Facilities Study Report

For: [redacted] ("Customer")

Queue #: 42432-01

Service Location: Rockingham County, NC

Total Output: 477MW Summer Ratings & 540MW Winter Ratings

Customer Requested Backfeed Date: 10/7/2019

Customer Requested Generating Testing Date: 2/3/2020

Commercial Operation Date: 12/1/2020

Prepared by:
Don Dickens / Kenneth Strahl / Steve Mc Clure / Tyler Johnson

Table of Contents

1.0 Introduction

The Customer has proposed to install new generation in the balancing authority area owned and operated by Duke Energy Carolinas, LLC ("Company"). The Customer's requested interconnection point will require the modification of an existing switching station located on property in Rockingham County, NC. *Appendix A - Schematic 6.1.1 provides a representative schematic of the interconnection station.* The Customer's proposed facility, referred to as the [redacted], shall be a Combined Cycle Plant capable of generating 477MW of power (summer rating at 35 degrees C) & 540MW of power (winter rating at 0 degree C). The Customer has a requested commercial operation date of December 1, 2020.

This Facilities Study interconnection request (Queue # 42432-01) reports on the interconnection and the network modifications.

At the request of the Customer, the Company performed and delivered to the Customer an Interconnection System Impact Study ("SIS"). The SIS, dated, December 6, 2016 summarized all thermal, short circuit, stability, and reactive capability constraints resulting from the interconnection of the Customer's proposed generating facility.

This Facilities Study quantifies the cost, work scope, and tentative schedules associated with the design and installation of all required interconnection facilities and network modifications.

The Interconnection Point ("IP") between the Company and the Customer shall be the point where the overhead generator bus line attaches on the line termination structure down to the first termination point inside the Company's Interconnection Switchyard.

For the purposes of this Facilities Study the Customer Interconnection Facilities are defined as those facilities between the Customer's generator step up transformers up to and including the IP inside the Company's switching station.

For the purpose of this Facilities Study Company Facilities are defined as all facilities that are owned and operated by Duke Energy Carolinas, LLC that operate at a voltage of 44kV or higher.

The interconnection shall be realized through the development of selected network facilities which may be directly associated with those grid elements found on the transmission side of the IP. These facilities henceforth are referred to as Associated Facilities in this Facilities study.

The Customer has requested interconnection as a Network Resource Interconnection Service ("NRIS") provider.

> **Definition:** NRIS – an enhanced service that contemplates the acquisition of full market rights (e.g., Installed Capacity payments), conditioned on the Interconnection Customer's obligation to pay for any Network Upgrades that may be required for its requested interconnection.

As an NRIS provider, the Associated Facilities include facilities as summarized below and further described in more detail in the section labeled, *"Facilities Directly Associated with Customers Interconnection"* and *"Required Network Modifications"*.

- Establishment of a new 230kV CC interconnection with in an existing switching station known as Ernest Switching Station adjacent to the new combined cycle plant.

The Customer has requested that all construction of new facilities and network modifications necessary for start up of the new generation facilities be complete to meet their requested in-service (back feed) date of October 7, 2019.

Subsequent to the requirements and preparation listed in this document a design review shall take place prior to any facilities constructed to maintain compliance with the North American Electric Reliability Corporation ("NERC") Reliability Standard FAC-002-1, or its successor. The objective of this review is to assure Customer's facilities are properly coordinated with the Company's.

Also in compliance with the NERC Reliability Standard FAC-002-1, or its successor a testing and inspection activity will take place prior to the in- service (back feed) date.

2.0 Baseline Assumptions

The Company's Facilities are based on application of Industry standard equipment. As such the total energy handling capability of the proposed switching station and network modifications will accommodate energy flows greater than the requested 477MW summer (540MW winter) rating in the Generation Interconnection Request. In the event the Customer decides to interconnect an additional increment of capacity, a new Generation Interconnection Request will be required to evaluate the impacts. Any constraints that may result will be identified as part of the new study request.

The following assumptions have been used to establish the project scope and cost estimates for the identified facilities.

This Facilities Study is premised on the Company providing a turnkey design and installation of all Associated Facilities and network modifications in conjunction with a 230kV interconnection of the Customer Facilities.

The interconnection voltage will be 230kV.

The Customer shall address the stability issues as identified in the SIS by installing power system stabilizers on their generators, which shall be enabled. As stated in the SIS "it is recommended that the Customer's generators have out of step protection installed and operational."

Any required outages necessary to support construction of the Company Associated Facilities must occur during a spring or fall time frame. If an outage of sufficient duration cannot be

obtained to support any of the required construction activity, temporary facilities may have to be constructed to maintain integrity of grid.

Provisions have been made for temporary line work involved with the Jacobs lines upgrade and the addition of series reactors at Sadler Tie and is included in the estimate provided herein.

The protection schemes installed by the Company at its Associated Facilities are intended to protect the Company's Network from the Customer's Facilities.

Electrical protection schemes for the generator step up transformers interconnecting the plant to the Network shall be the responsibility of the Customer. The protection scheme must include separate primary and secondary schemes whose operation shall be coordinated with the interconnection substation's protection schemes.

Customer's generator step-up transformers shall be equipped with suitable surge protection to properly protect the transformer from lightning and switching surges. The arresters shall be coordinated with the Company's standard insulation levels of the interconnection substation. The Customer should refer to the Company's *Facility Connection Requirements* ("FCR") document for further guidance.

Any required communications and control circuits between interconnecting switching station and the generating plant shall be the responsibility of the Customer.

All relay settings for the breakers at the interconnecting switching station will be the responsibility of the Company. For those breakers where joint use may be necessary, close coordination between representatives from both the Company and the Customer will be required. The protection schemes deployed for the bus line remains the responsibility of the Customer but are subject to the review of the Company.

Under the NRIS scenario, the major changes sited in the INTRODUCTION section must be implemented to allow for a safe and reliable interconnection.

The Company maintains all rights for the commission testing of any substation facility that it owns. The Company reserves the right to inspect and witness commission testing of any switchyard, transmission line, or other facility constructed on behalf of the Customer for the purpose of interconnecting to the Company's transmission grid. This shall include but not be limited to any required relay and control protection systems.

Metering responsibilities shall be in accordance with Section 24.1 of the Company's Open Access Transmission Tariff ("OATT"). Reference the metering section of this Facilities Study for specific meter requirements.

All telemetry circuits that provide the generation plant operational and billing data to the Company's System Operations Center ("SOC") will be the responsibility of the Customer.

All estimates prepared for this Facilities Study are considered to be good faith estimates represented in present day dollars as of the date of the study. The estimates are further premised on being able to perform work during normal business hours with minimum overtime or weekend work. The Customer will be responsible for all actual costs.

The Customer's financial responsibilities for the Company's regulated facilities will be determined in accordance with the Company's OATT in effect at the time of design and construction.

This Facilities Study assumes other generation projects which are in the Company Generator Interconnection Queue are viable projects and are progressing as planned. In the event any of those projects are delayed, removed or assigned new queue dates, reassignment for Network Upgrades associated with those projects may shift to others in the Generation Queue based on their respective queue position. At the time this study was performed no other generation projects appear to have any pending upgrades which would fall to the responsibility of the Customer. If a change of responsibility becomes necessary, the reassignment will be done in accordance with the Company's OATT and FERC policy.

Return to INTRODUCTION

3.0 Facilities Directly Associated with Customer's Interconnection

3.1 Cost Estimates

As per the requirements of the OATT, the following good faith estimate is provided. This estimate assumes no temporary facilities will be required to support construction efforts.

Table 1

Ref	Associated Facilities	Estimated Cost
A	Modification of 230kV Ernest Switching Station	$4,880,003
	TOTAL	**$4,880,003**

3.2 Work Scope

Interconnection Station Design and Construction Work Scope

3.2.1 General Description of The Company's Interconnection Facilities

The Company will modify the existing Ernest Switching Station which will operate at the Customer's requested interconnection voltage. The Customer's combined cycle generation plant will connect to the Company's transmission system with a targeted commercial operation date of 12/1/2020. The scopes of the facilities which are required to support this interconnection are addressed by this section of the Facilities Study.

The switchyard of the interconnection switching station, Ernest Switching Station, will be modified for an ultimate four bay breaker and a half bus configuration. The modified design for the 230kV switchyard configuration shall include four existing incoming line terminals, two existing generator bus line terminals, & one new generator bus line terminal. Interconnecting to the transmission grid will be realized by the connection of two double circuit 230kV lines. The Sadler 230kV lines currently provide a connection between Ernest Switching Station and Sadler Tie. The Jacobs 230kV lines currently provide a connection between Ernest Switching Station and Belews Creek Switching Station. The switch yard will require the installation of four additional 245kV, 3000 amp class circuit breakers. The compliment of isolating switches will consist of gang operated type manual hand operated switches. Refer to *Appendix A - Schematic 6.1.1* for a representative one line of the proposed associated facility.

The 230kV switchyard shall have a nominal continuous current rating of 3000A. The breakers shall be rated 63kA. The open air Basic Impulse Insulation Levels ("BIL") shall be 900kV.

The substation structures shall be a tubular steel design. Structural loadings will align with the Company's standard design practice for 230kV switchyards.

The scope of work shall include but not be limited to the following major tasks in the Interconnection Facilities (230kV yard):

- Fencing
- Foundations
- Structure design and layout
- Grounding
- Lighting
- Lightning Protection
- Insulation Coordination
- Protective Relaying
- Station Auxiliary design
- DC system Design
- Conduit and trenching
- Equipment selection and installation
- Bus and wiring

A set of verticle reach disconnect switches shall be installed on the generator bus line entering the new substation from the Customer's facilities. It will be controlled by the Company. It will provide a means to physically and visibly isolate the Company's System from the Customer.

The Company reserves the right to lock the switch in the open position:

- If it is necessary for the protection of maintenance personnel when working on de-energized circuits.
- If Customer or the Company equipment presents a hazardous condition.
- If Customer or the Company equipment interferes with the operation of the Company transmission network system.
- If the the Company transmission network system interferes with the operation of Customer.

3.2.2 Relay, Controls and Communications

The transmission line relay protection circuits continuously monitor the conditions of the offsite power system and are designed to detect and isolate the faults with maximum speed and minimum disturbance to the system. The principal features of these schemes are described below:

The existing 230kV Jacobs and Sadler lines (4 lines) are protected by independent primary and secondary distance relay schemes designed to clear a fault anywhere on the line. All four lines also have Permissive Overreach Transfer Trip (POTT) and Direct Transfer Trip (DTT) pilot schemes.

The existing 230kV Rockingham #1 and Rockingham #2 buslines (2 lines) are protected by independent primary and secondary line current differential and overcurrent relay schemes designed to clear a fault anywhere on the busline. Both buslines also have Direct Transfer Trip (DTT) pilot schemes.

Both 230kV switchyard buses will be protected by an independently operated primary and secondary bus differential relay scheme. The bus differential relays continuously monitor the current inflow and outflow from the bus section under their supervision.

All eleven 230kV switchyard breakers will be protected by breaker failure relays. The breaker failure relays operate through a timing relay and should a breaker fail to trip within the time setting of its timing relay, the associated breaker failure trip relay will trip and lock out all breakers on both sides of the failed breaker.

The new 230kV [redacted] Reidsville busline will be protected by independent primary and secondary line current differential and overcurrent relay schemes designed to clear a fault anywhere on the busline. The busline will also have Direct Transfer Trip (DTT) pilot schemes. This will require fiber connections between the plant facility and Ernest Switching Station. The Customer will be responsible for installing the single mode fiber strands from the [redacted] CC plant facility to the Switching Station per Company guidelines.

The station Serial to IP ("STIP") communications and alarms equipment will consist of (1) SEL3555 Computer, (2) SEL2440 Automation Controllers, (2) SEL2730U Ethernet Switches, (1) SEL3610 Port Server and an Arbiter Satellite Clock.

Install (1) SEL-2515 Remote I/O Module on each new and existing power circuit breaker (11 total) for breaker alarms that go to the relay house via fiber optic cable to the SEL-3610 Port Server.

Install capacitor voltage transformers on all three phases of the new Reidsville CT bus line for line voltage inputs to the revenue metering and relaying equipment.

Install capacitor voltage transformers on "Z" phase of the 230kV red and yellow bus for synchronizing.

DC System: There will be (1) 125 DC system with separate load centers for the primary and secondary relays.

3.2.3 Control House

A prefabricated relay house shall be installed at Ernest Switching Station to serve the needs of the switchyard. The projected size of this enclosure shall be approximately 16' x 55'. The switchyard relay house shall house all switchyard batteries (appropriately ventilated) and be capable of accommodating up to thirty (30) twenty-six (26) inch standard metal relay/control panels which may be required for the ultimate size of this switchyard. This new control house replaces the existing control house due to space limitation in the existing control house.

3.3 Schedule

Appendix B - Associated Facilities Milestones Schedules 6.2 provides the cycle time which will be required to implement the design and construction of the various associated facilities. The cycle time represents the time activities must start relative to the required in service date. Should facilities be required earlier close coordination between the Company and the Customer will be required.

A more detailed work plan and project schedule will be developed once an authorization to proceed is received.

Once the Company is authorized to proceed the Customer will be liable for all costs incurred.

Return to INTRODUCTION

4.0 Required Network Modifications

The SIS identified the constraining system elements resulting from the addition of the Customer's generation. Network Modifications are assigned based on queue position in accordance with FERC guidelines. Should other projects currently in the queue be delayed, cancelled, removed from the queue or assigned a different queue status, the assignment of responsibility for certain Network Modifications shift to the project creating the need for the modification based on the modified queue. There are no other queued projects identified that would influence any shifting of financial responsibility.

The cycle times required to design and construct the various network improvements are provided in *Appendix C - Network Modification Schedules 6.3*.

The SIS did indicate under certain NERC TPL-001-4 Category P6 multiple contingency Planning Event that if both lines between Ernest Switching Station and Belews Creek Switching Station were lossed the Customer may be directed to reduce the output of its facility as a pre-second contingency system adjustment. The SIS also indicated under certain NERC TPL-001-4 Category P7 multiple contingency Planning Event that if both lines between Ernest Switching Station and Belews Creek Switching Station were lossed a runback scheme will be required because time for operator action is not available given the emergency rating of the circuits. The Company will work closely with the Customer to establish mutually agreeable critical clearing times and reduced operating times to effectively mitigate unfavorable conditions as much as practical.

4.1 Cost Estimate

As per the requirements of the OATT, the following good faith estimate is provided. This estimate assumes temporary facilities will be required to support construction efforts of the Jacobs lines Ref A and at Sadler Tie-Ref B – references in Table 2 below.

Table 2

Ref	Required Network Modification	Estimated Cost
A	Upgrade Jacobs 230kV Lines (Belews Creek Switching Station to Ernest Switching Station) (13.71 Miles) with 1158 ACSS/TW 54/7	$26,605,789
B	Upgrade Belews Creek Switching Station 230kV Line Terminal	$374,445
C	Add 2% Reactors on Sadler 230kV Lines@Sadler Tie	$27,057,125
D	Add 230/100kV Transformer @ North Greensboro Tie	$0
E	100kV OD Breakers @ North Greensboro Tie	$0
F	GSU Neutral Reactors @ Belews Creek Steam Station	$0
G	100kV OD Breakers @ Sadler Tie	Included in "C"
H	Add 230/100kV Transformer @ Sadler Tie	Included in "C"
	TOTAL	**$54,037,360**

4.2 Work Scope

A. Upgrade the Jacobs 230kV Lines (Belews Creek Switching Station to Ernest Switching Station) (13.71 Miles) with 1158 ACSS/TW 54/7

Work on the Jacobs 230kV lines consists of rebuilding approximately 13.71 miles of transmission line on an existing right of way between Belews Creek Switching Station and the Ernest Switching Station. The line work will involve the following activities:

- Replace approximately 3 existing 2LD series tangent towers with 2N series tangent towers.
- Replace approximately 2 existing 2LL series strain towers with 2Q series strain towers.
- Install arm kits on all 2LD and 2HD suspension towers. Total of 58 structures.
- Conduct a ground line investigation of all lattice structures.
- Replace (2) existing 1/2" overhead ground wire with (2) new 48 strand overhead optical fiber/ground wire.
- Replace the existing 1272ACSR 54/19 phase conductors with 1158 ACSS/TW 54/7.

- Lattice towers being replaced will require temporary poles for one circuit. Approximately 10 temporary poles will be required

B. Upgrade Belews Creek Switching Station 230kV Line Terminal

It has been determined necessary to improve the protection at Belews Creek Switching Station as part of the Jacobs 230kV line rebuild. The station work will involve the following activities:

- Replace the Jacobs Black line primary relaying using 1-SEL421 and 2-SEL351S relays.
- Replace the Jacobs Black line secondary relaying using 1-SEL411L relay.
- Replace the Jacobs White line primary relaying using 1-SEL421 and 2-SEL351S relays.
- Replace the Jacobs White line secondary relaying using 1-SEL411L relay.

C. Add 2% Reactors on Sadler 230kV Lines @ Sadler Tie

The introduction of additional power capacity at Ernest Switching Station, has made it necessary to install 2% Reactors on both of the Sadler Black and White lines inside the Sadler Tie 230kV switch station. The work will involve the following activities:

Appendix A - Schematic 6.1.2 provides a representative schematic of Sadler Tie

- Expand the station footprint to accommodate the addition of reactors and new Sadler 230kV line terminals – approximately 60,960 sqft (254'x240')
- Install new concrete foundations to accommodate the addition of new bus supports, new line termination structures and new station equipment.
- Modify the existing Cable Raceways.
- Install new grounding and modify the existing grounding system.
- Install two new 230kV Sadler line terminals.
- Install 2% Reactors on both the Sadler Black Line and the Sadler White Line.
- Install Breaker Bypass for both sets of reactors which includes two IPO Type 230kV, 3000A breakers in positions 1R & 2R (six total).
- Install two 3 pole, 50 amp, bolt on molded case breakers in the 230kV bent AC box #3 for the three phase, 480 volt auxiliary requirement for the new breakers.
- Install an SEL351S relay and SEL9510 control module in the secondary line relay panels of each Sadler line for the new breakers control and relaying.
- Install three new SFO Type 230kV, 3000A, 63ikA breakers in positions 3, 13 &24.
- Install a SEL2515 module in the nine new breaker mechanisms for alarms.
- Install three new 230kV breaker failure relay panels for CB-3, 13, 14 and 24 with 1-SEL351S relay per breaker.
- Install new Trench, 230kV, 2000/1155:1 ratio CVT's on the Sadler Black and White lines (3 per line)
- Install a 480/240V, 50kVA, single phase pad mount transformer & 240/120V, 200A AC load center in a DDJB near the six new Sadler line/reactor bypass breakers with the pad mount high side fed from AC Box #3.

- Install a 3 pole, 125 amp, 480 volt molded case breaker in AC Box #3 to feed the pad mount transformer.
- Modify the existing 230kV Red and Yellow Main busses associated with the existing station's breaker and a half scheme.
- Install a Trench, 230kV, 2000/1155:1 ratio CVT on "Z" phase of the 230kV yellow bus.
- Install a 230kV red and yellow bus primary and secondary bus differential DDJB's (4 total boxes)
- Install a 230kV primary red and yellow bus differential relay panel with 6-PVD21D1A relays.
- Install a 230kV secondary red and yellow bus differential relay panel with 6-SBD11B2A relays.
- Replace existing 2TL structure 133 with two single circuit engineered dead end poles aligned with new station bays.
- A minimum of seven temporary poles will be required to maintain adequate clearance during construction activities.
- One new span will be pulled from the new engineered structure to the new station A-frames. Conductor will be single 1272 ACSR 54/19.

NOTE: Some temporary work has been identified associated with the installation of series reactors at Sadler Tie. If an outage of sufficient duration cannot be obtained to support any of the required construction activity, additional temporary facilities may have to be constructed to maintain integrity of grid and will impact the schedule.

D. Add 230/100kV Transformer @ North Greensboro Tie

The introduction of additional power capacity at Ernest Switching Station, has made it necessary to install a new auto transformer between the North Greensboro Tie 230kV switch yard and the North Greensboro Tie 100kV switch yard within North Greensboro Tie. The work will involve the following activities:

- This work should be completed by the end of 2018, funded by Duke Energy.

E. 100kV OD Breaker @ North Greensboro Tie (8 Breakers)

With the addition of the proposed auto transformer at the North Greensboro Tie switchyard, the available fault current as seen at the North Greensboro Tie 100kV bus will be increased. Fault studies indicate that the Dan River Bl, Dan River Wh, Graham St Bl, Graham St Wh, Guilford Bl, Guilford Wh, Page Bl & Page Wh breakers would be subject to interrupting current levels greater than their interrupting capability. This will require the following activities:

- This work should be completed by the end of 2020, funded by Duke Energy.

F. GSU Neutral Reactors @ Belews Creek Steam Station

With the addition of the proposed Combined Cycle generators, the available fault current as seen at the Belews Creek Steam Station 230kV bus will be increased. Fault

studies indicate that the PCB 5, PCB10, PCB 11, PCB 12, PCB, 13, PCB 14, PCB 15, PCB 24, PCB 25, & PCB 27 breakers would be subject to interrupting current levels greater than their interrupting capability. However, the installation of neutral reactors on the plant GSU's will reduce the fault current to acceptable levels. Therefore, the breakers mentioned will not need to be replaced, but the neutral reactors will need to be installed. This will require the following activities:

- This work should be completed the end of 2019, funded by Duke Energy.

G. 100kV OD Breakers @ Sadler Tie (4 Breakers)

With the addition of the proposed Combined Cycle generators, the available fault current as seen at the Sadler Tie 100kV bus will be increased. Fault studies indicate that the Reidsville Bl, Reidsville Wh, Wolf Creek Bl & Wolf Creek Wh breakers would be subject to interrupting current levels greater than their interrupting capability. This will require the following activities:

- Replace four 100kV breakers with new 63kA rated gas breakers.
- Install 100kV, 15k pfd rated capacitor voltage transformers, connected to "Z" phase of the line terminals of all four lines for synchronizing voltage
- Install a cable termination cabinet near each new breaker to be used as an interface cabinet and point of transition/termination between the existing breaker control cables and the new breaker wiring.
- An SEL2515 Remote I/O Module will be installed in the cable termination cabinets of all four breakers for alarms that go back to the STIP panel via fiber optic cable.
- Modify the auxiliary AC to supply single phase 240 volt, 50 amp service to each new breaker.

H. Add 230/100kV Transformer @ Sadler Tie

The introduction of additional power capacity at Ernest Switching Station, has made it necessary to install a new auto transformer between the Sadler Tie 230kV switch yard and the Sadler Tie 100kV switch yard with in Sadler Tie. The work will involve the following activities:

Appendix A - Schematic 6.1.3 provides a representative schematic of Sadler Tie

- Modify the existing oil containment sytem – a larger oil separator tank is required.
- Install new concrete foundations to accommodate the addition of new bus supports and new station equipment.
- Modify the existing Cable Raceways.
- Modify the existing grounding system.
- Modify the existing 230kV Red and Yellow Main busses associated with the existing station's breaker and a half scheme.
- Install one new 230 auto transformer bus line terminal.

- Install one new 100kV auto transformer bus line terminal.
- Modify the existing 100kV switch yard to accommodate two new breaker positions.
- Install a new 448MVA 230-100/44KV, auto transfomer in Bank 2 position.
- Install two new SFO Type 230kV 3000A 63ikA breakers in positions 12 and 22.
- Install two new SFO Type 100kV 3000A, 63ikA breakers, in positions LT2 Red & LT2 Yellow.
- Install a SEL2515 module in the four new breaker mechanisms for alarms.
- Install a Trench, 230kV, 2000/1155:1 ratio CVT on "Z" phase of the new Bank 2 busline.
- Install a 230-100/44kV Autobank 2 relay panel with 2-SEL487E and 1-SEL351S relay.
- Install a 100kV Bank 2 red and yellow LT breaker failure relay panel with 2-SEL351S relays.
- Install one new 230kV breaker failure relay panels for CB-12, and 22 with 1-SEL351S relay per breaker.

4.3 Schedule

Appendix C - Network Modification Schedules 6.3 provides the cycle time which will be required to implement the design and construction of the various network modifications. The cycle time represents the time activities must start relative to the required in service date. Should facilities be required earlier close coordination between the Company and the Customer will be required.

A more detailed work plan and project schedule will be developed once an authorization to proceed is received.

Once the Company is authorized to proceed the Customer will be liable for all costs incurred.

NOTE: No provisions have been made for the construction of any temporary facilities that might have to be constructed should outages not be granted.

5.0 Connection Requirements

5.1 General

This Facilities Study document is intended to provide a basic scope definition of facilities on which the Company has based its facilities study and cost estimates. It shall serve as the basis for the facilities that the Company proposes to design, build, and operate in connection with interconnection of Customer generation in the Rockingham County, NC area.

All Facilities installed by Customer and connected to the Company's Network shall comply with *Facility Connection Requirements* ("FCR") dated August 21, 2008. This document shall supplement those requirements where necessary.

5.2 Short Circuit Withstand Capability

The Company assumes no responsibility for appropriately sizing the short circuit withstands capability of any equipment installed on the Customer's Side of the IP. The Company will provide upon request the maximum available short circuit current based on its current models. The Customer however must realize that significant numbers of new generation requests are constantly being received all of which will add to the available short circuit current. The Customer will need to exercise extreme care in appropriately sizing its equipment while providing for reasonable margin for future increases in available short circuit current. The Company bears no responsibility in the sizing decision. Available short circuit currents on the Company's system can be in excess of 80 kA depending upon location and voltage.

5.3 Equipment Ratings

Prior to finalizing specification of equipment necessary to interconnect to the power grid Customer shall consult with the Company to establish the required ratings necessary to reliably interconnect and provide the expected Voltage and Var support as defined in the Interconnection and Operating Agreement. Specific parameters shall include but are not limited to available transformer taps and short circuit withstands capabilities.

5.4 Insulation Requirements

The Company's standard requirements for equipment installed on the 230kV systems shall meet the following minimum (BIL).

	230 BIL kV
Open Air	900
Transformer Winding	900

5.5 Instrument Transformer Requirements

Provisions must be made to provide meter function CT's in the transformer yard that will allow for metering of the plant output. This will require provisions of meter class CT's on the generator step-up transformer with accuracy class of 0.3W1.0 or better. It will also require the installation of CVT's.

5.6 Metering

THIS STUDY ASSUMES THAT THE CUSTOMER SHALL BEAR ALL REASONABLE DOCUMENTED COST ASSOCIATED WITH THE PURCHASE, INSTALLATION, OPERATION, TESTING AND MAINTENANCE OF THE PRIMARY METERING EQUIPMENT.

The information provided below is not a replacement of the information provided in the Large Generation Interconnection Agreement ("LGIA"). The Customer should refer to the LGIA document for further guidance.

This section is intended to provide a high level overview of some of the metering that shall be required by the Company's System Operating Center ("SOC") for both monitoring and billing purposes.

All plant output shall be tracked on a unit basis and shall be compensated relative to the point of interconnection. Adequate metering must be in place to determine each unit's performance relative to voltage support and how well it produces against the predefined schedule. For these applications revenue class metering is required. In addition appropriate metering to measure power consumption by the plant auxiliary systems when the plant is not running shall be necessary. In the event the Company determines that redundant metering is required, such metering will be done at a point mutually agreeable to all both parties.

All metered data shall be provided to the Company's SOC. Data from the substation will go to the Transmission Control Center ("TCC"). In addition, all meters shall be equipped with suitable communication ports to allow for direct access via a phone line or data circuit for downloading of data. This function shall be performed by the Company's Itron Enterprise Edition ("IEE"). Customer shall be responsible for providing all required phone circuits to allow for dial-up access.

Unless otherwise agreed by the Parties, the Company shall install metering equipment, compensated to the point of interconnection, prior to any operation of the Combined Cycle Plant and shall own, operate, test and maintain such metering equipment. The Company reserves the right to witness meter calibration and testing.

Customer shall provide the Company all pertinent meter data prior to back feed of the power island. This will include, but is not limited to, meter type/style, calibration test results, copies of all algorithms required for meter operation, serial numbers of meters for establishment of unique addresses in support of IEE, phone number for access thereof, and factory test data for all instrument transformers associated with energy measurements.

ALL METERING SYSTEMS SHALL BE THOROUGHLY TESTED FOR FUNTIONALITY PRIOR TO START OF FUNCTIONAL TESTING OF ANY GENERATOR. THE COMPANY RESERVES THE RIGHT TO WITNESS ALL TESTING ON SITE. TESTING WILL NOT BE DEEMED COMPLETE UNTIL TELEMETERED DATA FLOW BACK TO THE SYSTEM OPERATING CENTER IS VERIFIED AS BEING COMPLETE AND ACCURATE.

A high level description of minimum meter data can be found below on page 20.

a. Metering Equipment Requirements

A solid state meter shall be used to measure the real and reactive power interchange between the Company Facilities and the Customers Combined Cycle Plant. Three-element, three-phase, four-wire meters shall be utilized on wye connected power

systems. Two-element, three-phase, three-wire meters shall be utilized on delta connected power systems.

The metering devices must be fully compatible (approved meter type and communication media) with the Company's remote metering and data acquisition system.

b. Meter Accuracy

Meters shall be calibrated to 100% registration with a maximum deviation of +/- 0.5% accuracy at unity power factor for both full load and light load. These meters shall be calibrated to100% registration with a maximum deviation of +/- 1.0-% accuracy for 0.5 power factor at full load. Metering accuracy limits are stated in the following table.

MAXIMUM DEVIATION OF METER REGISTRATION			
Watt-hour Function			**Var-hour Function**
Full Load	Power Factor	Light Load	Power Factor
+/- 0.5 %	+/- 1.0 %	+/- 0.5 %	+/- 1.0 %

Notes:

- Watt-hour functions should be tested in both directions of energy flow (In and Out) (If applicable).
- Var-hour functions should be tested in both directions of energy flow (In and Out).
- When compensating for transformer or line loss, utilize stated limits above or 5% of desired compensation, whichever is greater.
- The meter shall be tested with compensation applied to obtain a true test of the installation.

Test Points	Volts	Amps	Power Factor
Full Load	120	5	1.0
Power Factor	120	5	0.5
Light Load	120	0.5	1.0

c. Instrument Transformers

Potential devices and current transformers shall be 0.3% metering accuracy class or better for both magnitude and phase angle over the burden range of the installed metering circuit. Instrument transformer correction factors may be applied to the meter to adjust the meter for inaccuracies associated with the secondary burdens in the current transformer and voltage transformer circuits. All instrument transformers shall comply with ANSI/IEEE Standard C57.13.

d. Loss Compensation

If the metering is not located at the Connection Point, then power transformer and/or line loss compensation shall be required. the Company approved power transformer and/or line loss compensation values shall be applied to the meter to properly compensate for the losses in the power transformer and/or line.

e. Standard Configuration

The meter's load profile recorder shall be configured with the channel assignments as follows:

Channel	Description
1	kWh Delivered
2	KVARH Delivered
3	KVARH Received
4	Available for optional data per *Transmission Provider's* request. For Example: kWh Delivered (Pulse Input from Check Meter) kWh Received

f. Access to Metering Data

If access to the meter is required, proper security measures must be taken to ensure the integrity of the meter is not compromised. If data pulses are required from the revenue meter, then the appropriate interface box with associated equipment must be installed to properly protect the revenue meter. If an additional meter is requested, good utility practices must be adhered to when terminating the connections in the meter circuit to ensure the integrity of the revenue-accuracy metering circuit is intact.

g. Station Service Power

Metering requirements for the plant auxiliary power will be determined on a case-by-case basis. Service to the plant auxiliary is considered to be a form of Retail Service and subject to various requirements as defined by the rate schedule selected for the particular service provided.

h. Check Meters

The Customer, at its option and expense, may install and operate, on its premises and on its side of the Point of Interconnection, one or more check meters to check the Company's meters. Such check meters shall be for check purposes only and shall not be used for the measurement of power. The check meters shall be subject at all reasonable times to inspection and examination by the Company or its designee. The

installation, operation and maintenance thereof shall be performed entirely by the Customer in accordance with Good Utility Practice.

i. Meter Enclosure

For metering equipment that might be located in Customer's Facility, a suitable enclosure for mounting the Company's required meter equipment, which may include the check meter, shall be provided. All necessary terminations inside this enclosure, including, but not limited to, CT & VT circuits at a test block, telephone or other communications requirements shall be included. There shall be separate enclosures for Customer's and the Company's metering equipment.

j. Meter Operations

Calibration of Metering Facilities

Metering facilities shall be tested and calibrated if necessary every two years. More frequent test intervals may be negotiated. All interested parties or their representatives may witness the calibration tests. Calibration records shall be made available to all interested parties. The accuracy of the standard utilized for calibration purposes shall be traceable to the National Institute of Standards and Technology, (NIST).

Meter Verification / Audit

Customer will allow the Company access, upon reasonable notice, to its facilities for the purpose of verifying and inspecting the metering either at installation or as part of a periodic audit or testing. Customer must provide any requested meter configuration information (i.e. program constants, instrument transformer tap settings, compensation calculation parameters, etc.), relevant to their equipment, requested as part of an audit.

Meter Configuration Changes

Changes to the metering configuration (i.e. program constants, instrument transformer tap settings, compensation calculation parameters, etc.) will be communicated to the Company's meter engineering at least 30 days in advance. Changes due to equipment failures must be communicated to the Company's meter engineering within one business day after the failure is identified. In all cases, the Company's master station operator shall be notified immediately before and after any metering work is performed so that the meter device may be interrogated before and after the work. Any configuration changes shall be communicated at this time as well.

	DATA Use Data Source	Operation Functions						Billing & Generator Imbalance Calculations				
		For SOC/TCC Needs From Revenue Class Meter or Transducer Compensated to Interconnection						From Revenue Class Metering Devices For ET & Retail Billing				
AREA or DEVICE TO BE METERED		MW		MVARS				MW-	MVAR-Hours			
		Instantaneous	Hourly Integrated	Instantaneous		Hourly Integrated		Hourly Integrated	Instantaneous		Hourly Integrated	
				Del.	Rec.	Del.	Rec.		Del.	Rec.	Del.	Rec.
Unit 1		X	X	X	X	X	X	X			X	X
Unit 2		X	X	X	X	X	X	X			X	X
Aux "1" Total Usage With or Without generation on		X	X	N/A	X	N/A	X					
Aux 1 Total use with no Generation On Line				N/A	N/A	N/A	N/A	X				
Aux "X" Total Usage With or Without generation on		X	X	N/A	X		X					
Aux "X" Total use with no Generation On Line				N/A	N/A	N/A	N/A	X				

NOTES: Everything based on High Side of GSU or Aux Transformers

Rec. is defined as VARS received by The Company from Generator (Generator Operating at Lagging PF)

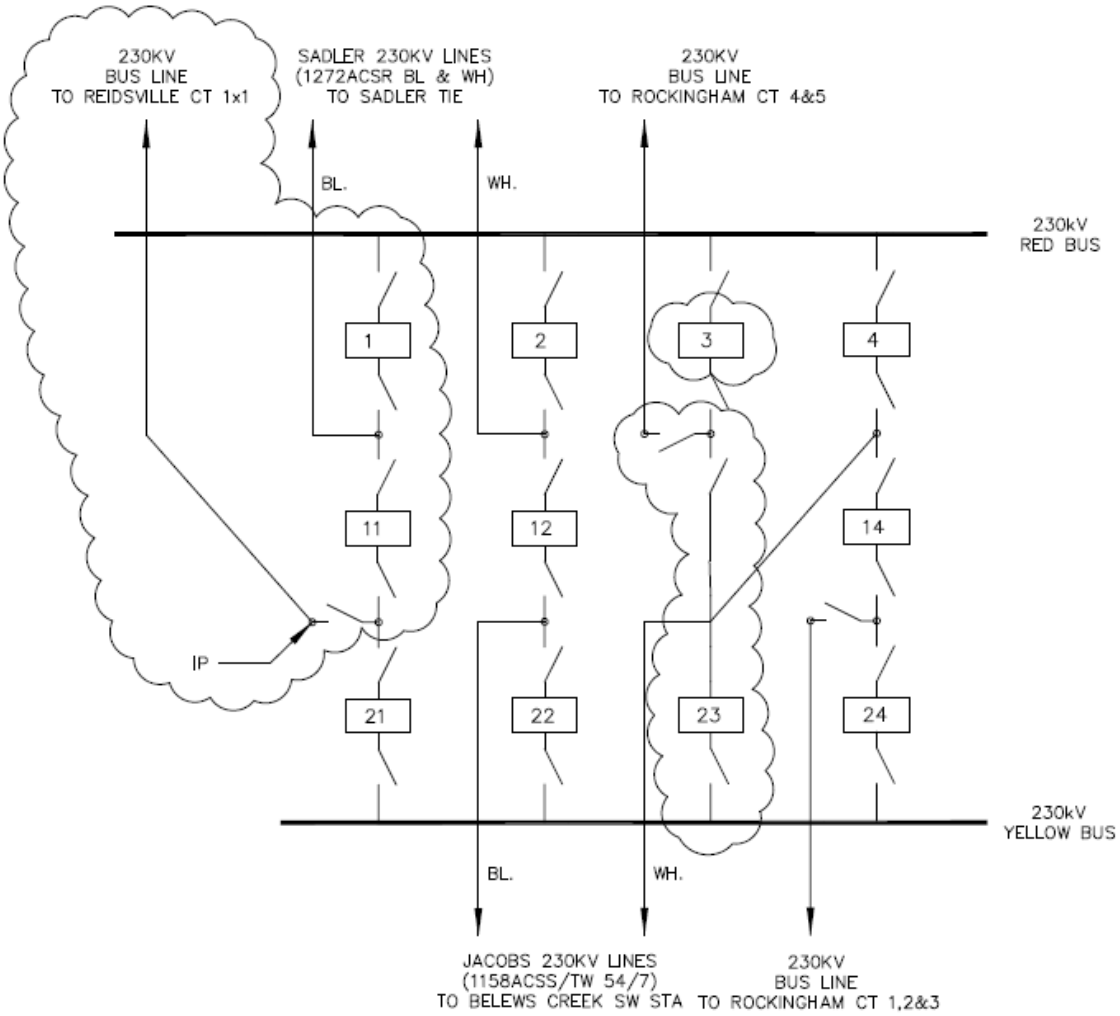
Del. Is defined as VARS consumed by generator off the system (Generator Operating at Leading PF)

Return to INTRODUCTION or
Return to 3.2.1 General Description of The Companys Interconnection Facilities

6.0 Appendixes

6.1 Appendix A – SCHEMATICS

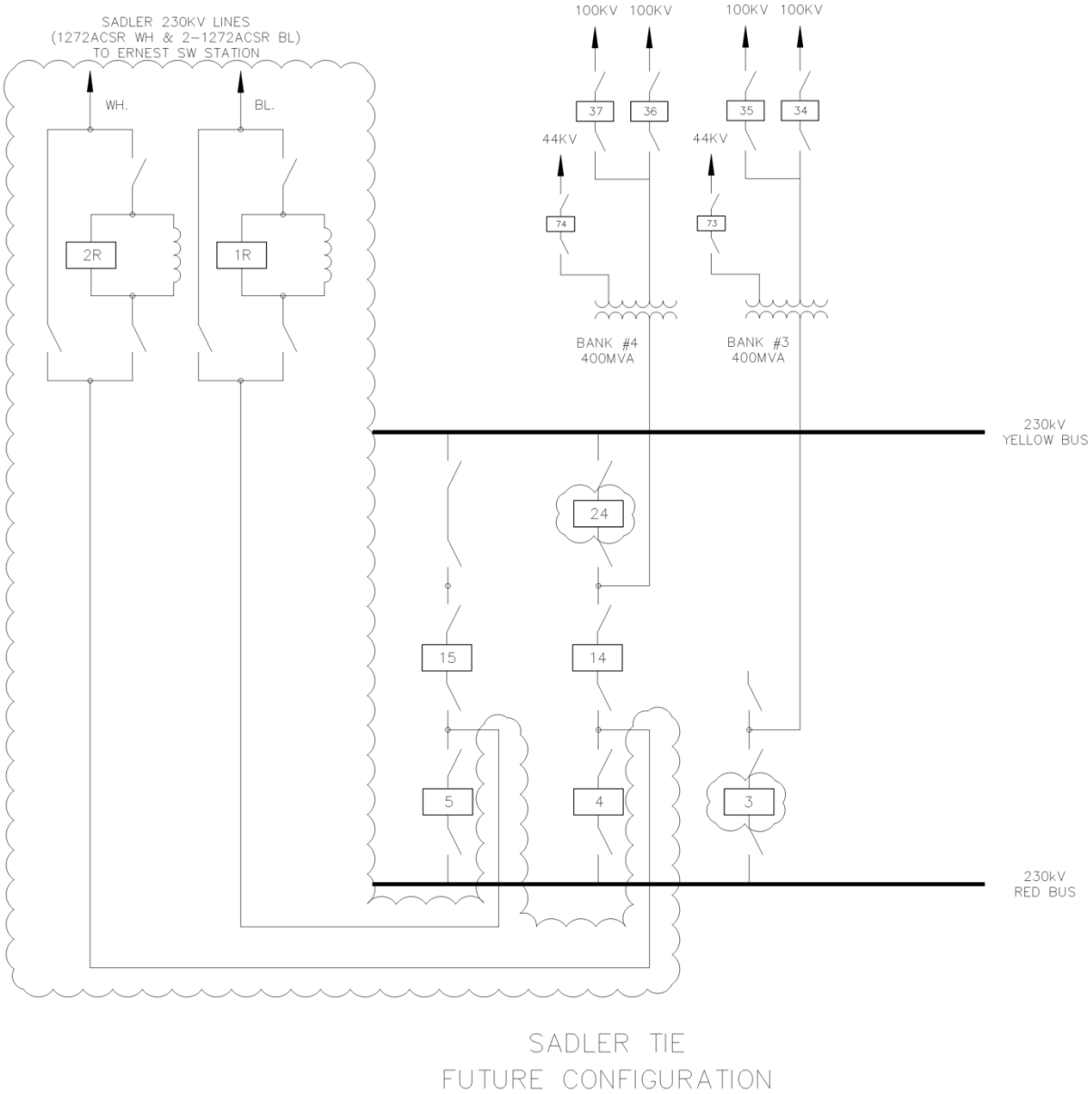
6.1.1 Proposed Modification One Line of the 230kV Ernest Switching Station (New Generation Interconnection Point)



ERNEST SWITCHING STATION
FUTURE CONFIGURATION

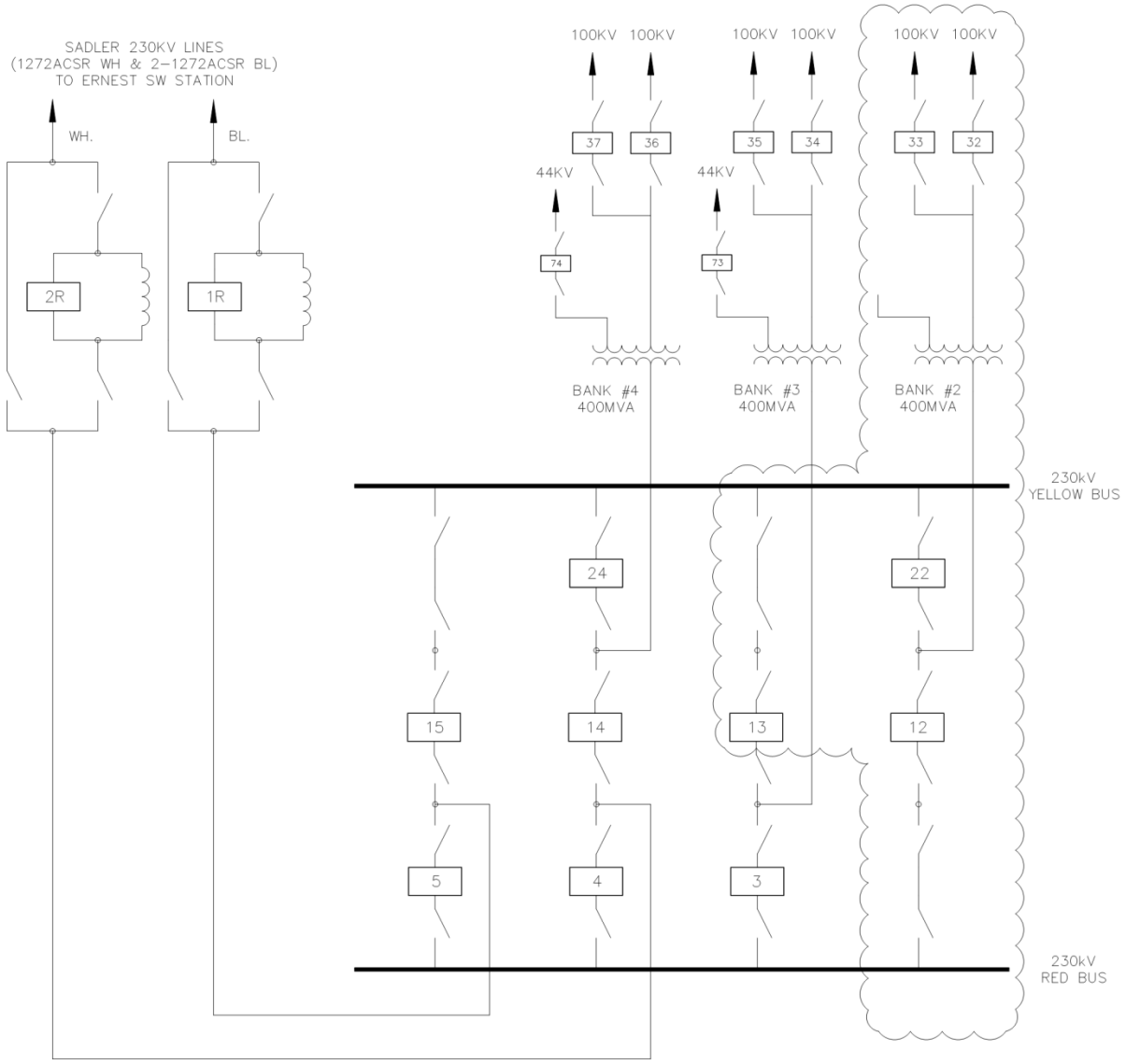
Return to INTRODUCTION or
Return to 4.2 Work Scope

6.1.2 Proposed Modification One Line of the 230kV Sadler Tie Station – (Install 2% Reactors on Sadler lines)



Return to INTRODUCTION or
Return to 4.2 Work Scope

6.1.3 Proposed Modification One Line of the 230kV Sadler Tie Station – (Add 230/100kV Transformer)



SADLER TIE
FUTURE CONFIGURATION

6.2 Appendix B – ASSOCIATED FACILITIES MILESTONES SCHEDULES

Return to SCHEDULE

Ref	Associated Facilities	Time Prior to Back Feed For Start of Activity
A	Modification of 230kV Ernest Switching Station	23 months

6.3 Appendix C – NETWORK MODIFICATION SCHEDULES

Return to INTRODUCTION or
Return to REQUIRED NETWORK MODIFICATION or
Return to SCHEDULE

Network Modification Schedule Requirements

Ref	*Required Network Modification*	Time Prior to Back Feed For Start of Activity
A	Upgrade Jacobs 230kV Lines (Belews Creek Switching Station to Ernest Switching Station) (13.71 Miles) with 1158 ACSS/TW	43 months
B	Upgrade Belews Creek Switching Station 230kV Line Terminal	14 months
C	Add 2% Reactors on Sadler 230kV Lines@Sadler Tie	38 months[1]
D	Add 230/100kV Transformer @ North Greensboro Tie	12/31/2018[2]
E	100kV OD Breakers @ North Greensboro Tie (8 Breakers)	6/1/2020[2]
F	GSU Neutral Reactors @ Belews Creek Steam Station	12/31/2019[2]
G	100kV OD Breakers @ Sadler Tie (4 Breakers)	38 months[1]
H	Add 230/100kV Transformer @ Sadler Tie	38 months[1]

1. Sadler Tie work will be worked in conjunction as one project
2. Projected in service date for work funded by Duke Energy

6.4 Appendix D – PROJECT PAYMENT SCHEDULE

Return to INTRODUCTION

Payment Date	Associated Activity	Cost
November 1, 2017	Signed LGIA	$500,000
May 1, 2018	Conceptual Design Complete	$1,100,000
October 1, 2018	DEC Project Commit/Material Procurement	$8,500,000
March 1, 2019	Engineering Complete	$17,750,000
October 1, 2019	Transmission Backfeed Available	$31,067,363