSWs
- Three (3) 100 kV CT/PT single phase metering units

The primary equipment and bus work support structures listed below have been identified as Network Upgrades.

- Two (2) 230 kV H-Frames
- Eight (8) 230 kV ABSW towers
- 13 – 230 kV single phase bus support towers
- Five (5) 100 kV A-Frames
- Six (6) 100 kV H-Frames
- 17 – 100 kV bus support towers
- Four (4) 100 kV ABSW towers
- Six (6) 100 kV single phase PT towers

Substation civil site work, access roads, fencing and associated requirements listed below have been identified as Network Upgrades.

- Approximately 116,800 ft^2 substation pad development - See General Arrangement drawing for details
- Access road development – not identified at this time.
- 925 ft site fencing

Network Upgrades include the foundations, structural steel, bus work, conduit and ground mat associated with the equipment identified above.

NWE will design, procure, install and own all equipment and associated infrastructure.

Construction of Network Upgrades will be performed internally by NWE or by NWE Contractor.

Broadview Switchyard Relay:

Protective relaying equipment and associated requirements identified at Broadview Switchyard have been assigned as Interconnection Customer Interconnection Facilities, Transmission Provider Interconnect Facilities or Network Upgrades in the sections below.

Network Upgrades

The equipment and associated requirements listed below have been identified as Network Upgrades.

Protective Relaying
A new control house will be installed with all new relaying associated with the 100 kV lines. Line relaying will be SEL 411L/T401. SEL 351S will be used for breaker fail. Dual 487E for both 230-100 kV banks. SEL 487B for bus relaying. New SCADA panel. Also includes remote end line relay upgrades at Painted Robe, Harlowton, and Roundup City. Modifications to the existing 230 kV bus relaying and SCADA.

SCADA Remote Terminal Unit (RTU)
Modifications to existing 230 kV SCADA and new 100 kV SCADA.

Tie Point Remote Terminal Unit RTU
None identified

Voltage Transformer Junction Box
Two new junction boxes for the two sets of 100 kV bus PTs.

Network Upgrades include relay control panels and control wiring associated with the protective relaying, RTU's and metering capabilities identified above.

NWE will design, procure, own, and operate all equipment and associated infrastructure.

Construction of Network Upgrades will performed internally by NWE or by NWE Contractor.

Distribution Facilities

The following is a detailed summary of the Distribution Upgrades needed to interconnect the Customer Project with the NWE system. The general minimum specifications for NWE Transmission, Distribution, and Substation equipment are listed in Appendix 6: NWE Standard Equipment Requirements. NWE reserves the right to modify its design at the time of construction or adjust for conditions that have changed or were unknown at the time of this facilities study.

Interconnection Customer Interconnection Facilities

None Identified

Distribution Upgrades

None Identified

Transmission Facilities

The following is a detailed summary of the Transmission facilities needed to interconnect Customer with the NWE system. The general minimum specifications for NWE Transmission, Distribution, and Substation equipment are listed in Appendix 6: NWE Standard Equipment Requirements. NWE reserves the right to modify its design at the time of construction or adjust for conditions that have changed or were unknown at the time of this facilities study.

Interconnection Customer Interconnection Facilities

None Identified.

Transmission Provider Interconnection Facilities

None Identified

Network Upgrades

The equipment, modifications and associated requirements listed below are Network Upgrades.

Re-conductor Broadview Switchyard – Painted Robe 100 kV line with 556 ACSS. The estimate includes all engineering, PMO, mob/de-mob, A&G, Row, environmental, and material for the Project. Any OPGW work is also included in the estimate.

Land and Right of Way:
All work will be in an existing easement for the 100 kV line. However, a review of all easement documentation is required to ensure documents are up to date and accurate.

Transmission Line and Conductor Design:
Broadview Switchyard – Painted Robe 100 kV line will require a re-conductor to 556 ACSS or other sufficient conductor. The line will require a full rebuild with little to no existing structures able to remain due to the age of the line and the new conductor installation clearance requirements.

The structure framing will mostly be H-frames with some areas of single pole structures. There will be some use for three pole running angles and dead-end structures.

Air Break Switches:
A single air break switch outside of the Painted Robe substation will need to be replaced due to its age and the new conductor tensions.

Potential Line Conflicts:
This line crosses multiple other transmission lines when routing into the substation. This will add a level of difficulty to the re-conductor. Additional cost were added to this estimate to account for pole replacements on the other lines outside of Broadview Switchyard due to possible clearance violations.

Collection of topographic survey data, staking of new or rerouted transmission lines, negotiation for material laydown locations and related access agreements will be performed internally by NWE or by NWE contractors.

Design of transmission line facilities will be performed internally by NWE or by NWE contractors. NWE will procure, own and operate all equipment and associated infrastructure.

Construction of Network Upgrades will performed internally by NWE or by NWE Contractor.

Distribution Upgrades

None Identified

Communications Facilities

The following is a summary of the Communications facilities needed to interconnect the project with the NWE system. This summary includes, but is not limited to the listed items.

When conditions require a higher degree of reliable telecommunications as determined by NWE, means such as alternate geographically diverse telecommunications routes may be utilized.

Interconnection Customer Interconnection Facilities

This Project does not require geographic diverse telecommunications between the Customer's collector/GSU substation and the Roundup City substation for this Project's telecommunication protection and SCADA requirements.

NWE requires and assumes that the Customer will provide and install a 24 fiber minimum, single mode fiber optic cable on the lead line from their collector/GSU substation to the transmission dead-end tower at the Roundup City substation. NWE will splice and terminate the Customer's fiber in the POI substation to a patch panel in the POI substation control shelter.

Communications circuits over the Customer's fiber will include, but not be limited to the following:

- Direct fiber relay channel – relay # 1
- Direct fiber relay channel – relay # 2
- DNP SCADA circuit (server) using serial RS-232 to single mode fiber transceivers
- DNP SCADA circuit (client) using serial RS-232 to single mode fiber transceivers
- Customer SCADA to POI substation serial RS-232 circuit over fiber for Energy Imbalance Market (EIM) SCADA if designated a participating resource in the EIM Market

Transmission Provider Interconnection Facilities

The following facilities and requirements are Transmission Provider Interconnection Facilities.

- Materials: fiber cable, splice can, splice case, ADSS fiber cable and fiber optic patch panel
- Labor at the POI substation for termination of the Customer supplied fiber on the Generation tie line (as outlined above).
- Fiber and network materials and labor for communications to the GPOR meter at the POI substation for:
    - Real time metering values to NWE tie point SCADA RTU
    - MV-90 (billable meter data) to NWE

Network Upgrades

The following facilities and requirements are Network Upgrades.

- Addition of a communications rack with DC power converters wiring and a new network router and switch to accommodate additional network communications to the tie point RTU as well as the two (2) line protection relays. This would include an available network port for the EIM communications circuit outlined above if so required.

- Materials, labor and expenses associated with splicing materials and labor for termination of the OPGW fiber optic cable included on the Broadview Switchyard – Painted Robe 100 kV line re-conductor.

Distribution Upgrades

None Identified

Metering Facilities

The following is a detailed summary of the Metering facilities needed to interconnect the project with the NWE system. NWE's standard revenue metering is at the interconnection point, this will be on the high side of any Customer transformers if applicable.

Interconnection Customer Interconnection Facilities

Metering Interconnection Customer Interconnection Facilities will include, but are not limited to, the following items:

Communications

Communications channel(s) to meters will be provided by NWE.

- The channel will transmit EMS "real-time" data, billing data and provide remote access to the meter.
- Billing data will be received from the EMS system for Load Research (MV-90).
- Meter Department access will also be through the EMS system.

Transmission Provider Interconnection Facilities

Meter Form, Voltage, & Class, Type/Manufacturer

This project will require one Form 9S, 120 Volt, billing revenue class watt-hour meter. Typically an ION 8600 multi-function meter or equivalent.

Meter Communication Requirements

Telemetered Data

Data from the meter to the communications cabinet will be transmitted through a fiber optic cable. The interface between the meter and the fiber and between the fiber and the RTU requires transceivers. These transceivers convert RS232 signals to optical signals and/or optical signals to RS232 signals.

- NWE will install the fiber optic cable.
- The contracted construction crew will install one, 2-inch (minimum) Schedule 40 PVC conduits from the communications cabinet to the metering enclosure with a pulling tape installed inside the conduit.
- Two optical transceivers will be required.
- Optical transceivers will be supplied by NWE.
- Data transmission from the optical transceivers (located inside the meter enclosure) to all downstream points will be determined by the metering/relay departments of NWE.
- The RS232 port on the meter is strictly for internal NWE use.
- MODBUS or DNP protocol will be used for "EMS" data transmission on the RS232 port of the revenue meter as specified by Grid Operations.
- Metered metrics extracted from the revenue meter for the "EMS" data stream are limited to:

- Delivered & Received MWH, Instantaneous ± MW, Instantaneous ± Mvar, Instantaneous Phase "A" Volts & Amps, Instantaneous Phase "B" Volts & Amps and Instantaneous Phase "C" Volts & Amps.
- Depending upon timing issues the instantaneous amps might not be included in the telemetered data.

MV-90 Data & Meter Diagnostics

Data from the meter to the MV-90 Load Research Center & Electric Meter Shop must be transmitted through the EMS network.

Special Programming Requirements

- Bi-directional metering will be required at the billing metering point.
- Transformer loss compensation will not be required.

Auxiliary Power Requirements (meter only)

- DC auxiliary power will be required on the revenue meter.
- If DC is not available, then AC may be used in conjunction with a backup UPS.
- The UPS will be installed inside the meter enclosure.

Meter Location – Physical

Distance from the CTs

Distance should be as short as possible. In the event that the total secondary circuit length exceeds fifty feet per phase, greater than # 10 AWG copper will have to be used. Actual size will be dependent upon the circuit length.

Distance from the PTs

Distance will be the same requirements as for the CTs.

Enclosure requirements

The standard meter enclosure built by NWE will be used at the meter site.

Mounting Structure

The contracted construction crew will provide a structure that meets the above requirements on which the meter enclosure will be mounted.

Meter Wiring Instrument Transformers and Ancillary Equipment

Current Transformers

Four # 10 AWG or larger, copper conductors. Actual size dependent upon overall circuit length.

Voltage Transformers (PTs)

Four # 10 AWG or larger, copper conductors. Actual size dependent upon overall circuit length.

The secondary of the instrument transformers shall be routed to avoid the pick-up of induced voltages from other conductors. A separate conduit must be provided for the metering secondary circuits. The

secondary circuits of instrument transformers should never be placed in Tramways, Gutters, or Raceways that contain other current carrying conductors.

Auxiliary DC Power (Auxiliary power for the revenue meter)
Two # 12 AWG or larger copper conductors.

Heater and AC Power to the Meter Enclosure
One three-wire 240-volt circuit of at least # 10 AWG or greater, copper conductors.

Conduit Requirements to Meter Enclosure

- One "2 inch (minimum)" conduit from the communications cabinet to the "bottom" side of the meter enclosure.
- One "1 inch" conduit from the metering CT's to the "bottom" side of the meter enclosure.
- One "1 inch" conduit from the metering PT's to the "bottom" side of the meter enclosure.
    - Conduits shall never enter the "top" of the meter enclosure.
    - All conduit connectors and fittings must maintain the NEMA-3R rating of the enclosure.

Meter Testing
The revenue meter will be fully tested prior to installation and will be re-certified for accuracy on a periodic basis as defined in the contract, typically every 2 years.

Instrument Transformer Requirements

Voltage Transformers (PTs/VTs)

- The metering VTs/PTs should be of sufficient ratio to supply 115 VAC to the potential metering circuits inside the watt-hour meter.
- A secondary winding dedicated to revenue metering only.
- Accuracy class to be ±0.15% at all typical PT "Standard Burdens".
- A Thermal Rating of at least 1000 VA (minimum).
- The BIL to be determined by substation design.

Current Transformers (CTs)

- The CTs must be of sufficient ratio to supply at least 5 amps of secondary current to the metering elements at normal operating loads.
- Accuracy class to be ±0.15% through a burden rating of 0.5 Ω or higher. These CTs must remain within ±0.15% from 5% (or less) rated current to their RF limits.
- The BIL to be determined by substation design.

Instrument Transformer Testing
All instrument transformers will be fully tested at NWE's G.O. Meter Shop prior to installation, if possible.

NWE can test the instrument transformers "On Site" using NWE's "Mobile Metering Lab", (MML). This testing normally requires a four-man crew and a bucket truck. If the instruments transformers are not connected and sitting on the ground then testing may only require a two man crew and a ladder.

Further Considerations - Instrument Transformer Testing – Installation of bypasses.

It may be prudent to design and install operational bypasses on all instrument transformers.

"On-Site" instrument transformer testing using NWE's MML may be required. Prior to testing, all instrument transformers must be isolated and disconnected from the circuit with the appropriate clearances taken. If circuit bypasses are not installed, shutdowns will be required. The average "shut down" is approximately six hours.

Network Upgrades

None Identified

Distribution Upgrades

None Identified

Energy Management Systems (EMS) Facilities

The following is a detailed summary of the Energy Management System (EMS) facilities needed to interconnect the Customer with the NWE system:

Interconnection Customer Interconnection Facilities

Energy Management System Interconnection Customer Interconnection Facilities will include, but are not limited to, the following items:

Energy Management System Databases

The status of the generator synchronizing breakers will be telemetered into the EMS (Energy Management System). This device (or devices) will need to be modeled in the EMS SCADA (Supervisory Control and Data Acquisition) and Networking databases.

Energy Management System Displays

One-Line displays will be modified as well as the mapboard in the NWE System Operation Control Center control room to show the indication of the generator synchronizing breakers. An LED will be defined for each breaker so that the open versus closed state can be shown on the mapboard.

Tie Point Remote Terminal Unit (RTU) Database

The EMS personnel are responsible for adding the indication of the generator synchronizing breaker(s) to the database for the Generation Tie Point RTU. This is the same Tie Point RTU that is discussed in more detail in the Transmission Provider Interconnections Facilities section.

Transmission Provider Interconnection Facilities

Energy Management System Databases to Support the Intertie

The EMS (Energy Management System) personnel will need to model the actual generator plant (Multiple wind turbines will be considered as one plant.) in the EMS Generation Database and in the Dispatcher Training Simulator. Several values and status points will be modeled in the EMS SCADA (Supervisory Control and Data Acquisition) and Networking databases. These values include metering quantities and several monitoring quantities as well as status points. The values and monitoring points will be transmitted from the Tie Point RTU (Remote Terminal Unit) to the EMS SCADA over a communication circuit to be provided by the Generator (Interconnection Customer).

Metering quantities include but are not limited to three phase currents, three phase voltages, instantaneous bi-directional megawatts, instantaneous bi-directional megavars, hourly megawatts delivered, hourly megawatts received, and power factor.

Energy Management System Displays

One line and Generation displays will be modified as well as the mapboard in the NWE System Operation Control Center control room. The displays will show the Generator and the Generator interconnect breaker(s) as well as metering values.

Tie Point Remote Terminal Unit (RTU) Database

The EMS personnel are responsible for modeling the database for the Generation Tie Point RTU. The database may include some alarm points defined by the NWE Protective Relay Department as well as all of the metering quantities as listed in the EMS Databases to Support the Intertie section above. Calculations are defined in the database to 1) convert metering secondary quantities to the primary quantities expected in the Control Center and 2) "freeze" and calculate megawatt hourly calculations carrying forward partial megawatt hours and considering roll-overs.

OATI Scheduling System

The EMS personnel are responsible for making any necessary updates in the interface to the Scheduling System to include the hourly metering values associated with the Generator (or the Balancing Authority boundary in the case of a separate Balancing Authority for the Generator). These values are passed from the SCADA system to the Scheduling System at least hourly. The Scheduling System provides the information used in the accounting of the energy transactions.

Historical Databases

The OSIsoft PI (Plant Information) database will be modified so that the metering values for the generation will be stored historically.

Network Upgrades

Energy Management System Generation Software Licensing

The EMS (Energy Management System) personnel will need to model the 70 Megawatts of generation in the EMS Generation database. This will incur one-time licensing fees from the EMS software vendor, GE Grid.

Energy Management System Databases to Support the Transmission Operations

The EMS personnel will need to model the physical transmission devices for the NWE Substation at the point of interconnection in the EMS SCADA (Supervisory Control and Data Acquisition) and Networking databases. These devices generally include but are not limited to circuit breakers, air break switches, disconnects, PT's, and the like. The associated alarms will also be modeled in the SCADA database. The alarms are generally defined by the NWE Protective Relay Department and include items such as relay watchdogs, relay operations, SF-6 monitors, loss of potential, and other various relay alarms. Line analog values including but not limited to three phase current reads, megawatt reads, megavar reads, kilovolt reads and fault location values will be added to the associated database. Controls on devices such as the circuit breaker will be added to the SCADA database. These controls should include trip, test close, and normal close controls.

Licensing costs for the values and status points to be added (from this section and the Energy Management System Databases to Support the Intertie section) to the EMS SCADA database will be incurred.

Energy Management System Displays

Displays will be modified as well as the mapboard in the NWE System Operation Control Center control room. LED's will be assigned to the transmission devices such as circuit breakers, disconnects, and air break switches.

Remote Terminal Unit (RTU) Database

The EMS personnel are responsible for creating the database for the SCADA RTU for the NWE Substation at the point of interconnection. Most of the database is defined by the NWE Protective Relay Department. The NWE Telecommunications Department will specify the connection between the RTU and the NWE's System Operation Control Center in Butte, Montana.

Inter-Control Center Communications Protocol (ICCP) Databases

The Open Access Gateway Model database will be modified so that other neighboring utility entities such as the Regional Coordinator, to exchange operational data via the ICCP protocol.

Historical Databases

The OSIsoft PI (Plant Information) database will be modified so that the line analog values will be stored historically.

Distribution Upgrades

None Identified

Lands and Permitting Facilities

The following is a detailed summary of the Lands and Permitting needed to interconnect the Customer with the NWE system:

Lands and Permitting support may consist of the following:

- Negotiation, preparation and processing necessary to establish easements supporting entry of Interconnection Customer Interconnection Facilities to the POI substation at Roundup City substation.
    - Coordination with impacted landowners and infrastructure operators (irrigation and pipe line systems)
    - Associated lands professional support, legal review and fees
    - Associated environmental professional support and fees

Interconnection Customer Interconnection Facilities

The Generating Facility will be required to document the routing of facilities connecting in the POI substation and establish appropriate easements as needed to support siting of Generating Facility systems.

Transmission Provider Interconnection Facilities

This Project will interconnect at the southern end of Roundup City substation requiring the purchase of additional land from the neighboring owner (Musselshell County).

This Project requires a Storm Water Pollution Prevention Plan (SWPPP) and sage grouse mitigation.

Note: Cost assignment for property purchase and lands and environmental professional support has been split evenly between TPIF and Network categories.

Network Upgrades

This Project will interconnect at the southern end of Roundup City substation requiring the purchase of additional land from the neighboring owner (Musselshell County).

This Project requires a Storm Water Pollution Prevention Plan (SWPPP) and sage grouse mitigation.

Note: Cost assignment for property purchase and lands and environmental professional support has been split evenly between TPIF and Network categories.

Distribution Upgrades

None Identified

Cost Estimate

The tables below provide preliminary cost estimates, allocated to Transmission Provider Interconnection Facility and Network categories.

Table 2: TPIF, Network Upgrade Costs

	TPIF Cost	Network Cost
System Modifications (POI)		
POI Substation	$ 1,348,000	$ 76,000
Metering	$ 81,000	$ --
Communications	$ 22,000	$ 27,000
EMS	$ 11,000	$ 27,000
Lands and Permitting	$ 95,000	$ 95,000
T-Line	$ --	$ --
Additional System Modifications		
Upgrade Painted Robe – Broadview Switchyard 100 kV line		$ 11,027,000
Rebuild Broadview Switchyard substation		$ 12,229,000
Subtotal TPIF & Network Upgrade Cost Estimates	**$ 1,557,000**	**$ 23,481,000**

Table 3: Contingent Facility Costs

Contingent Facilities	
GIA Network Upgrades	
Project 335:	
Upgrade Crooked Falls – Wayne Pump tap – North Raynesford Cenex Pump tap – Spion Kop Wind tap 100 kV line	$ 13,885,000
Upgrade Benchland – Stanford Auto 100 kV line	$ 5,021,000
Upgrade Harlowton – Judith Gap Tap – Judith Gap Auto 100 kV line	$ 8,571,000
Project 347	
Upgrade Spion Kop Wind tap – Raynesford Pump tap – Stanford Auto 100 kV line	$ 11,643,000
Upgrade Benchland – Utica Pump tap – Utica Rural – Front Range tap – Judith Gap Auto 100 kV 100 kV line	$ 15,283,000
Planned Network Upgrades	
(1) Uprate Broadview Switchyard 230/100 kV bank '2'	$ --
Subtotal Contingent Facilities Cost Estimate	**$ 54,403,000**

Table 2: Total Cost

	Cost
Transmission Provider Interconnection	$ 1,557,000
Network Upgrades	$ 23,481,000
Total Cost Estimate	**$ 25,038,000**

Note:

- All costs shown are fully loaded. Costs are in 2024 dollar values and are subject to change due to inflationary cost escalation and supply chain issues. The Customer will pay all actual charges required for the interconnection of the Project.
- (1) The noted system upgrades have been previously included in NWE network upgrade plans. These upgrades are required to be in place before the Project can interconnect under system normal operating conditions and configurations. This upgrade is currently expected to be completed in 2028. However, if these upgrades are not complete prior to interconnection, the Customer would be required to incur their cost. Costs for assuming these upgrades will be provided as needed.
- Contingent Facilities are required to be in place before the Project can interconnect under system normal operating conditions and configurations. If not, Customer may be required to provide security for construction of the Contingent Facilities prior to interconnection and will incur costs up to the total estimated cost for Contingent Facilities list in the table above.

Construction Schedule

Design and construction of the POI upgrades is anticipated to require approximately 48 months once adequate property has been secured. This timeline is driven by recent significant increases in procurement lead times for critical equipment. The following milestones and durations define the anticipate construction schedule for the POI.

Execute Interconnection Agreement	TBD
Interconnection Customer Provision of Financial Security & Notice to Proceed	Month 0
Transmission Provider Permitting and Property Design Commences	Month 2
Interconnection Customer Property Acquisition/Transfer/Permits/ ROW Complete	Month 9
Interconnection Customer Design Information Provided	Month 9
Transmission Provider Engineering Design Commences	Month 9
Transmission Provider Long Lead Procurement Commences	Month 10
Transmission Provider Engineering Design Complete	Month 15
Transmission Provider Civil Site Work Commences	Month 42
Transmission Provider Physical Construction Commences	Month 43
Transmission Providers Facilities Complete	Month 47
Initial Synchronization/Testing	Month 48
Commercial Operation	Month 48

Note that the time line above assumes that Civil Site Work commences between approximately March and August. Start dates for this milestone outside this period may extend the duration of subsequent milestones due to seasonal constraints.

Current and expected supply chain issues for major equipment, material and labor may extend expected milestone schedule deliveries.

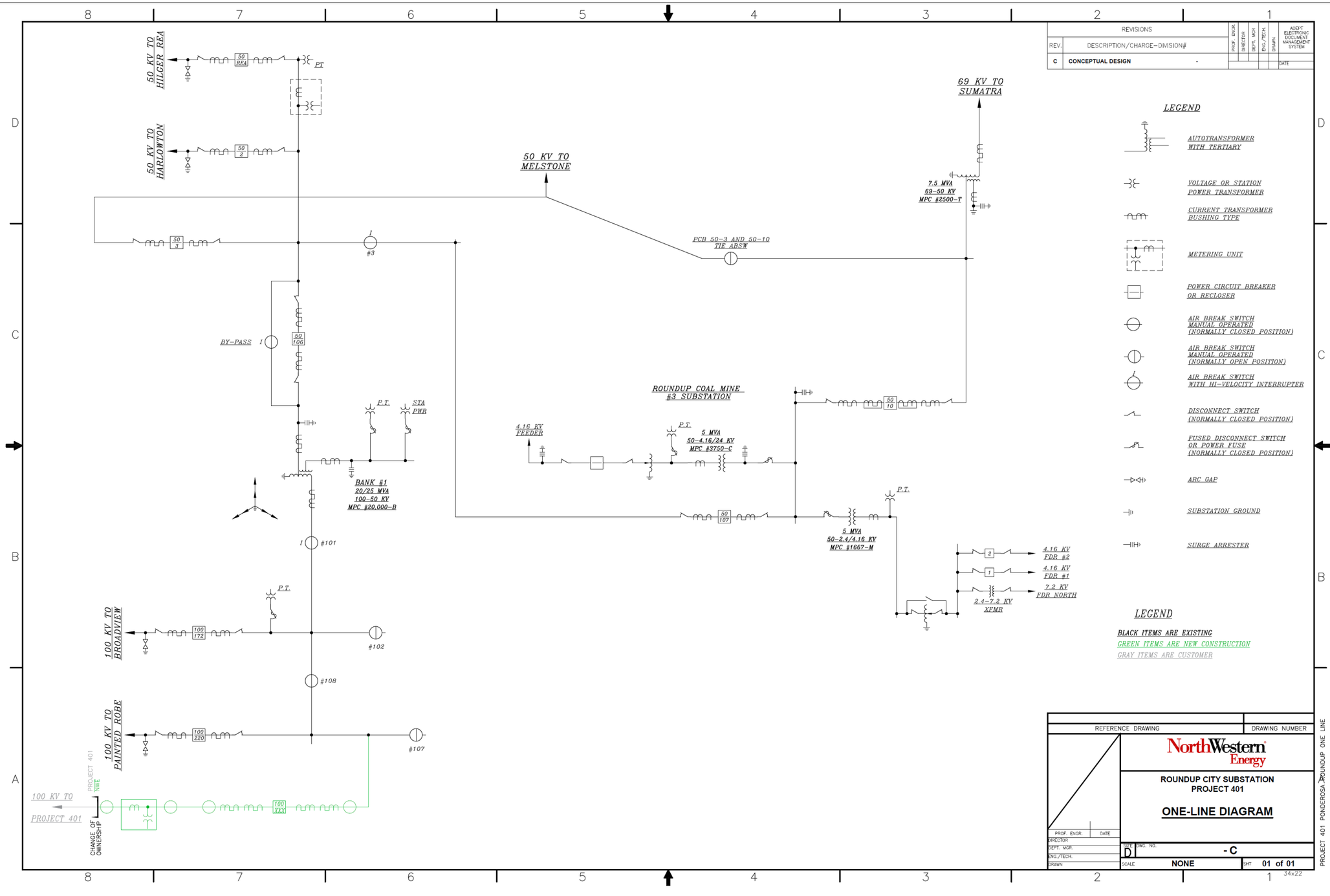
Design and construction of the Broadview substation upgrades are expected to require up to 60 months to complete. This time line is primarily based on recent significant increases in procurement lead times for critical equipment. Broadview substation construction could likely proceed independently of POI construction, however, reconfiguration of the existing 230 kV bus and cutover of 100 kV lines to the new 100 kV bus would need to be coordinated with other system requirements.

A detailed schedule integrating all the above activities has not been developed, nor has a time line been established for implementation of the identified Contingent Facilities.

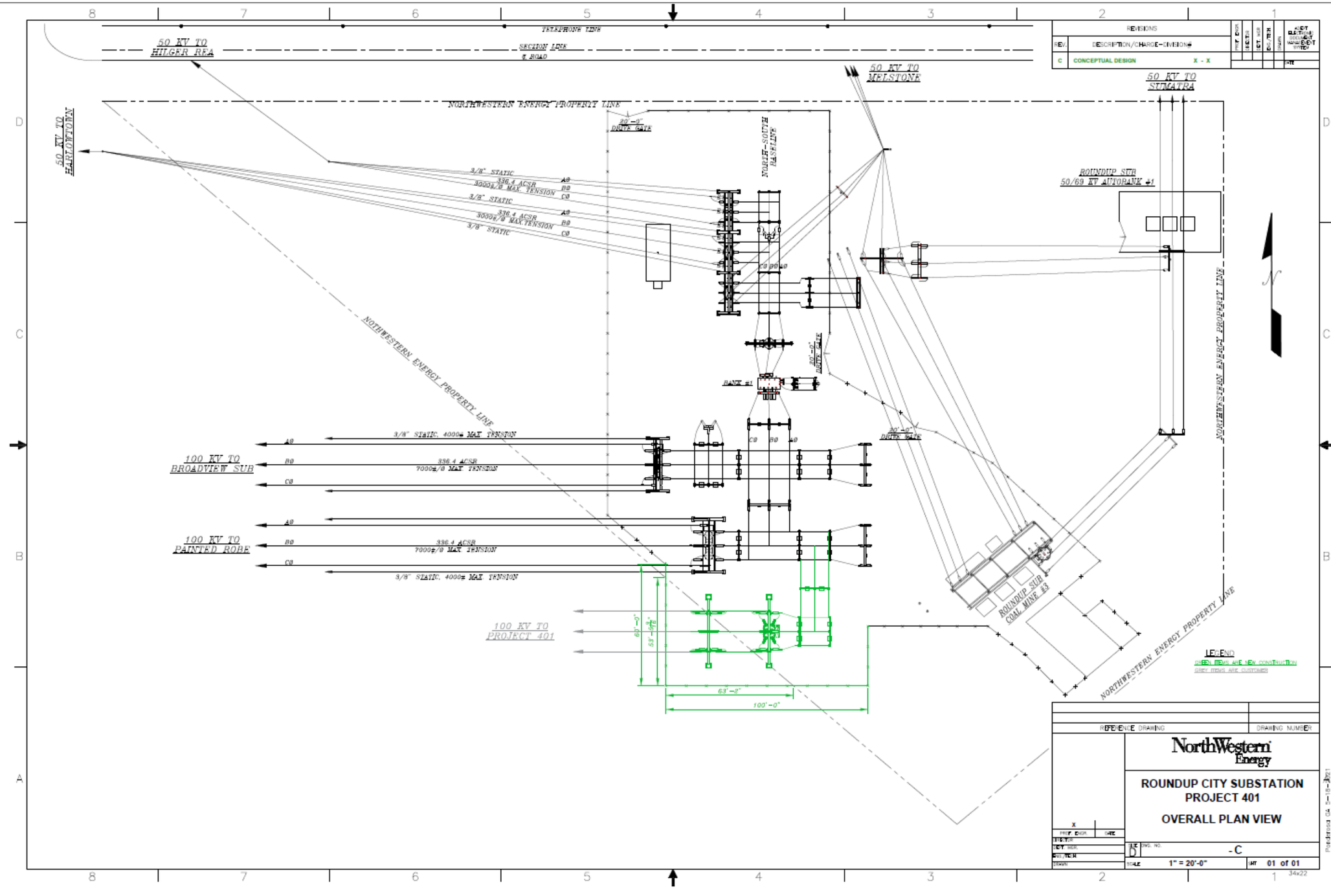
The time line presented above does not support the Interconnection Customers requested Commercial Operation Date of November 15, 2023.

The milestones above provide a preliminary construction schedule. Milestone durations and specific start/completion dates will be negotiated and documented as milestones in the Generation Interconnection Agreement.

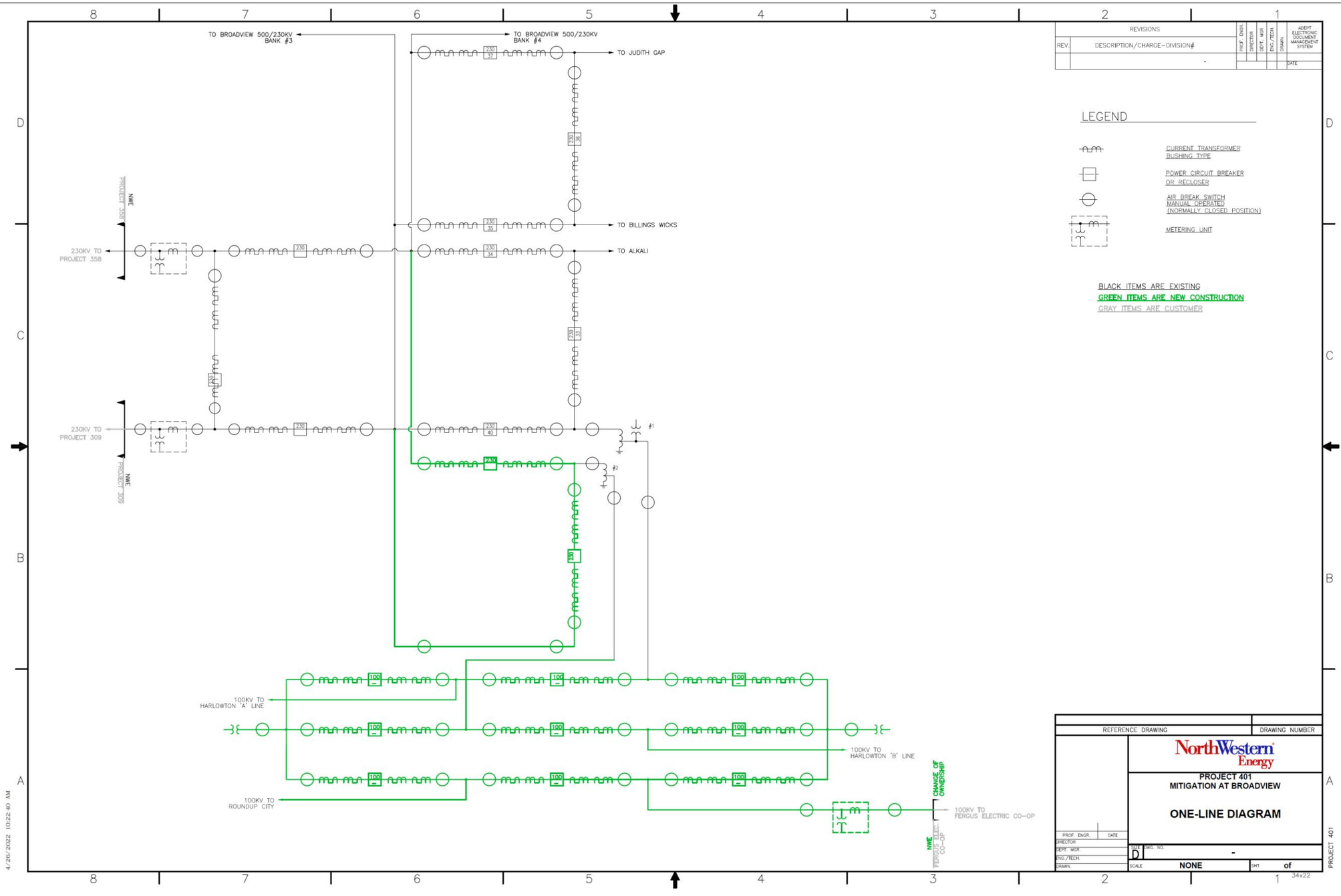
Appendix 1: One-Line Diagram of the interconnection substation



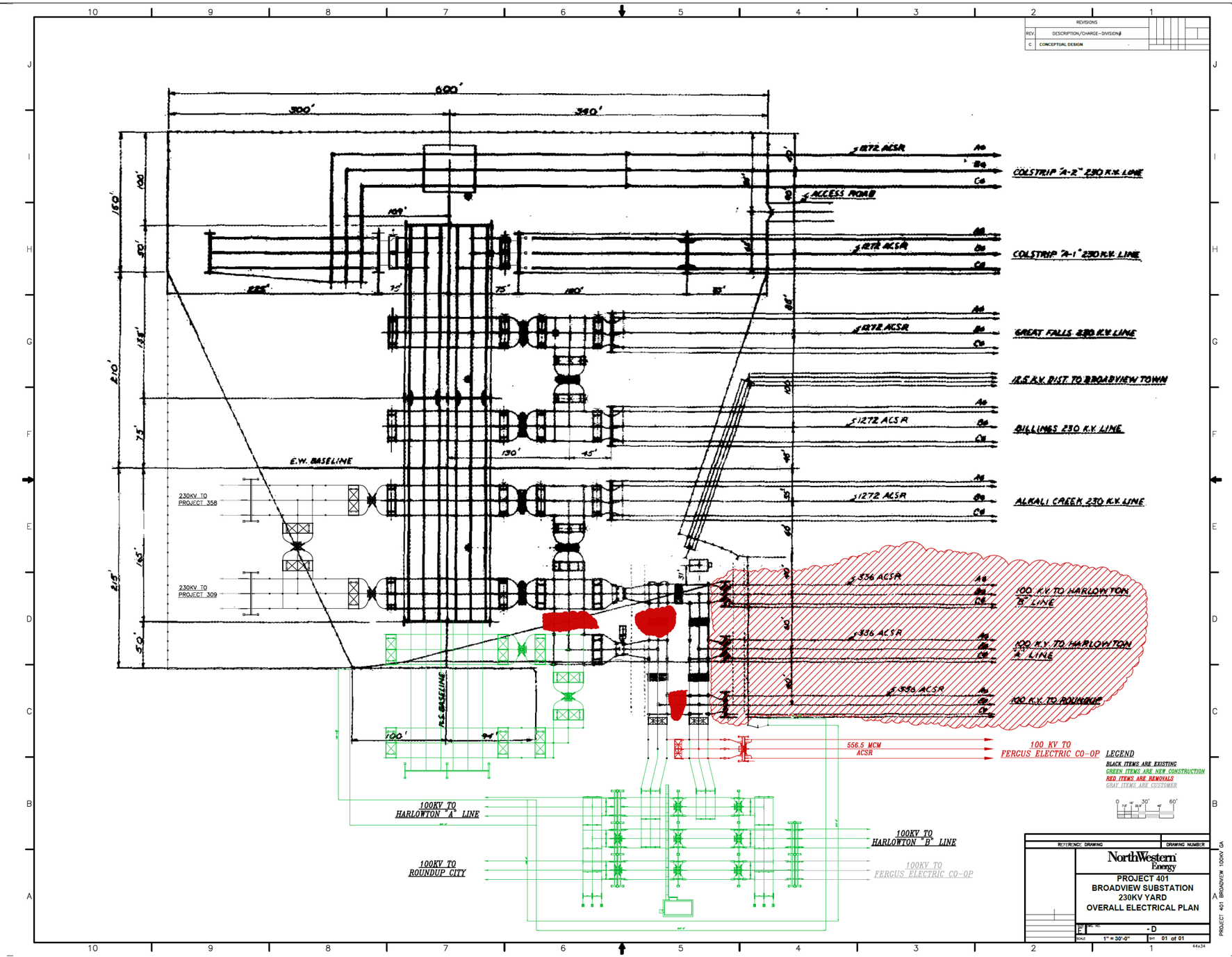
Appendix 2: General Arrangement Diagram of the interconnection substation



Appendix 3: One-Line Diagram of Broadview Switchyard



Appendix 4: General Arrangement Diagram of Broadview Switchyard



Appendix 5: Definitions

Contingent Facilities shall mean those unbuilt Interconnection Facilities and Network Upgrades upon which the Interconnection Request's costs, timing, and study findings are dependent, and if delayed or not built, could cause a need for Re-Studies of the Interconnection Request or a reassessment of the Interconnection Facilities and/or Network Upgrades and/or costs and timing.

Distribution Upgrades shall mean the additions, modifications and upgrades to the Transmission Provider's Distribution System at or beyond the Point of Interconnection to facilitate interconnection of the Generating Facility and render the transmission service necessary to affect Interconnection Customer's wholesale sale of electricity in interstate commerce. Distribution Upgrades do not include Interconnection Facilities.

Energy Resource Interconnection Service (ERIS) allows the Interconnection Customer to connect its Generating Facility to the Transmission Provider's Transmission System and to be eligible to deliver the Generating Facility's electric output using the existing firm or non-firm capacity of the Transmission Provider's Transmission System on an as available basis. Firm or non-firm service must be requested through the transmission service process. Energy Resource Interconnection Service in and of itself does not convey transmission service. As an ERIS, the Interconnection Customer will be responsible for any required upgrades necessary for connection to the POI. The ERIS findings included in this study do not assure the Interconnection Customer that the planned Generating Facility will be allowed to operate at full or reduced capacity under any or all operating conditions.

Generating Facility shall mean Interconnection Customer's device for the production of electricity identified in the Interconnection Request, but shall not include the Interconnection Customer's Interconnection Facilities.

Interconnection Facilities shall mean the Transmission Provider's Interconnection Facilities and the Interconnection Customer's Interconnection Facilities. Collectively, Interconnection Facilities include all facilities and equipment between the Generating Facility and the Point of Interconnection, including any modification, additions or upgrades that are necessary to physically and electrically interconnect the Generating Facility to the Transmission Provider's Transmission System. Interconnection Facilities are sole use facilities and shall not include Distribution Upgrades, Stand Alone Network Upgrades or Network Upgrades.

Interconnection Customer's Interconnection Facilities shall mean all facilities and equipment owned, controlled, or operated by the Interconnection Customer, that are located between the Generating Facility and the Point of Change of Ownership, including any modification, addition or upgrades to such facilities and equipment necessary to physically and electrically interconnect the Generating Facility to the Transmission Provider's Transmission System. Interconnection Customer's Interconnection Facilities are sole use facilities.

Network Resource Interconnection Service (NRIS) allows the Interconnection Customer to be designated as a Network Resource, up to the Large Generating Facility's full output, on the same basis as existing Network Resources interconnected to the Transmission Provider's Transmission System. NRIS identifies all system upgrades necessary for the project to operate at the full requested output. NRIS does not convey reservation of transmission service nor does it convey any right to deliver electricity to any specific customer or Point of Delivery.

Network Upgrades shall mean the additions, modifications, and upgrades to the Transmission Provider's Transmission System required at or beyond the point at which the Interconnection Facilities connect to the Transmission Provider's Transmission System to accommodate the interconnection of the Generating Facility to the Transmission Provider's Transmission System.

Point of Change of Ownership between NorthWestern Energy's transmission system and the Interconnection Customer's Interconnection Facilities is the point where the Interconnection Customer's overhead or underground line meets the NWE bus connecting to the NWE disconnects and metering set.

Point of Interconnection is the point where the Interconnection Customer's Interconnection Facilities tap a NWE Transmission or Distribution line or connects to an existing NWE substation.

Transmission Provider's Interconnection Facilities shall mean all facilities and equipment owned, controlled, or operated by the Transmission Provider from the Point of Change of Ownership to the Point of Interconnection including any modifications, additions or upgrades to such facilities and equipment. Transmission Provider's Interconnection Facilities are sole use facilities and shall not include Distribution Upgrades, Stand Alone Network Upgrades or Network Upgrades.

Appendix 6: NWE Standard Equipment Requirements

Transmission and Substation Equipment: General Minimum Specifications

Nominal System Voltages	500 kV	230 kV	161 kV	115 kV	100 kV	69 kV	50 kV	34.5 kV	25 kV	12.5 kV
MVA and Current Ratings	Project and equipment specific as required to avoid thermal overloads									
Equipment BIL (kV)[1]	1800 or 1550	900	750	550	550	350	350	200	150	110
Maximum Design Voltage (kV)[2]	550	242	169	121	121	72.5	72.5	38	27	15.5
Breaker interrupt Current (kA)	63	40	40	40	40	40	40	40	25	25
Breaker/Switch Continuous Current (A)[3]	3000	2000	1200	1200	1200	1200	1200	1200	1200	1200
Arrester Duty Rating/MCOV (kV)[4]	396/318	172/140	127/98	90/70	90/70	54/42	39/31.5	27/22	18/15.3	10/8.4
Substation Insulator Class	TR-391	TR-304	TR-291	TR-286	TR-286	TR-216	TR-214	TR210	TR-208	TR-205
Transmission Line BIL, wood (kV)[5]	--	1105	780	610	525	440	355	200	150	110
Transmission Line BIL, steel (kV)[6]	1905	1265	695	610	525	440	--	--	--	--

Notes:

1. 1050kV BIL is also used on some 230 kV equipment
2. At least 5% over nominal
3. 2000 amp equipment is used is some applications
4. For effectively grounded systems
5. Insulator support hardware ungrounded
6. Insulator support hardware grounded