Generation Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AD2-180

"Elk Garden-Parr Run 138 kV"

November 2020

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Preface

The intent of the Facility Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances, an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The Facility Study estimates attempt to identify the estimated time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right-of-way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

A. Transmission Owner Facilities Study Summary

1. Description of Project

Black Rock Wind Force, LLC (hereinafter referred to as the "Interconnection Customer" or "IC") has proposed a wind generating facility located in Mineral County, West Virginia. The installed facilities for AD2-180 will have a total Maximum Facility Output (MFO) of 110 MW with 15.08 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Mon Power (MP) a First Energy Company (FE), hereinafter referred to as "Transmission Owner" (TO), at a newly constructed 138 kV three-breaker ring bus substation (Sulphur City Substation) tapped off of the Kelso Gap-Parr Run 138 kV transmission line.

2. Amendments to the System Impact Study or System Impact Study Results

Since the System Impact study phase, it has been determined that the Albright Substation reconfiguration is not required for the AD2-180 interconnect project. The study is now written with the understanding that the IC is exercising their option-to-build the new ring bus station, so direct costs have been reduced accordingly.

3. Interconnection Customer's Milestone Schedule

IC's requested Commercial Operation Date (COD) for the generation facility is **October 1, 2021.**

Milestone Schedule:

08/01/2021	Initial Back-feed through Project Substation Date
10/01/2021	Project Commercial Operation Date based on two months for the IC to commission equipment after Back-feed is available.

4. Customer's Scope of Work

IC is responsible for all design and construction related to activities on their side of the Point of Interconnection (POI). This includes, but is not limited to, the generation step-up (GSU) transformer, 138 kV (AD2-180) attachment line conductor and connection to the new 3 breaker ring bus interconnection substation.

Point of Interconnection (POI): The POI will be located within the new 138 kV ring bus interconnection substation where IC-owned 138 kV attachment line conductor will terminate on the insulators on the dead-end takeoff structure and will be defined as the POI.

IC is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer, as well as the necessary revenue metering equipment. The revenue metering current and voltage transformers shall be installed on the high voltage side of the GSU, on the generation side of the fault-interrupting device, and within the local zone of fault protection for the facility. The protective relaying and metering design must comply with First Energy's applicable standards as well as with PJM requirements.

The easements and associated rights of way for the TO owned substation along with the 138 kV line taps to the substation will be acquired by the IC and transferred to the TO at no cost. Site preparation for the TO owned substation, including clearing, grading and an access road, as necessary, is assumed to be by the IC. The access road design must be approved by First Energy to ensure it provides adequate access to the substation to support construction and maintenance activities. Route selection, line design, and right-of-way acquisition for the IC's facilities are not included in this report and are the responsibility of the IC.

Assumptions / Notes:

- IC will coordinate design and alignment of proposed 138 kV attachment line conductor with the Transmission Owner for review of any clearance, right-of-way or right-of-way encroachment issues with TO owned facilities.
- IC will coordinate design and construction of proposed 138 kV attachment line conductor. For these areas, the IC shall provide TO with proposed drawings prior to construction and as-built drawings, confirmed by as-built survey data post-construction.
- Transmission Owner's preference would be to limit interference and avoid transmission line crossings with new 138 kV terminal positions. As a minimum, IC facilities should not encroach within 100 feet of TO centerline at blowout conditions. If IC's line design does not comply with this requirement TO would need to review this area as a special exception.
- Additional costs will be incurred by the IC, if final alignment of the 138 kV attachment line conductor causes encroachments, changes, or modifications to any existing or relocated TO facilities.
- IC is responsible to make all arrangements for electric distribution service (if required) for its generation station. No costs or schedule are included herein.
- The IC will be required to install a transformer with a delta low side winding and a wye

grounded winding on the 138 kV side.

5. Description of Facilities Included in the Facilities Study

Attachment Facilities

The IC has exercised their option-to-build these facilities, so they will design, furnish and construct the new 138 kV line terminal and take off structure in the new Sulphur City ring bus substation. This work will include, but not be limited to, installation of a 138 kV line exit take-off structure, foundations, disconnect switch and associated equipment to accommodate the termination of the 138 kV generator lead line. Transmission Owner will oversee the design and construction and perform testing and commissioning.

Direct Connection

Sulphur City 138 kV

The IC has exercised their option-to-build these facilities, so they will design, furnish and construct a new three breaker ring bus substation, Sulphur City 138 kV, along the Kelso Gap-Parr Run 138 kV transmission line to interconnect the AD2-180 wind project with the Mon Power transmission system. The POI will be at the TO-owned deadend structure inside the substation yard where the generator lead line terminates. Transmission Owner will oversee the design and construction and perform testing and commissioning.

Non-Direct Connection

Kelso Gap-Parr Run 138 kV line

The Kelso Gap-Parr Run 138 kV line will be cut and looped into the new Sulphur City 138 kV interconnect substation. This cut will take place at a location that is approximately 2.8 miles from the Elk Garden substation and 7 miles from the Parr Run Substation. It is assumed that the Sulphur City substation will be located within 0.1 miles from the existing line.

Elk Garden 138 kV

Drawings and nameplates will be modified to account for the new line name.

Parr Run 138 kV

A new transmission line protection panel will be installed for the line section between the Parr Run and Sulphur City substations. The wave trap and associated line tuner will be retuned and reused. The existing anti-islanding transmitter will be replaced.

Kelso Gap 138 kV

The existing transfer trip receiver will be replaced. The wave trap and associated line tuner will be retuned and reused. An anti-islanding transmitter will be installed.

6. Total Cost of Transmission Owner Facilities Included in the Facilities Study

Description	Total (w/o Tax)	Tax (if applicable)	Total Cost (w/Tax)
Attachment Facilities:	$ 0	$ 0	$ 0
Total Direct Connection (DC) Costs:	$ 538,600	$ 0	$ 538,600
Total Non-Direct Connection (NDC) Upgrade Costs:	$ 2,810,500	$ 66,200	$ 2,876,700
New System Upgrades	$ 0	$ 0	$ 0
TOTAL Costs (ALL Categories)	$ 3,349,100	$ 66,200	$ 3,415,300

7. Summary of the Schedule for Completion of Work for the Facilities Study

Attachment Facility	*Duration*
Engineering, Procurement, and Construction	10 months

B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by First Energy to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

1. Transmission Lines –New

None

2. Transmission Lines – Upgrade

Kelso Gap – Parr Run 138kV line

- Construct a loop from the Kelso Gap- Parr Run 138kV line to the new Sulphur City substation.
- Per TAMI, existing line is constructed on H-frame wood structures, strung with 556.5 kcmil 26/7 ACSR and (2) ½" 7-Strand EHS Steel
- New loop will consist of the following:
    - Install (2) 138kV single circuit 3-pole wood deadend structures (TR-138075)
    - Remove existing H-frame structure #246
    - Install 556.5 kcmil 26/7 ACSR conductor and (2) 7#8 Alumoweld shield wires in loop to new substation, approximately 0.1 miles (to and from substation).
    - Remove existing conductor and static wire between the two proposed 3-pole wood deadend structures.
- Siting/Licensing
    - Assume minimal ecological impact
- Assumptions
    - Aerial LiDAR Survey will be required
    - Exact location of substation has been finalized; if location moves from what is shown in Attachment 3, the scope may need to be revised.
    - Existing structures #245 and #247 are assumed to be in good condition and can withstand a change in loading. An engineering analysis will be required.
    - Existing conductor and shield wire are assumed to be in good condition and will be transferred onto new deadend structures.
    - It is assumed new loop conductor will match existing.

3. New Substation/Switchyard Facilities

Sulphur City (IC has exercised their Option-to-Build this facility)

- Below Grade
    - Rough graded site provided by customer.
    - Drainage, fence & gates, grounding and stoning for 138kV Sulphur City substation neighboring collector substation with shared fence.
    - Foundations, conduit, trench and grounding for new structures and equipment as required.
- Above Grade
    - Install (3) 138kV SF6 Circuit Breakers.
    - Install (6) 138kV, 2000A breaker disconnect switches

  - Install (3) 138kV, 2000A motor operated line disconnect switches
  - Install (9) 138kV CCVT's
  - Install (2) 138kV, 2000A wide band wave trap and line tuners
  - Install (9) 138-kV surge arresters
  - Install (1) prefabricated control building with battery, charger, ATS, AC, and DC panels
  - Install (2) station service transformer with fused safety switch
  - Install one lot of steel structures and insulators for high and low bus supports
  - Install one lot of steel and insulators for (3) H-Frame dead-end structures. H-frame structure will be used to mount line CCVTs, MODs, surge arresters and wave traps.
  - Install one lot of steel for six (6) switch stands
  - Install one lot of rigid bus, jumper cables, and fittings
- R&C
  - Install relaying for Kelso Gap, Parr Run, and AD2-180 Gen 138kV lines in the prefabricated control building with the following equipment:
    - Install (1) pre-wired panel to include dual SEL-411L line current differential relaying over fiber to AD2-180 generation collector substation. Panel will also include SEL-2506 Fiber I/O module for transfer trip send and receive, SEL-501 for BFT and SATEC digital multimeter.
    - Install (2) pre-wired panels to include primary SEL-421 and backup SEL-411L relay, SEL-501 BFT.
    - Install (2) carrier panels consisting of (1) RFL-9785, (1) RFL-9780 for anti islanding, and (1) Powercomm PCM 5350
    - Install (1) PCM5350, (1) RFL 9780 & (1) Hybrid Chassis additional for anti-islanding
    - Install (1) SCADA RTU panel
    - Install (1) HMI panel
    - Install (1) GPS clock
- Additional Equipment to be Removed
  - None
- Siting/Licensing
  - Siting as required for new substation
- Assumptions
  - Ground grid for 115kV Sulphur City and collector station will be tied together.
  - Ground grid analysis for Sulphur City and collector station will be completed under this scope of work.

4. Substation/Switchyard Facility Upgrades

Kelso Gap (PE-20-200428-110807)

- Below Grade
  - None
- Above Grade
  - Re-tune line traps and tuners.
- R&C
  - Replace existing CR51C transfer trip receiver with an RFL-9780 TX/RX
  - Add checkback to RFL 9785
  - Add PowerComm PCM5350
  - Add balanced hybrid
- Additional Equipment to be Removed
  - None
- Assumptions

- Assumed existing wave trap and tuner can be reused

Parr Run (PE-20-200428-105734)

- Below Grade
  - None
- Above Grade
  - Re-tune line traps and tuners.
- R&C
  - Install (1) pre-wired panel to include primary SEL-421 and backup SEL-411L relay, SEL-501 BFT (Bus-Tie Breaker)
  - Change frequencies for existing DCB and anti-islanding schemes
  - Add PowerComm PCM5350
  - Replace existing RFL-6785P DCB ON/OFF carrier set with an RFL-9785
  - Replace existing CT51C TX with an RFL-9780
  - Install (1) GPS clock and (1) SEL-3530 RTAC
- Additional Equipment to be Removed
  - Existing line relay panel, carrier and DTT
- Assumptions
  - R&C based on attached protection specs.
  - Assumed existing wave trap and tuner can be reused
  - Assumes space available for new panels

Elk Garden

- Below Grade
  - None
- Above Grade
  - Modify drawings and nameplates for new line name
- R&C
  - None
- Additional Equipment to be Removed
  - None
- Siting/Licensing
  - None
- Assumptions
  - None

AD2-180 Generation

- Below Grade
  - None
- Above Grade
  - Nameplates and drawing review
  - Add to HV circuit diagram.
- R&C
  - Drawing Review
- Additional Equipment to be Removed
  - None
- Siting/Licensing
  - None
- Assumptions
  - None

5. Telecommunications Facilities – Upgrades

IC will design, provide, install, own and maintain a fiber-optic communications cable between the new **interconnection** substation, and IC's **generation** (collector) substation. Two (2) fiber-optic channels are required for each generator protection scheme to obtain high- speed tripping capability for any fault within the zone of protection. Should subsequent/additional PJM studies indicate that stability issues exist, the primary and backup relay fiber-optic communication channels must be in separately-routed cable paths and additional fiber-optic connection costs would apply (not included herein).

The IC will make the fiber-optic cable termination connections for its cable(s) referenced in the paragraph above at the interconnection substation control house.

Transmission Owner will make the fiber termination connections previously referenced for its cable(s) at the interconnection substation control house. IC is responsible for obtaining and maintaining all associated Rights-of-Way (ROW), Easements, and Permits for its fiber cable.

The Transmission Owner will not assume responsibility for the installation of the communication required for SCADA system at the Sulphur City 138kV substation. The IC has agreed to install a fiber connection from the Sulphur City 138 kV substation and connect to the Frontier network for the SCADA communication as part of their option to build proposal. A leased line will be used on the Frontier Network to connect to the First Energy Network via a Ethernet Virtual Private Lan (EVPL). Upon completion of this fiber connection, the IC will turn the fiber over to the Transmission Owner. The details on this fiber connection and the ongoing costs associated with the leased line should be outlined in the final construction agreement.

6. Metering & Communications

IC shall install, own, operate, test and maintain the necessary revenue metering equipment. IC shall provide Transmission Owner with dial-up communication to the revenue meter.

The revenue metering system (particularly the revenue metering current transformers) shall be designed to accurately meter the light loads that will occur when the facility is not generating power and only back-feeding station service from the Transmission Owner. This may require the use of high accuracy extended range current transformers.

Transmission Owner's Revenue Metering Requirements may be found FirstEnergy Corporation Requirements for Transmission Connected Facilities dated October 3, 2016 document located at the following links:

www.firstenergycorp.com/feconnect

www.pjm.com/planning/design-engineering/to-tech-standards.aspx

These requirements are in addition to any metering required by PJM.

Transmission Owner will provide the telecommunication circuits for the SCADA RTU and the telephone in the Transmission Owner interconnection substation.

Transmission Owner will obtain real-time, site-specific, generation data from PJM, via the required communication link from IC to PJM. Transmission Owner will work with PJM and IC to ensure the generation data provided to PJM meets Transmission Owner's requirements.

Communications for transmission line protection between the new **interconnection** substation, and IC's **generation** (collector) substation, will be via fiber optics (see "Telecommunication Facilities" section above).

7. Environmental, Real Estate and Permitting

The following are possible environmental, real estate and permitting issues:

- Environmental permitting, Real Estate acquisition, and West Virginia Public Service Commission (WVPSC) notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Developer to purchase the property, a Phase 1 Environmental Assessment should be conducted for the entire site to avoid assumption of environmental liabilities by Developer or Transmission Owner.
- The Transmission Owner interconnection substation may involve environmental surveys, permits, approvals and plans with federal, state, and/or local agencies.
- Assumed Developer is to provide all access rights, easements, ROW and permits necessary to complete the Project to the satisfaction of Transmission Owner. Environmental permitting shall encompass all federal, state and local requirements, consultations and agency coordination. Confirmation of meeting all permitting requirements shall be provided to Transmission Owner, prior to start of construction. Following construction and energization, confirmation of permit closeout shall be provided to the satisfaction of Transmission Owner, prior to transfer of ownership. If any of these elements are not included in the final agreement between Transmission Owner and Developer, twelve (12)-to-eighteen (18) months should be added to the Project Schedule to secure necessary permits, and additional costs would apply.
- Developer will provide copies of all of the relative environmental permits and other necessary approvals to Transmission Owner before Transmission Owner accepts the interconnection facilities.

- Developer is required to install an access road from the new interconnection substation to the nearest public road (must be approved by Transmission Owner), and obtain access rights for Transmission Owner. Developer is responsible for maintaining access road and ensuring unimpeded access for Transmission Owner at all times.
- Developer is responsible for all property acquisition (including easements/rights-of-way (ROW)) for transmission, distribution and communication facilities needed for the generator interconnection.
- If Developer owns the project property, in fee title, Transmission Owner will require a fee property transfer for the interconnection substation site which may require subdivision approval, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation. Developer is responsible for all costs, including but not limited to subdivision, associated with the property transfer.
- If Developer leases the project property, the Developer will be required to obtain fee property from the underlying fee property owner, on behalf of Transmission Owner, for the interconnection substation site, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation.
- All property rights must be surveyed and metes and bounds descriptions prepared for incorporation into Transmission Owner's document forms, for transfer of title.
- The Transmission Owner interconnection substation and transmission line loop will involve West Virginia Public Service Commission (WVPSC) notification/approval.
- All work occurs within an existing transmission line right-of-way or on Developer's property with access to all existing structures possible via that property and the right-of- way following established access routes that do not cross wetlands or streams.
- Developer will develop, and secure regulatory approval for, all necessary Erosion and Sediment Control (E&SC) plans and National Pollutant Discharge Elimination System (NPDES) permits.
- Developer will obtain all necessary permits.
- Developer will conduct all necessary wetlands and waterways studies and permits.
- Developer will conduct all necessary historical and archaeological studies.
- If the Developer plans to cross the transmission line right of way with facilities or access roads, please refer to the Transmission Rights-of-Way Restrictions information located at: https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform

8. Summary of Results of Study

Since the IC has exercised the option to build the direct connect and attachment facilities, only the TO's estimated costs to oversee engineering and construction and to perform any required testing and commissioning activities are included. All other costs in these categories will be determined by the IC.

Description	Total Cost (w/o Tax)	Tax (if applicable)	Total Cost (w/ Tax)
Attachment Facilities			
AD2-180 Generator Lead Termination: Installation of a 138 kV line exit take-off structure, foundations, disconnect switch and associated equipment to accommodate the termination of the 138 kV generator lead line.	Option-to-Build	Option-to-Build	Option-to-Build
Total Attachment Facilities (AF) Costs	**$ 0**	**$ 0**	**$ 0**
Direct Connect Facilities			
AD2-180 Sulphur City: Engineering oversight, witness testing and commissioning for new 138 kV 3-bkr Ring Bus interconnection	$ 538,600	$ 0	$ 538,600
Total Direct Connect (DC) Costs	**$ 538,600**	**$ 0**	**$ 538,600**
Non-Direct Connect Facilities			
Kelso Gap- Parr Run 138 kV Line Loop: Cut the Kelso Gap- Parr Run 138 kV line and install a line loop to the proposed AD2-180 substation.	$ 846,800	$ 0	$ 846,800
Kelso Gap: Anti-Islanding Upgrade	$ 416,000	$ 66,200	$ 482,200
Parr Run: Anti-Islanding Upgrade	$ 372,100	$ 0	$ 372,100
AD2-180 Sulphur City: Design, install, and test/commission MPLS Equipment to provide SCADA transport.	$ 250,100	$ 0	$ 250,100
Estimated SCADA work at Kelso Gap substation to support relay installations.	$ 34,600	$ 0	$ 34,600
Estimated SCADA work at Parr Run substation to support relay installations.	$ 34,600	$ 0	$ 34,600
Elk Garden: Modify drawings and nameplates for new line name.	$ 26,200	$ 0	$ 26,200

AD2-180 Generation: Nameplates, drawing review and energization support.	$ 15,600	$ 0	$ 15,600
Engineering oversight of Power Producer's specification and installation of revenue metering equipment at generation facility. Support set up of Power Producer-owned metering in FE's MV90 and other systems.	$ 5,300	$ 0	$ 5,300
Project Management, Environmental, Forestry, Real Estate and Right of Way.	$ 809,200	$ 0	$ 809,200
Total Non Direct Connect (NDC) Costs	**$ 2,810,500**	**$ 66,200**	**$ 2,876,700**
Total AF + DC + NDC Costs	**$ 3,349,100**	**$ 66,200**	**$ 3,415,300**

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. First Energy does not expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

First Energy reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by First Energy.

9. Schedules and Assumptions

A proposed **10 month Direct Connection** schedule is estimated to complete the engineering, construction and the associated activities, from the date of a fully executed Interconnection Construction Service Agreement and Construction Kick-Off Meeting. This schedule assumes that all issues covered by the "Environmental, Real Estate and Permitting Issues" section of this document are resolved, and outages (typically not granted from June through September) will occur as planned. Construction cannot begin until after all applicable permits and/or easements have been obtained.

Transmission Line Loop (Transmission Line)
10-month Schedule (September 2020 start)

Activity	Start Month	End Month
Preliminary Engineering	1	2
Siting, Permits & Real Estate	2	5
Detailed Engineering	2	5
Equipment Delivery	7	8
Below Grade Construction – T-Lines	8	9
Above Grade Construction – T-Lines	8	9

Testing & Commissioning	10	10

Remote terminal work (substation)
9-month Schedule (September 2020 start)

Activity	Start Month	End Month
Preliminary Engineering	1	2
Siting, Permits & Real Estate	3	5
Detailed Engineering	2	4
Equipment Delivery	7	7
Above Grade Construction – Substation	7	8
Testing & Commissioning	9	9

10. Information Required for Interconnection Service Agreement

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
AD2-180 Generator Lead Termination: Installation of a 138 kV line exit take-off structure, foundations, disconnect switch and associated equipment to accommodate the termination of the 138 kV generator lead line.	OTB	OTB	OTB	OTB	$ 0
Total Attachment Facilities Cost	**$ 0**	**$ 0**	**$ 0**	**$ 0**	**$ 0**
AD2-180 Sulphur City: Engineering oversight, witness testing and commissioning for new 138kV 3-bkr Ring Bus interconnection	$ 345,200	$ 0	$ 193,400	$ 0	$ 538,600
Total Direct Connection Cost	**$ 345,200**	**$ 0**	**$ 193,400**	**$ 0**	**$ 538,600**
Kelso Gap- Parr Run 138 kV Line Loop: Cut the Kelso Gap- Parr Run 138 kV line and install a line loop to the proposed AD2-180 substation.	$ 500,000	$ 59,800	$ 280,200	$ 6,800	$ 846,800

Kelso Gap: Anti-Islanding Upgrade	$ 267,300	$ 48,300	$ 96,700	$ 3,700	$ 416,000
Parr Run: Anti-Islanding Upgrade	$ 218,400	$ 69,500	$ 78,900	$ 5,300	$ 372,100
AD2-180 Sulphur City: Design, install, and test/commission MPLS Equipment to provide SCADA transport.	$ 109,500	$ 71,300	$ 61,300	$ 8,000	$ 250,100
Estimated SCADA work at Kelso Gap substation to support relay installations.	$ 22,200	$ 0	$ 12,400	$ 0	$ 34,600
Estimated SCADA work at Parr Run substation to support relay installations.	$ 22,200	$ 0	$ 12,400	$ 0	$ 34,600
Elk Garden: Modify drawings and nameplates for new line name.	$ 16,800	$ 0	$ 9,400	$ 0	$ 26,200
AD2-180 Generation: Nameplates, drawing review and energization support.	$ 10,000	$ 0	$ 5,600	$ 0	$ 15,600
Engineering oversight of Power Producer's specification and installation of revenue metering equipment at generation facility. Support set up of Power Producer-owned metering in FE's MV90 and other systems.	$ 3,400	$ 0	$ 1,900	$ 0	$ 5,300
Project Management, Environmental, Forestry, Real Estate and Right of Way.	$ 506,100	$ 13,000	$ 283,600	$ 6,500	$ 809,200
Total Non-Direct Connection Network Upgrades	**$ 1,675,900**	**$ 261,900**	**$ 842,400**	**$ 30,300**	**$ 2,810,500**
Total Project Costs	**$ 2,021,100**	**$ 261,900**	**$ 1,035,800**	**$ 30,300**	**$ 3,349,100**

Attachment #1: Protection Study

PROTECTION SCOPE

SHORT CIRCUIT DATA for a fault at the proposed location of the connection of **Sulphur City SS** on the existing Kelso Gap - Parr Run 138kV line (Symmetrical Values Only)
Initial conditions (percent on 100 MVA base)

138kV
Z1 = 1.376 + j 7.596%
Z0 = 6.095 + j 19.969%

3 phase fault – 5508A
Single line to ground fault – 3465A 3I0

Note: These fault values do not include the AD2-180 Generator or GSU step up transformer as being modeled in the calculations.

Impedances are given on a 100 MVA and 138kV bases. The faults provided are bolted, symmetrical values for normal system conditions. Future increases in fault currents are possible and it is the customer's responsibility to upgrade their equipment and/or protective equipment coordination when necessary.
All proposed generation interconnection points and load-serving delivery points must comply with the technical requirements detailed in FE's "Requirements for Transmission Connected Facilities" document.

See also the protection specifications document for Parr Run SS and Kelso Gap SS for additional required work (MP-20-190109-135414, Order 16555893).

DESCRIPTION OF WORK

Construct a 3 breaker 138kV ring bus substation to be named Sulphur City, on the existing Kelso Gap – Parr Run 138kV line, approximately 7 miles from Parr Run (which is between Parr Run and Elk Garden, Elk Garden is a tap station with no 138kV line breakers or protection).

Each 138kV line exit shall be equipped with three phase CCVTs. The two lines which use power line carrier shall be equipped with a 2000A wide band line trap and tuner, and PowerComm PCM-5350 power line carrier monitor.

At Parr Run, the line relays and power line carrier transceivers will be replaced, and power line carrier frequencies will change.

At Kelso Gap, the CR-51 an anti-islanding receiver will be replaced with an RFL-9780 anti-islanding transceiver. A checkback card will be added to the existing RFL-9785 DCB transceiver.

PROTECTION REQUIREMENTS - DESIGN NOTE

As separate primary and backup relays are being installed for this project, primary and backup relays shall use separate CTs, shall be fed from different PT windings, have separate DC circuits from the station 125V battery, and operate different trip coils of the breakers. The CTs used for the primary and backup relays will be located such that the zone of protection for the backup relays overlaps the zone of protection of the primary relay. Breaker failure to trip relaying needs to be on an independent DC circuit and the protective relay breaker failure initiate contacts must be independent of the tripping contacts.

MAJOR EQUIPMENT SPECIFICATIONS

3 – New, 138kV circuit breakers nominal, rated 145kV, 2000A minimum continuous, 40kA or higher interrupting, with 4 sets (2 per bushing) of CTs, 2000/5 MR, C800 @ 2000:5, thermal factor of 2.0.

2 – New, set of 3, nominal 138kV system - 1200/700:1 capacitor voltage transformers, with two secondary windings, 0.3MWXYZ, to be used on the Kelso Gap and Parr Run line terminal positions. Each secondary winding shall be wye connected. X and Y secondary winding taps shall be wired to independent test switches. 115 and 66 volt secondary voltages from each winding shall be run to the control building. All CCVTs to be provided with carrier accessories for coupling of power line carrier signal.

1 – New, set of 3, nominal 138kV system - 1200/700:1 capacitor voltage transformers, with two secondary windings, 0.3MWXYZ, to be used on the generator line terminal position. Each secondary winding shall be wye connected. X and Y secondary winding taps shall be wired to independent test switches. 115 and 66 volt secondary voltages from each winding shall be run to the control building. No carrier accessories are required.

2 - Wide band line tuner, one each to be used on the Kelso Gap and Parr Run line terminal positions.

2 – Wide band line trap, 2000A, one each to be used on the Kelso Gap and Parr Run line terminal positions.

3 – PowerComm Solutions PCM-5350 power line carrier monitor, catalog number PCM-5350-301A1, 30-500kHz frequency range, with 125 VDC power supply, with relay and power fail alarm outputs, (2) 125VDC inputs, IRIG-B timecode input, DNP3 communication protocols, USB front port, two Ethernet RJ-45 10BASE-T/100BASE-TX front/rear ports, RS-232 rear port, and RS-422/485 rear port. New, to be used to monitor the DCB on/off power line carrier transmitter/receiver and anti-islanding transmitter.

RELAY SPECIFICATIONS

Kelso Gap – Sulphur City 138kV Line PR DCB PLC

1 Schweitzer SEL-421 "4214415XB0X4H21XXXXX" 138kV line protection, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for primary phase and ground line protection utilizing power line carrier pilot channel & DCB scheme. (21/67NP-KG)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the X winding of the Kelso Gap line CCVTs
PT Ratio (VAZ, VBZ, VCZ): (not used)

W Winding CT ratio: 2000/5 from Bkr B1 inner Parr Run line-side CTs, wye connected, common toward the Kelso Gap 138kV line
X Winding CT ratio: 2000/5 from Bkr B2 inner generator line-side CTs, wye connected, common toward the Kelso Gap 138kV line

Kelso Gap – Sulphur City 138kV Line BU non-pilot

1 – Schweitzer SEL-411L "411L0X4X5B8D0XH52424XX" 138kV line protection, current differential, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for backup phase and ground line protection utilizing a phase step distance and ground directional overcurrent scheme, and automatic reclosing of breaker B1 with SCADA supervision. (21/67NB-KG)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the Y winding of the Kelso Gap line CCVTs
PT Ratio (VAZ, VBZ, VCZ): 1200:1 from the Y winding of the Parr Run line CCVTs

W Winding CT ratio: 2000/5 from Bkr B1 outer Parr Run line-side CTs, wye connected, common toward the Kelso Gap 138kV line
X Winding CT ratio: 2000/5 from Bkr B2 outer generator line-side CTs, wye connected, common toward the Kelso Gap 138kV line

Kelso Gap – Sulphur City 138kV Line PR DCB PLC

1 - RFL Electronics 9785 on/off power line carrier transceiver (85-KG), catalog number RFL-978512222202A,65-156kHz range, 10 watt, 1000Hz bandwidth, 125 VDC power supply, with keying unit, checkback module, SOE IRIG-B module, for use with the SEL421 primary relay (21/67NP-KG) on the Kelso Gap line at 131.0kHz for the On-Off DCB relay scheme. Configure the checkback unit at Sulphur City SS as the master and configure the checkback unit at Kelso Gap SS as the slave.

Install a carrier test push button switch to initiate carrier start to RFL-9785

Parr Run – Sulphur City 138kV Line PR DCB PLC

1 Schweitzer SEL-421 "4214415XB0X4H21XXXXX" 138kV line protection, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for primary phase and ground line protection utilizing power line carrier pilot channel & DCB scheme. (21/67NP-PR)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the X winding of the Parr Run line CCVTs
PT Ratio (VAZ, VBZ, VCZ): (not used)

W Winding CT ratio: 2000/5 from Bkr B1 inner Kelso Gap line-side CTs, wye connected, common toward the Parr Run 138kV line
X Winding CT ratio: 2000/5 from Bkr B3 inner generator line-side CTs, wye connected, common toward the Parr Run 138kV line

Parr Run – Sulphur City 138kV Line BU non-pilot

1 – Schweitzer SEL-411L "411L0X4X5B8D0XH52424XX" 138kV line protection, current differential, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for backup phase and ground line protection utilizing a phase step distance and ground directional overcurrent scheme, and automatic reclosing of breaker B1 with SCADA supervision. (21/67NB-PR)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the Y winding of the Parr Run line CCVTs
PT Ratio (VAZ, VBZ, VCZ): 1200:1 from the Y winding of the Kelso Gap line CCVTs

W Winding CT ratio: 2000/5 from Bkr B1 outer Kelso Gap line-side CTs, wye connected, common toward the Parr Run 138kV line
X Winding CT ratio: 2000/5 from Bkr B3 outer generator line-side CTs, wye connected, common toward the Parr Run 138kV line

Parr Run – Sulphur City 138kV Line PR DCB PLC

1 - RFL Electronics 9785 on/off power line carrier transceiver (85-PR), catalog number RFL-978513222202A, 156-392kHz range, 10 watt, 1000Hz bandwidth, 125 VDC power supply, with keying unit, checkback module, SOE IRIG-B module, for use with the SEL421 primary relay (21/67NP-PR) on the Kelso Gap line at 172.0kHz for the On-Off DCB relay scheme. Configure the checkback unit at Sulphur City SS as the master and configure the checkback unit at Parr Run SS as the slave.

Install a carrier test push button switch to initiate carrier start to RFL-9785

Generator 138kV PR Line Diff Dedicated Fiber

1 – Schweitzer SEL-411L "411L0X4X5B8D0XH52424XX" 138kV line protection, current differential, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for primary phase and ground line protection, and providing SCADA close supervision for B2. (87L/21/67NP)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the X winding of the generator line CCVTs
PT Ratio (VAZ, VBZ, VCZ): 1200:1 from the Y winding of the Kelso Gap line CCVTs

W Winding CT ratio: 2000/5 from Bkr B2 inner Kelso Gap line-side CTs, wye connected, common toward the generator 138kV line
X Winding CT ratio: 2000/5 from Bkr B3 inner Parr Run line-side CTs, wye connected, common toward the generator 138kV line

Generator 138kV BU Line Diff Dedicated Fiber

1 – Schweitzer SEL-411L "411L0X4X5B8D0XH52424XX" 138kV line protection, current differential, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for backup phase and ground line protection, and providing SCADA close supervision for B3. (87L/21/67NB)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the Y winding of the generator line CCVTs
PT Ratio (VAZ, VBZ, VCZ): 1200:1 from the Y winding of the Parr Run line CCVTs

W Winding CT ratio: 2000/5 from Bkr B2 outer Kelso Gap line-side CTs, wye connected, common toward the generator 138kV line
X Winding CT ratio: 2000/5 from Bkr B3 outer Parr Run line-side CTs, wye connected, common toward the generator 138kV line

Anti-islanding panel

The anti-islanding protection panel shall contain the following:

1 - RFL-9780 FSK Receiver, 9780RX1225D1A, 500 Hz bandwidth, 65-156 kHz band, SOE. Will be configured to receive the anti-islanding transfer trip signal from Kelso Gap at 135.5kHz. The outputs for trip and for loss of guard will be wired to trip the LJ (94TTX) relay in accordance with Section 14.3 and Figure 14.1 of the First Energy Transmission System Protection Practices. (dated March 2012).

1 - RFL-9780 FSK Receiver, 9780RX1325D1A, 500 Hz bandwidth, 156-392 kHz band, SOE. Will be configured to receive the anti-islanding transfer trip signal from Parr Run at 172.0kHz. The outputs for trip and for loss of guard will be wired to trip the LJ (94TTX) relay in accordance with Section 14.3 and Figure 14.1 of the First Energy Transmission System Protection Practices. (dated March 2012).

1 - RFL-9780 FSK Transmitter, 9780TX1225D1A, 10 watt, 65-156 kHz band, SOE. Will be configured to re-transmit a trip and/or loss of guard received from Parr Run to Kelso Gap at 137.0kHz. Will also transmit for breaker B-1 and B-2 open (both breakers open), B-1 and B-3 open (both breakers open), and for an operation of the B-1, B-2, or B-3 breaker failure to trip LOR relays.

1 - RFL Hybrid chassis with two skewed hybrids and one balanced hybrid

1 - Struthers Dunn timer relay, part number 246BBXP-010-115-125V DC, 1 Form C and 2 Form A contacts, 1-10 second time delay. (2-94X). To operate 94TTX.

1 - Relay Associates type LJ auxiliary relay, LJ13EBN82 (94TTX)

B1 138kV Breaker Failure

1 - Schweitzer SEL-501 “050100BX561XXB” overcurrent relay with metering, suitable for use at 125V DC. New, with level sensitive inputs, to be used for failure-to-trip protection.

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

X unit CT ratio: 2000/5 from Bkr B1 inner Parr Run line side CTs (same CTs as used for Kelso Gap line Primary relay)
Y unit CT ratio: not used

B2 138kV Breaker Failure

1 - Schweitzer SEL-501 “050100BX561XXB” overcurrent relay with metering, suitable for use at 125V DC. New,
with level sensitive inputs, to be used for failure-to-trip protection.

3. Access to back of Schweitzer relays is required for PC connection.
4. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

X unit CT ratio: 2000/5 from Bkr B2 inner Kelso Gap line side CTs (same CTs as used for generator line Primary
relay)
Y unit CT ratio: not used

B3 138kV Breaker Failure

1 - Schweitzer SEL-501 “050100BX561XXB” overcurrent relay with metering, suitable for use at 125V DC.

New, with level sensitive inputs, to be used for failure-to-trip protection.

5. Access to back of Schweitzer relays is required for PC connection.
6. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

X unit CT ratio: 2000/5 from Bkr B3 outer generator line side CTs (same CTs as used for Parr Run line Backup relay)
Y unit CT ratio: not used

Indicating & SCADA Data Panel Meters

6 - Satec "PM174-U-60-5-ACDC-00-00" three element, digital indicating Advanced Power Quality Meter with DNP3.0 protocol, one per 138kV line exit. Meter used to supply analog data to substation RTU. Meter to be powered by 125/48V DC. For use one on each 138kV line terminal exit (to monitor line current) and each breaker SEL-501 current circuit (to monitor breaker current).

GPS Clock

1- Arbiter Systems GPS Antenna with mounting kit AS0044600 and GPS satellite clock, 1094B with 1094OPT10 125VDC power supply and 50 feet of cable. To provide IRIG-B time synch input to the SEL relays, Power-line carrier transmitter/receivers, and SCADA RTU

1 lot - Cables to connect the relays and teleprotection boxes to either the modulated or unmodulated output of the clock to the MOD or TTL (respectively) BNC connector to provide GPS time sync:
-RFL-9785 (2)
-RFL-9780 (3)
-SEL-421 (2)
-SEL-411L (4)
-SEL-501 (2)

Note: Teleprotection boxes (such as UPLC or RFL GARD) shall NOT be connected to any other device (Such as the RTAC). Such connections may result in a CIP violation.

Relay Remote Access Requirements

1 – Schweitzer "3530HB0XX313A0XXXXXX," Real-Time Automation Controller (RTAC) with 33 serial ports.

9 – Schweitzer cables, model number C273A, used to connect the RTAC to the following relays:
SEL-421 (2)
SEL-411L (4)
SEL-501 (3)

1 – RG-58 coax cable with BNC (male) connectors of required length to connect the Arbiter 1094B unmodulated IRIG-B output to the RTAC.

Generation Substation Protection Requirements for 138 kV line to Sulphur City SS

It is the responsibility of the Generator Owner (GO) to assure protection, coordination and equipment adequacy within their facility for conditions including but not limited to:

- Single phasing of supply

- System faults
- Equipment failures
- Deviations from nominal voltage or frequency
- Lightning and switching surges
- Harmonic voltages
- Negative sequence voltages
- Separation from FE supply
- Synchronizing generation
- Synchronizing facilities between independent transmission system and FE
- Transmission System

The generator owner (GO) is to design their protective system to clear any faults within their zones of protection with one or more of their local breakers. Each zone of protection covering the 138 kV portion of the GO system (including the GSU(s)) is to be protected by two fully independent relay schemes that each provides high speed fault protection. The terminal breaker at the GO end of the direct connection line is to be included in one of these zones of protection. Two SEL-411L relays shall be used for protection of the interconnect line, to match the companion relays at AD2-180 Substation.

The customer is solely responsible for protecting its own equipment in such a manner that electrical faults or other disturbances on the FE system do not damage its equipment.

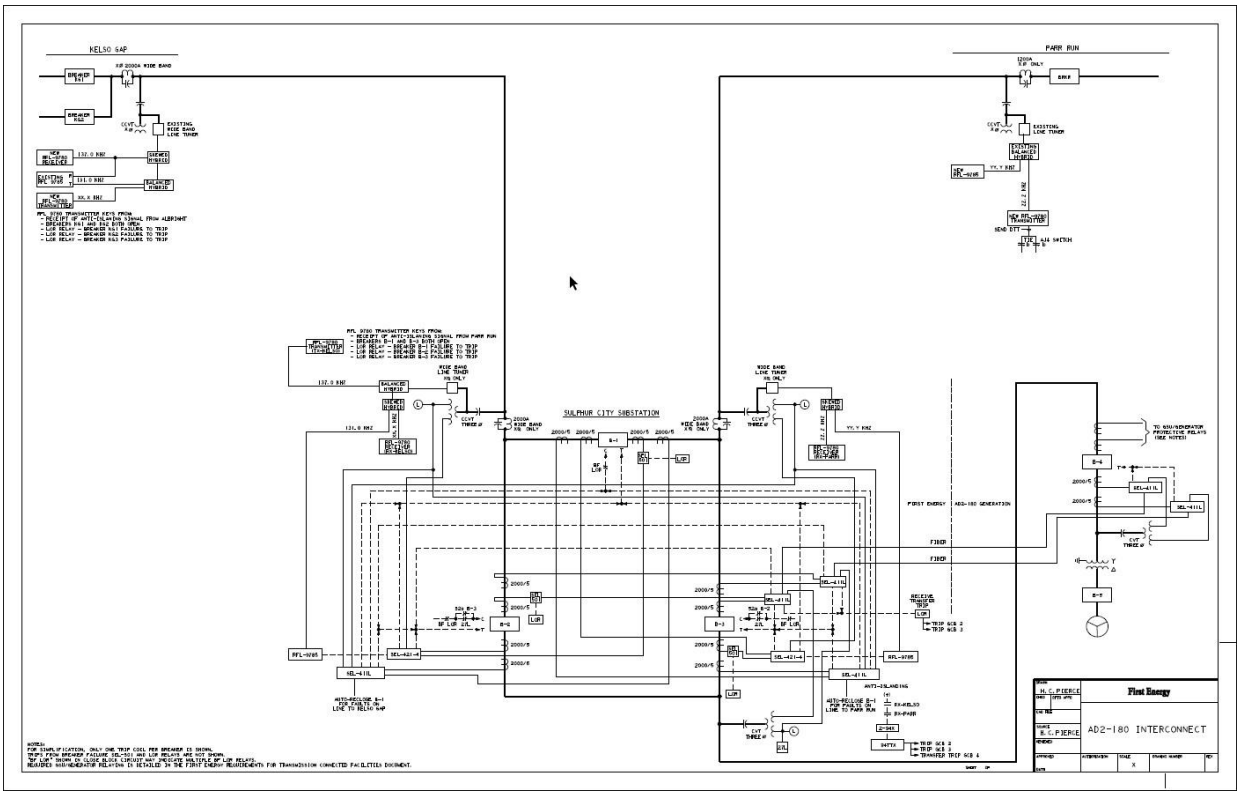
Metering Requirements

A revenue metering installation is required for this installation. Requirements are outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document.

Operational metering is also required for this generation connection. These requirements are also outlined in FirstEnergy's "Requirements for Transmission Connected Facilities" document. These requirements are in addition to any metering required by PJM.

Generator Step-Up Transformer Requirements

As per section 14.2.6 of the First Energy Requirements for Transmission Connected Facilities document, because this area of the system is effectively grounded, the transformer shall have a wye grounded winding on the high (transmission system) side and have a delta connected winding on the low side. This is required to maintain proper ground relay coordination on the First Energy system. No exceptions to this standard shall be granted.



SHORT CIRCUIT DATA for a fault at **Parr Run SS** (Symmetrical Values Only) Initial conditions (percent on 100 MVA base)

138kV

Z1 = 1.362 + j 7.647%
Z0 = 6.893 + j 22.096%

3 phase fault – 5386A
Single line to ground fault – 3251A 3I0

Note: These fault values do not include the AD2-180 Generator or GSU step up transformer as being modeled in the calculations.

Impedances are given on a 100 MVA and 138kV bases. The faults provided are bolted, symmetrical values for normal system conditions. Future increases in fault currents are possible and it is the customer's responsibility to upgrade their equipment and/or protective equipment coordination when necessary.

All proposed generation interconnection points and load-serving delivery points must comply with the technical requirements detailed in FE's "Requirements for Transmission Connected Facilities" document.

See also the protection specifications document for the construction of Sulphur City SS (MP-20-190109-135414, Order 16536359).

DESCRIPTION OF WORK
At Parr Run SS:

- Replace electromechanical line relays with new FE standard panel
- Change frequencies for existing DCB and anti-islanding transfer trip schemes
- Re-tune traps and tuners as necessary
- Replace existing RFL-6785P DCB ON/OFF carrier set with RFL-9785
- Replace existing anti-islanding CT51C transmitter with an RFL-9780 Tx
- Add PowerComm PCM5350

At Kelso Gap SS:

- Add frequency for new anti-islanding transmitter
- Re-tune traps and tuners as necessary
- Replace existing CR51C transfer trip receiver with an RFL-9780 Tx/Rx, which includes a transmitter for the anti-islanding scheme
- Add a checkback card to the existing RFL-9785
- Add PowerComm PCM5350
- Add balanced hybrid

PROTECTION REQUIREMENTS - DESIGN NOTE

As separate primary and backup relays are being installed for this project, primary and backup relays shall use separate CTs, shall be fed from different PT windings, have separate DC circuits from the station 125V battery, and operate different trip coils of the breakers. The CTs used for the primary and backup relays will be located such that the zone of protection for the backup relays overlaps the zone of protection of the primary relay. Breaker failure to trip relaying needs to be on an independent DC circuit and the protective relay breaker failure initiate contacts must be independent of the tripping contacts.

RELAY SPECIFICATIONS at Parr Run

Parr Run – Sulphur City 138kV Line PR DCB PLC

1 Schweitzer SEL-421 "4214415XB0X4H21XXXXX" 138kV line protection, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for primary phase and ground line protection
utilizing power line carrier pilot channel & DCB scheme. (21/67NP-SC)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the 138kV bus A CCVTs
PT Ratio (VAZ, VBZ, VCZ): (not used)

W Winding CT ratio: 1200/5 from the 138kV bus tie breaker, Bus A side CTs, wye connected, common toward the Sulphur City 138kV line
X Winding CT ratio: (not used)

Parr Run – Sulphur City 138kV Line BU non-pilot

1 – Schweitzer SEL-411L "411L0X4X5B8D0XH52424XX" 138kV line protection, current differential, phase distance and ground directional overcurrent relay, with standard outputs on two I/O boards. New, for backup phase and ground line protection utilizing a phase step distance and ground directional overcurrent scheme. (21/67NB-SC)

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

PT Ratio (VAY, VBY, VCY): 1200:1 from the 138kV bus A CCVTs
PT Ratio (VAZ, VBZ, VCZ): (not used)

W Winding CT ratio: 1200/5 from the 138kV bus tie breaker, Bus A side CTs, wye connected, common toward the Sulphur City 138kV line
X Winding CT ratio: (not used)

Parr Run – Sulphur City 138kV Line PR DCB PLC

1 - RFL Electronics 9785 on/off power line carrier transceiver (85-SC), catalog number RFL-978513222202A,
156-392kHz range, 10 watt, 1000Hz bandwidth, 125 VDC power supply, with keying unit, checkback module, SOE IRIG-B module, for use with the SEL421 primary relay (21/67NP-SC) on the Kelso Gap line at 166.0kHz for the On-Off DCB relay scheme. Configure the checkback unit at Sulphur City SS as the master and configure the checkback unit at Parr Run SS as the slave.

Install a carrier test push button switch to initiate carrier start to RFL-9785

2 - PowerComm Solutions PCM-5350 power line carrier monitor, catalog number PCM-5350-301A1, 30-500kHz frequency range, with 125 VDC power supply, with relay and power fail alarm outputs, (2) 125VDC inputs, IRIG- B timecode input, DNP3 communication protocols, USB front port, two Ethernet RJ-45 10BASE-T/100BASE-TX front/rear ports, RS-232 rear port, and RS-422/485 rear port. New, to be used to monitor the DCB on/off power line carrier transmitter/receiver and anti-islanding transmitter.

Anti-islanding equipment

The existing CT-51C at Parr Run which is used to transmit the anti-islanding transfer trip signal shall be replaced with an RFL-9780 FSK transmitter, 9780TX1325D1A, 10 watt, 156-392 kHz band, SOE. Will be configured to re-transmit a trip and/or loss of guard received from Parr Run to Sulphur City at a frequency of **172.0kHz.**

138kV Bus Tie Breaker Failure

1 - Schweitzer SEL-501 "050100BX561XXB" overcurrent relay with metering, suitable for use at 125V DC. New, with level sensitive inputs, to be used for failure-to-trip protection.

1. Access to back of Schweitzer relays is required for PC connection.
2. Appropriate test/disconnect switches are required to provide connections for relay testing and isolation.

X unit CT ratio: 1200/5 from the 138kV bus tie breaker bus A side CTs (same CTs as used for the Sulphur city primary and backup line relays).

Y unit CT ratio: not used

1 -Electroswitch "LOR", spring operated, hand reset, multi-stage auxiliary tripping relay. New, to be used with the above SEL-501 Breaker Failure to trip relay for Bkr B1. (86BF-BT)

Indicating & SCADA Data Panel Meters

1 - Satec "PM174-U-60-5-ACDC-00-00" three element, digital indicating Advanced Power Quality Meter with DNP3.0 protocol, one per 138kV line exit. Meter used to supply analog data to substation RTU. Meter to be powered by 125/48V DC. For use one on each 138kV line terminal exit (to monitor line current) and each breaker SEL-501 current circuit (to monitor breaker current).

GPS Clock

1- Arbiter Systems GPS Antenna with mounting kit AS0044600 and GPS satellite clock, 1094B with 1094OPT10 125VDC power supply and 50 feet of cable. To provide IRIG-B time synch input to the SEL relays, Power-line carrier transmitter/receivers, and SCADA RTU

1 lot - Cables to connect the relays and teleprotection boxes to either the modulated or unmodulated output of the clock to the MOD or TTL (respectively) BNC connector to provide GPS time sync:
-RFL-9780
-RFL-9785
-SEL-421
-SEL-411L
-SEL-501

Note: Teleprotection boxes (such as UPLC or RFL GARD) shall NOT be connected to any other device (Such as the RTAC). Such connections may result in a CIP violation.

Relay Remote Access Requirements

1 – Schweitzer "3530HB0XX313A0XXXXXX," Real-Time Automation Controller (RTAC) with 33 serial ports.

9 – Schweitzer cables, model number C273A, used to connect the RTAC to the following relays:
SEL-421 (1)
SEL-411L (1)
SEL-501 (1)

1 – RG-58 coax cable with BNC (male) connectors of required length to connect the Arbiter 1094B unmodulated IRIG-B output to the RTAC.

RELAY SPECIFICATIONS at Kelso Gap

1 - RFL-9780 FSK Receiver, 9780RX1225D1A, 500 Hz bandwidth, 65-156 kHz band, SOE. Will be configured to receive the anti-islanding transfer trip signal from Sulphur City at 137.0kHz. This will replace the existing CR-51C.

1 - RFL-9780 FSK Transmitter, 9780TX1225D1A, 10 watt, 65-156 kHz band, SOE. Will be configured to re-transmit a trip and/or loss of guard received from Albright to Sulphur City at 135.5kHz. Will also transmit if the 138kV breakers B-1 and B-2 open (both breakers open), B-1 and B-3 open (both breakers open), and for an operation of the B-1, B-2, or B-3 breaker failure to trip LOR relays.

1 - RFL Hybrid chassis with one skewed hybrid and one balanced hybrid

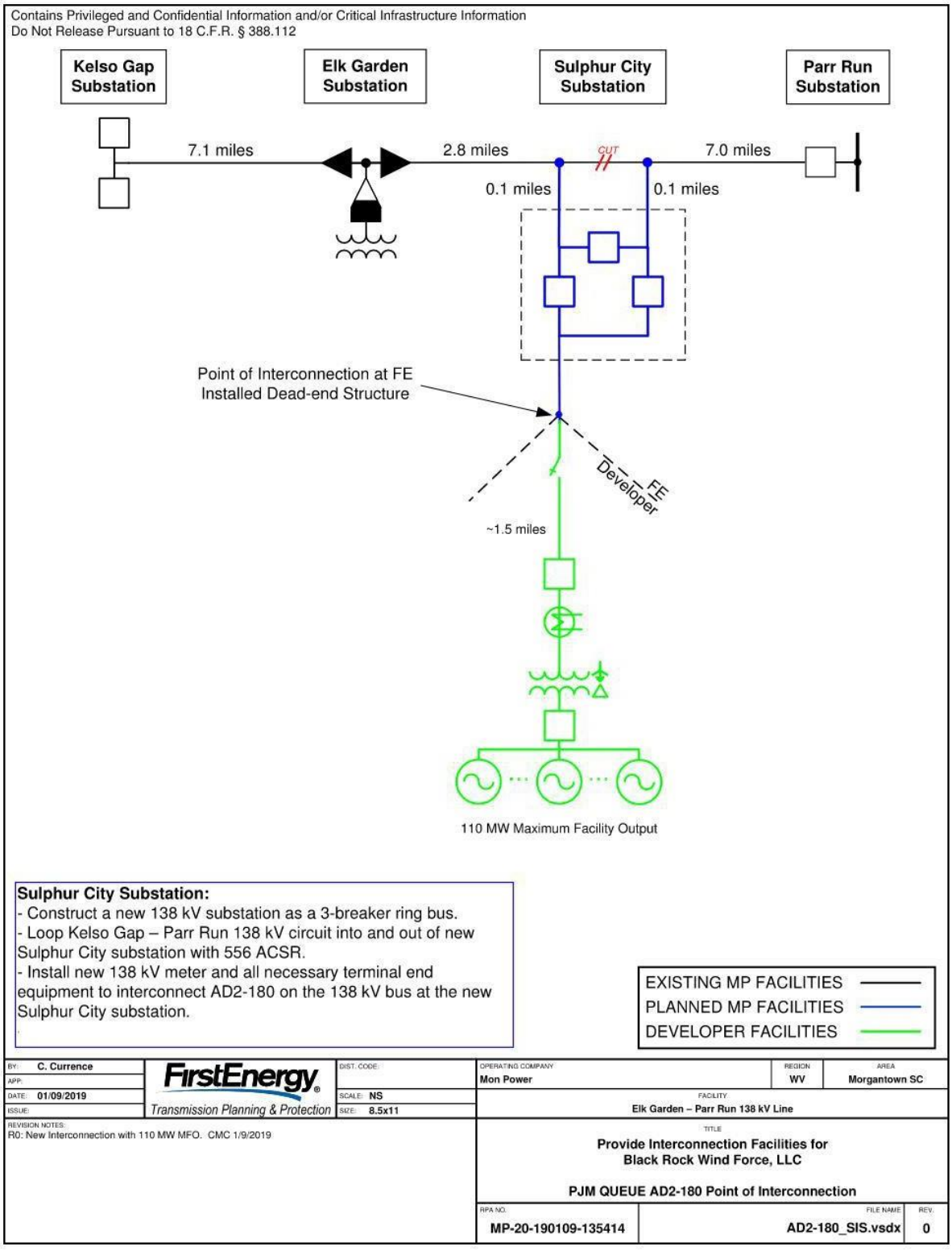
1 - RFL-9785 Checkback Module, for use in existing RFL-9785 carrier on line to Sulphur City, RF-SP106525, configure as "slave", and the checkback at Sulphur City as "master".

2 - PowerComm Solutions PCM-5350 power line carrier monitor, catalog number PCM-5350-301A1, 30-

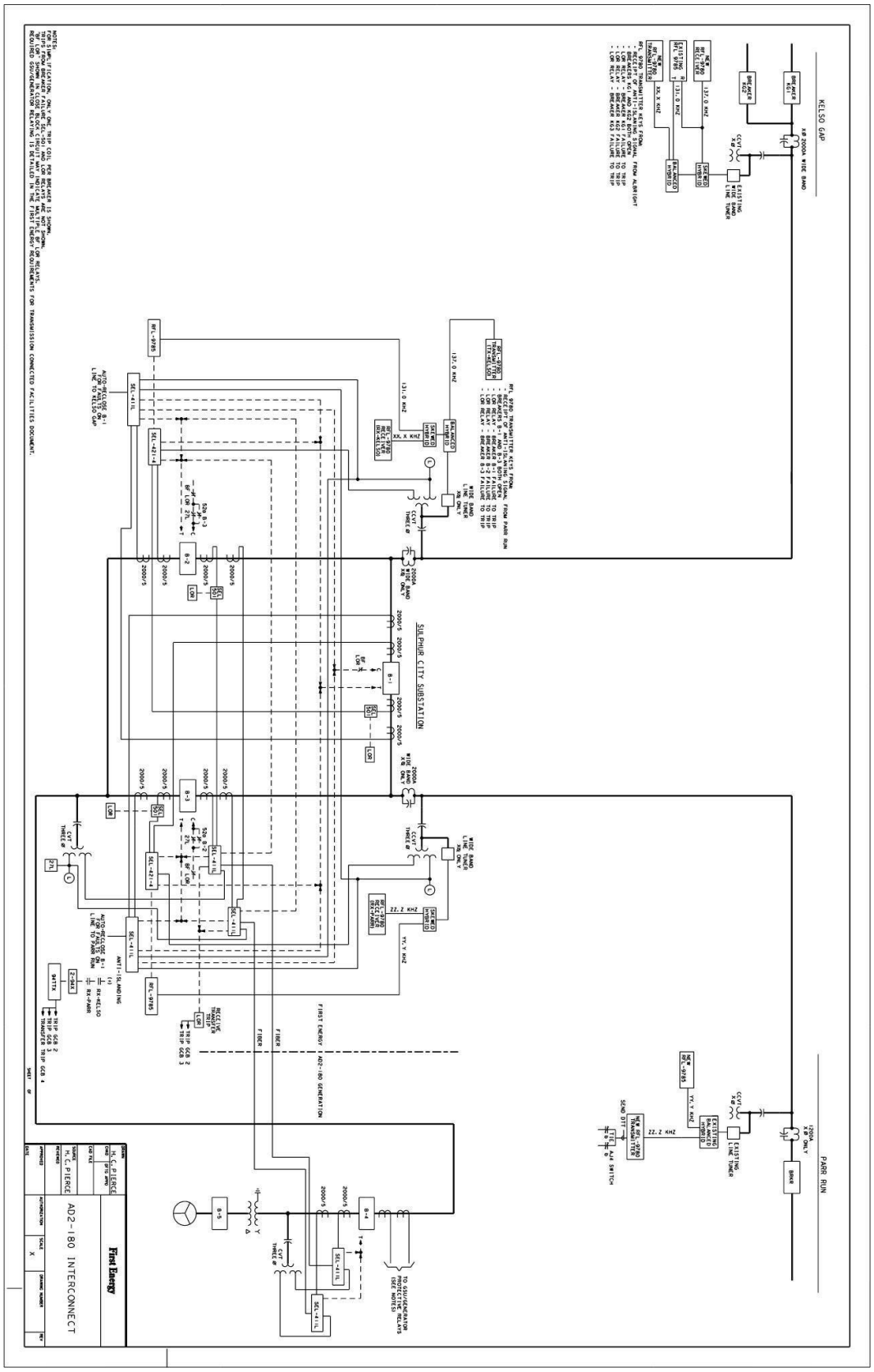
500kHz frequency range, with 125 VDC power supply, with relay and power fail alarm outputs, (2) 125VDC inputs, IRIG-Btimecode input, DNP3 communication protocols, USB front port, two Ethernet RJ-45 10BASE-T/100BASE-TX front/rear ports, RS-232 rear port, and RS-422/485 rear port. New, to be used to monitor the DCB on/off power line carrier transmitter/receiver and anti-islanding transmitter

Attachment #2: One-Line Diagrams

First Energy Facilities One-Line

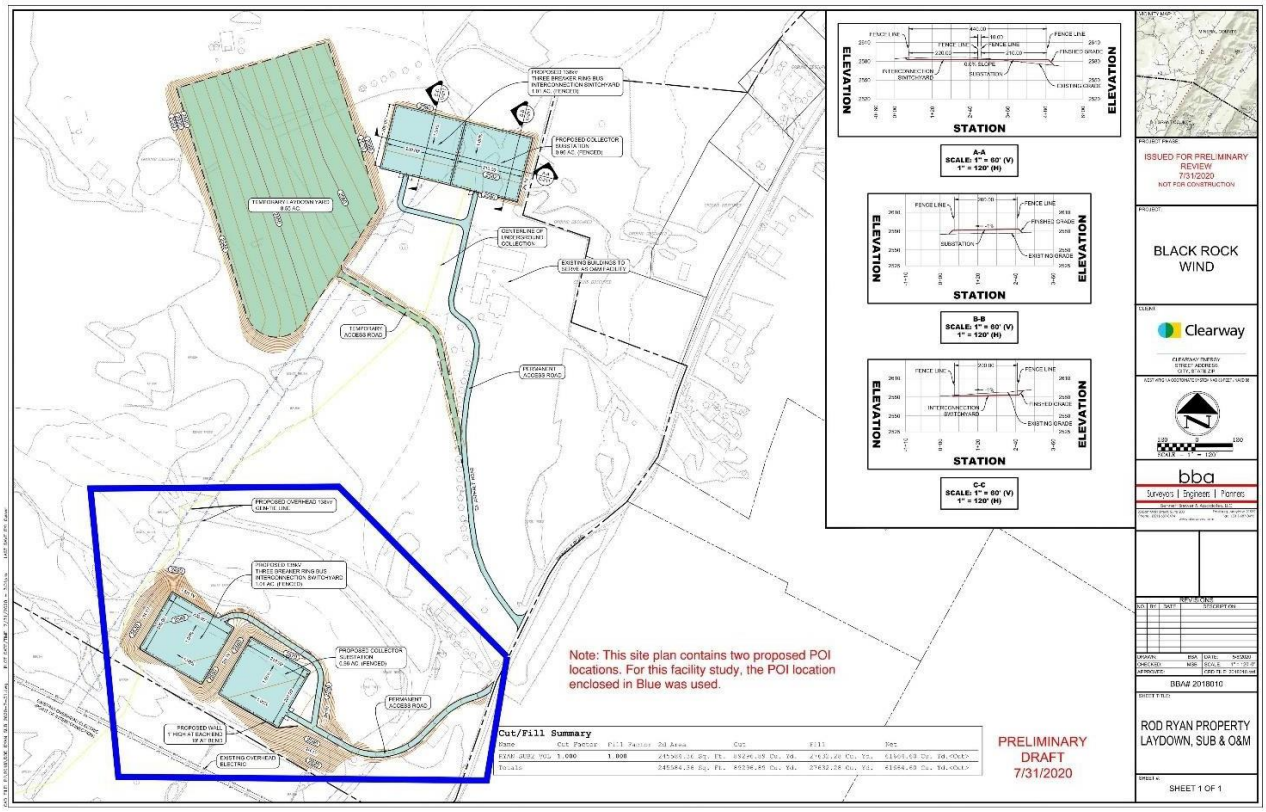


IC Facilities One-Line



Attachment #3: Project Site Plan

IC Site Plan, IC Substation Location and Point of Interconnection to FE



Attachment #4: Generation Connection Requirements

Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with the Transmission Owner's *Requirements for Transmission Connected Facilities* documents located at either of the following links:

www.firstenergycorp.com/feconnect

www.pjm.com/planning/design-engineering/to-tech-standards.aspx

The following is an excerpt taken from Transmission Owner's *Requirements for Transmission Connected Facilities* document:

> *For all generation facilities, other than wind-powered and other non-synchronous generating facilities, the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at continuous rated power output at a power factor as defined in the table below. This requirement will be measured at either the POI or generator terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when demanded.*
>
> *For all wind-powered or other non-synchronous generating facilities the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at a power factor as defined in the table. This requirement will be measured at either the POI or generator's terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when needed.*

For projects that entered PJM's New Service Queue after November 1, 2016, the power factor requirement will be as follows:

Generation Type	New / Increase	Size	Power Factor Requirement	Measurement Location
Synchronou	New	> 20 MW	0.95 leading to 0.90 lagging	Generator's Terminals
Synchronou	New	<= 20	0.95 leading to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	New	All	0.95 leading to 0.95 lagging	High Side of the Facility Substation Transformers
Synchronou	Increa	> 20 MW	1.0 (unity) to 0.90 lagging	Generator's Terminals

Synchronou	Increa	<= 20	1.0 (unity) to 0.90 lagging	Point of Interconnection
Wind or Non-Synchronous	Increase	All	0.95 leading to 0.95 lagging	High Side of the Facility Substation Transformers

Any different reactive power requirements that FE and/or PJM determines to be appropriate for wind-powered or other non-synchronous generation facilities will be stated in the applicable interconnection agreement(s).

Induction generators and other generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar-sized synchronous generator.

Design Requirements

Developer is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with Transmission Owner's Transmission System. Developer is also responsible for meeting any applicable federal, state, and local codes.

Transmission Design Requirements

Design Criteria

Facilities owned and operated by Transmission Owner shall comply with the applicable Transmission Owner technical requirements and standards posted on the PJM website per the PJM Tariff, and the following criteria. Where there are different requirements for the same criterion, the more restrictive shall apply. Developer must abide by any PJM, RFC or NERC criteria imposed that is more restrictive than those of Transmission Owner.

General Design Requirements

- System phasing (counter clockwise) — X-Y-Z
- System frequency: — 60 hertz
- Elevation, AMSL: — Less than 1000 meters
- Isokeraunic level: — 40
- Maximum ambient temperature: — 40 degrees C
- Minimum ambient temperature: — -40 degrees C
- Maximum conductor operating temperature: — Contact Transmission Owner
- Wind Loading (round shapes): — Per ASCE 7-98, per Fig. 6-1 depending on location
- Ice loading – Substations (no wind): — 25 mm
- Seismic zone: — Per ASCE 7-98, per Fig. 9.4.1.1(a) and (b). Equipment qualification per IEEE 693-97

Voltage and Current Ratings

- Nominal phase-to-phase: 138 kV
- Maximum phase-to-phase: 145 kV
- Basic impulse level (BIL): 550 kV
- Maximum continuous current carrying capacity: 2000 A
- Design fault current: 40 kA
- Single Contingency (breaker failure) clearing time: 60 cycles

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 84”
- Minimum phase-to-phase, metal-to-metal distance: 53”
- Recommended phase-to-ground: 45”
- Minimum phase-to-ground: 42”
- Low bus height above top of foundations (match existing): 17’-0”
- High bus height above top of foundations (match existing): 25’-0”
- Minimum vertical clearance from live parts to grade: 11’-7”
- Minimum horizontal clearance from live parts: 6’-1”
- Minimum conductor clearance above roads in switchyard: 25’-0”
- Minimum bottom of insulator to top of foundation: 8’-6”