Generator Interconnection Request

Facilities Study Report

For: [redacted]

Rowan County Combined Cycle Plant

Service Location: Rowan County, NC

Total Output: Additional 937 MW

Commercial Operation Date: 6/1/2017

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INTRODUCTION

[redacted] ("Customer") has proposed to install additional new generation at Rowan County Combined Cycle Plant in the control area owned and operated by Duke Energy ("Duke"). The Customer's requested interconnection point will require the modification of an existing switching station located on property in Rowan County, NC. *Appendix A.1 provides a representative schematic of the 525kV interconnection station.* The Customer's proposed facility shall be a combined cycle 937 MW plant. The Customer has a requested commercial operation date of June 1, 2017.

This Facilities Study interconnection request (Queue # 40598-01) reports on the interconnection and the network modifications.

At the request of the Customer, Duke performed and delivered to the Customer an Interconnection System Impact Study ("SIS"). The SIS, dated December 1, 2011, 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. Certain adjustments in critical clearing times will be evaluated to address stability issues. It will be the responsibility of the Customer to address the stability issues on its side of the interconnection point.

The Interconnection Point (IP) between Duke and the Customer shall be the point where the Generator bus lines attach on the line termination structure entering Duke'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 connection point (IP) inside Duke's switching station.

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 Associated Facilities include: *Appendix D.1 provides a pictorial overview of the 230kV Associated Facilities.*

The Customer has requested interconnection as either an Energy Resource Interconnection Service (ERIS) provider or a Network Resource Interconnection Service (NRIS) provider. The Associated Facilities between the two options are similar but network modifications are significantly different.

As an ERIS provider, the Associated Facilities will be as defined in the section labeled "FACILITIES DIRECTLY ASSOCIATED WITH CUSTOMERS INTERCONNECTION"

As an NRIS provider, the Associated Facilities include all ERIS related facilities along with facilities as summarized below and further described in more detail in the section labeled, "REQUIRED NETWORK MODIFICATIONS".

- Establishment of a new 230kV switching station in the Cooleemee area along the fold in of the existing Marshall Black & White lines corridor. This site is approximately 5.3 miles NNW of the Rowan County Combined Cycle Plant site. *Appendix A.2 provides a representative schematic of the 230kV interconnection station*
- Construction of a new double circuit 230kV transmission line from the new Cooleemee are switching station to the Rowan Plant site. *Appendix D.2 provides a pictorial of the proposed routes of the 230kV Cooleemee to Woodleaf lines.*
- Significant expansion of the 230kV switching station at the Rowan plant site to accommodate the new double circuit 230kV line from Cooleemee plus a 2nd line from the Rowan sit to Buck Tie station. *Appendix A.3 provides a representative schematic of the 230kV interconnection station. Appendix D.3 provides a pictorial of the proposed routes of the 230kV Buck to Woodleaf lines.*
- The existing Buck Tie station will be modified to add two line terminal connection points for the new Buck to Woodleaf double circuit lines. *Appendix A.4 provides a representative schematic of the 230kV interconnection station.*

BASELINE ASSUMPTIONS

Duke'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 could potentially accommodate energy flows greater than the requested 937 MW's 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 Duke providing a turnkey design and installation of all Associated Facilities and network modifications in conjunction with a 525kV interconnection of the Customer Facilities.

The interconnection voltage will be 525kV.

The Customer shall address the stability issues as identified in the SIS by installing Out of Step Relay Protection on their generators.

Any required outages necessary to support construction of Duke 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. No provisions have been made for temporary work in the estimates provided herein.

The protection schemes installed by Duke at its Associated Facilities are intended to protect Duke'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 coordinate with Duke's standard insulation levels of the interconnection substation. Customer should refer to Duke's Facility Connection Requirement ("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 Duke. For those breakers where joint use may be necessary, close coordination between representatives from both Duke 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 Duke.

Under the NRIS scenario, the major changes sited in the INTRODUCTION section must be implemented to allow for a safe and reliable interconnection. To support this interconnection the following must be provided by the Customer:

- The Customer shall provide a graded substation lot to Duke as outlined in the "Duke Energy Substation Site Development Guidelines"- *Attached Exhibit A*. The site development of the proposed substation shall include clearing of trees, maintaining required buffers, grading, storm water development, etc. The proposed finished substation pad size is approximately 450' x 450'. *Refer to Appendix D.4 for an overview of the 230Kv Woodleaf Switching Station.*
- The Customer shall provide a substation access road to Duke as outlined in the "Duke Energy Substation Access Road Guidelines"- *Attached Exhibit B*.

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A Design Review shall take place prior to any facilities construction 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 Duke's.

Duke maintains all rights for the commission testing of any substation facility that it owns. Duke 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 Duke'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 7.1 of Duke'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 Duke'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 Duke's regulated facilities will be determined in accordance with the Duke's OATT in effect at the time of design and construction.

This Facilities Study assumes other generation projects which are in the Duke 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 Duke's OATT and FERC policy.

Upon receipt of the Customer's notice to proceed, Duke will develop appropriate work plans and initiate certain design and procurement activities. The Customer will be responsible for all costs incurred by Duke associated with those efforts.

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FACILITIES DIRECTLY ASSOCIATED WITH CUSTOMERS INTERCONNECTION

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 Facility	NRIS	ERIS	Estimated Cost
1	New Woodleaf 525kV Switching Station Interconnection Point @ Rowan County CC Plant	X	X	$7,788,242
	TOTAL			**$7,788,242**

2. WORK SCOPE DESCRIPTION FOR THE WOODLEAF 525kV SWITCHING STATION

Station Design and Construction Work Scope

a. General Description

Duke will modify the existing Woodleaf 525kV switching station which will operate at the Customer's requested interconnection voltage. The Customer's combined cycle generation plant will connect to the 525kV transmission system with a targeted commercial operation date of 6/1/2017. The scopes of the facilities which are required to support this interconnection are addressed by this section of the Facilities Study.

The switching station is designed for an ultimate three bay breaker and a half bus configuration and will be completely built out to accommodate the new generator bus line and required four breakers. In addition, the site will have to be expanded to the west approximately seventy five feet encompassing an area of approximately thirty seven thousand five hundred square feet to accommodate a tubular steel generator line catch off structure. *Refer to* *Appendix A.1* *for a representative one line of the proposed associated facility.*

The 525kV yard shall have a nominal continuous current rating of 4000A. The breakers shall be rated 40kA. The open air Basic Impulse Insulation Levels (BIL) shall be 1800kV.

The substation structures shall be a tubular steel design. Structural loadings will align with Duke's standard design practice for 525kV switchyards.

The scope of work shall include but not be limited to the following major tasks in the Interconnection Facilities (525kV yard):

- Fencing
- Foundations
- Structure design and layout
- Grounding
- Lighting
- Lightning Protection
- Insulation Coordination

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- Protective Relaying
- Station Auxiliary design
- DC system Design
- Conduit and trenching
- Equipment selection and installation
- Bus and wiring

A group operated 3 phase disconnect switch shall be installed on the bus line entering the new substation from the Customer's facilities. It will be controlled by Duke. It will provide a means to physically and visibly isolate the Duke's System from the Customer.

Duke 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 Duke equipment presents a hazardous condition.
- If Customer or Duke equipment interferes with the operation of the Duke transmission network system.
- If the Duke transmission network system interferes with the operation of Customer.

b. Relay, Controls and Communication

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:

Both of the existing 525kV lines are protected by independent pilot schemes designed to clear a fault anywhere on the line. The scheme for the Godbey and Guardian lines are directional distance for multi-phase and phase-to-ground faults with the primary relaying operating with Permissive Over-reaching Transfer Trip pilot logic. The primary and secondary relay schemes have separate 125 volt DC systems.

Both 525kV 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.

The three existing and four new 525kV switchyard breakers will be protected by breaker failure relays with current supervision from separate instrument current transformers on the breaker. 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 the bus side plus the associated line breakers.

The relay and electrical equipment to be installed consists of the following:

(a) The probable Rowan County Bus Line protection will be a Line Current Differential scheme using an SEL411L relay and a Permissive Overreach Transfer Trip (POTT) scheme using an SEL421 relay. This will require fiber connections between the plant facility and the switch yard facility for relay to relay communications. The customer will be responsible for running the required number of single mode fiber strands from the plant facility to the switchyard facility per Duke Energy guidelines.

(b) The 525kV main buses will each have a primary and secondary Bus Differential (87B) scheme. The primary relays will be GE, typePVD21D1A relays, and the secondary will be SEL487B relays.

(c) Install Capacitor Voltage Transformers on each phase of the Rowan County Bus line one on "A" phase of each 525kV main bus, for line and bus voltage inputs to the relays.

(d) Install on each circuit breaker (1) SEL-2515 Remote I/O Module for breaker alarms to go to the relay house via fiber optic cable to the existing SEL-3610 Port Servers.

c. Switchyard Relay Enclosure

The existing relay house will be utilized for the new relay equipment.

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3. SCHEDULE FOR THE ASSOCIATED FACILITES

Appendix B provides the cycle time which will be required to implement the design and construction of the various interconnection switching station. The cycle time represents the time activities must start relative to the required in service date. Should facilities be required earlier close coordination between Duke 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 Duke 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.

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. Table 2 summarizes the required modifications along with the associated costs with a Commercial Operation Date of June 1, 2017.

Certain Network Modifications which are initially required by higher queued projects with later commercial operation dates may also be required by the lower queued projects. In such cases FERC regulations would require the project requiring the Network Modifications earlier due to their earlier commercial operation date pay for those Modifications but then collect from the higher queued project at such time that the higher queued project would have been required to have those modifications in place. Table 3 summarizes the required modifications along with the associated costs if the project with queue ID 40577-01 is NOT built with a Commercial Operation Date of January 1, 2021.

The cycle times required to design and construct the various network improvements are provided in Appendix C.

The SIS did indicate under certain NERC Category D faults the proposed generating units might incur a condition in which the units might become transiently unstable. To address stability the Customer shall be required to install Out of Step Relay protection to adequately protect their generators for NERC Category D faults. Duke will work closely with the Customer to establish mutually agreeable critical clearing times to effectively mitigate instability conditions as much as practical.

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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 2
(If the project queue ID 40577-01 is built or is NOT built.)

Ref #	Required Network Modification	NRIS	ERIS	Date Required	Estimated Cost
A	New Woodleaf 230kV Switching Station @ Rowan County CC Plant	X		June 1, 2017	$9,876,279
B	New Cooleemee 230kV Switching Station near Mt Vernon, NC	X		June 1, 2017	$11,738,984
C	Marshall 230 kV Line Fold-in @ New Cooleemee Switching Station (0.38 Miles) w/954kcmil ACSR	X		June 1, 2017	$2,635,327
D	Marshall 230 kV Line Relay Upgrade @ Beckerdite Tie Station	X		June 1, 2017	$171,524
E	Marshall 230 kV Line Relay Upgrade at Marshall Steam Station	X		June 1, 2017	$171,753
F	New Double Circuit 230 kV Lines (Cooleemee to New 230kV Woodleaf Switching Station (5.8 Miles) w/2156kcmil ACSR	X		June 1, 2017	$13,034,273
G	New Double Circuit 230kV Lines (Buck Tie to New 230kV Woodleaf Switching Station (15.7 Miles) w/2-1272kcmil ACSR	X		June 1, 2017	$44,043,411
H	New Double Circuit Lines Terminals @ Buck Tie 230kV Switch Yard	X		June 1, 2017	$995,651
I	Add (2) 230/100kV 448MVA Auto Transformers (AT1 & AT2) @ Buck Tie	X		June 1, 2017	$16,785,838
J	Rebuild the Bus Sec 4 Red & Yellow Lines (Buck Tie to Buck Steam Station Switch Yard) (0.29 Miles) w/bundled 2156kcmil ACSR	X		June 1, 2017	$1,339,427
K	Replace existing 230/100kV 200MVA Auto Transformer #3 with a 448MVA Unit @ Beckerdite Tie	X		June 1, 2017	$4,842,591
L	Install 230kV Norman Lines Reactors @ Riverbend Steam Station (New)	X		June 1, 2017	$3,436,365
M	Replace 100kV OD Breaker @ Beckerdite Tie (8 Breakers)	X		June 1, 2017	$4,815,603
N	Install 100kV Bus Sec 4 Red & Yellow Lines Reactors in lieu of Replacing 100kV OD Breaker @ Buck Steam Station (7 Breakers)	X		June 1, 2017	$3,438,365
O	Replace 230kV OD Breaker @ Buck Tie (1 Breaker)	X		June 1, 2017	$391,487
P	Replace 100kV OD Breaker @ Buck Tie (1 Breaker)	X		June 1, 2017	$625,235
Q	Replace 100kV OD Breaker @ Linden St Switch Station (1 Breaker)	X		June 1, 2017	$267,170
R	Replace 230kV OD Breaker @ Marshall Steam Station (7 Breakers)	X		June 1, 2017	$4,367,347
S	Replace 230kV OD Breaker @ Winecoff Tie (2 Breakers)	X		N/A	$0
T	Replace 100kV OD Breaker @ Winecoff Tie (6 Breakers)	X		June 1, 2017	$3,161,823
	TOTAL				**$126,138,453**

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Table 3

(If the project queue ID 40577-01 is NOT built.)

Ref #	Required Network Modification	NRIS	ERIS	Date Required	Estimated Cost
U	Replace 100kV OD Breaker @ Rural Hall Tie (2 Breakers)	X		June 1, 2017	$549,921
V	Replace 230kV OD Breaker @ Winecoff Tie (2 Breakers)	X		N/A	$0
W	Replace 100kV OD Breaker @ Winecoff Tie (2 Breakers)	X		June 1, 2017	$1,343,169
	TOTAL				**$1,893,090**

2. WORK SCOPE FOR REQUIRED NETWORK MODIFICATIONS FROM TABLE 2

(If the project queue ID 40577-01 is built.)

A. New Woodleaf 230kV Switching Station @ Rowan County CC Plant

Duke will develop a new switching station which will consist of one discrete switch yard which will operate at the Customer's interconnection voltages. It will require the Customer to modify their existing 230kV switch station to accommodate the Customers installation of two new 230kV interconnection lines from their station to the new Duke 230kV Woodleaf station. The scopes of the facilities which are required to support this interconnection are addressed in Exhibit C. *Appendix A.3 provides a representative schematic of the 230kV interconnection station.*

B. New Cooleemee 230kV Switching Station near Mt Vernon, NC

Duke will develop a new switching station. This station is established to allow for the fold in of the Marshall lines which establishes an additional interconnection to Duke's transmission system. The scopes of the facilities which are required to support this interconnection are addressed in Exhibit C. *Appendix A.2 provides a representative schematic of the 230kV interconnection station.*

C. Marshall 230 kV Line Fold-in @ New Cooleemee Switching Station (0.38 Miles) w/954kcmil ACSR

The new Cooleemee switching station will be tied into the grid by folding in the Marshall Black and White 230kV Lines which currently link Beckerdite 230kV Tie station to Marshall 230kV Steam station. A small segment of additional right of way will be required to fold the lines into the new switching station. The lines that fold in shall utilize 954 kcMil ACSR per phase. This will require the construction of approximately 1.52 circuit miles consisting of approximately 0.38 miles of double circuit 230 kV from the interconnection substation to the Marshall lines in both directions. Exact location and routing of the fold-in will be determined at a later date subject to a comprehensive survey of the area. The fold in will require a right of way no less than 270 feet in width. Each circuit is anticipated to be approximately 2000 feet in length.

The line work will involve the following activities:

- Install (4) 2Q lattice steel strain towers.
- Remove (2) 2F lattice steel suspension towers.
- Install new 954 ACSR conductors with (2) ½" OHGWs.

D. A Marshall 230 kV Line Relay Upgrade @ Beckerdite Tie Station

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The Protection and control schemes which are deployed at the Beckerdite Tie station which are associated with the existing Marshall Black and White 230 kV lines must be upgraded to be compatible with those schemes as deployed at the new substation:

- The protective relaying will be upgraded on the 230kv Marshall Black and White lines at Marshall Steam station to coordinate with the relay scheme that will be installed at the new Cooleemee switching station. The probable scheme will be a primary and secondary directional distance for multi-phase and phase-to-ground faults with both operating with permissive over-reaching transfer trip pilot logic using two SEL421 relays per line.

E. Marshall 230 kV Line Relay Upgrade at Marshall Steam Station

The Protection and control schemes which are deployed at the Marshall Steam station which are associated with the existing Marshall Black and White 230 kV lines must be upgraded to be compatible with those schemes as deployed at the new substation:

- The protective relaying will be upgraded on the 230kv Marshall Black and White lines at Beckerdite Tie station to coordinate with the relay scheme that will be installed at the new Cooleemee switching station. The probable scheme will be a primary and secondary directional distance for multi-phase and phase-to-ground faults with both operating with permissive over-reaching transfer trip pilot logic using two SEL421 relays per line.

F. New Double Circuit 230 kV Lines (Cooleemee to New 230kV Woodleaf Switching Station (5.8 Miles) w/2156kcmil ACSR

Work on the Cooleemee to Woodleaf 230kV lines consists of building approximately 5.8 miles of transmission line on a new right of way between Cooleemee switching station and Woodleaf 230kV switching station in Rowan County, North Carolina. This work was identified in the SIS report as being attributable to the studied generating facility. The line work will involve the following activities:

- Clear 5.8 miles of new 150' R/W.
- Install access roads and erosion control measures.
- Install approximately (36) 2N type lattice steel towers.
- Install (2) circuits of 2156 ACSR conductors with (2) ½" OHGWs.

G. New Double Circuit 230kV Lines (Buck Tie to New 230kV Woodleaf Switching Station (15.7 Miles) w/2-1272kcmil ACSR

Work on the Buck to Woodleaf 230kV lines consists of building approximately 15.7 miles of transmission line on a mix of new and existing right of way between Buck Tie station and Woodleaf 230kV switching station in Rowan County, North Carolina. This work was identified in the SIS report as being attributable to the studied generating facility. The line work will involve the following activities:

- Clear 15.7 miles of 150' R/W.
- Install access roads and erosion control measures.
- Install approximately (96) 2N type lattice steel towers.
- Install (2) circuits of 2 bundle 1272 ACSR conductors with (2) ½" OHGWs.

H. New Double Circuit Lines Terminals @ Buck Tie 230kV Switch Yard

In conjunction with the construction of the new double circuit Buck to Woodleaf 230kV line, it will be necessary to establish new line terminals at Buck Tie 230kV station. The work will involve the following activities:

- Install new tie down points for the new Buck to Woodleaf 230kV lines.

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- Install two 230kV, 3000A, 63kA breakers.
- Modify the existing aluminum pipe bus as necessary to accommodate the installation of new breakers.
- Install two new relay panels with two SEL421 relays per panel.
- Both lines will have a POTT and DTT pilot scheme with mirrored bits communications via fiber cable.

I. Add (2) 230/100kV 448MVA Auto Transformers (AT1 & AT2) @ Buck Tie

In conjunction with the construction of the new double circuit Buck to Woodleaf 230kV line, it will be necessary to install new auto transformers between Buck Tie 230kV station and Buck Tie 100kV station. The work will involve the following activities:

- Install four switch structures complete with 230kV, 3000A, vertical break gang switches along with associated aluminum pipe and wire bus to accommodate three new breakers.
- Install three 230kV, 3000A, 63kA breakers (PCB7, PCB8 and PCB9) in Buck Tie 230kV station.
- The 230kv Providence White line will be relocated from its present location between PCB11 and PCB12 and will terminate between new breakers PCB7 and PCB8.
- Install two new 230/100kV, 448MVA auto transformers (AT1 & AT2) in Bank 1 and Bank 2 positions.
- Install a new 230kV bus line to AT1 from a new line terminal connection between PCB8 and PCB9.
- Install a new 230kV bus line to AT2 from a new line terminal connection between PCB11 and PCB12.
- Install 230kV CVT's on "A" phase of the new AT1 and AT2 bus lines (2) for sync.
- Install switch and bus support structures to accommodate the installation of four 100kV low tension breakers and the low side connection of the auto transformers.
- Install four 100kV (230kV frame), 3000A, 80kA (AT1 Red LT, AT1 Yellow LT, AT2 Red LT and AT2 Yellow LT) breakers.
- Install 100kV, 15k pfd CVT's on "A" phase on the transformer side of all four 100kv LT Breakers for sync.
- Install 100kV 15k pfd Capacitors on "B" and "C" phases on the transformer side of all four 100kv LT Breakers.
- Install 100kV, 10k pfd Capacitors on the bus side of all three phases on all four 100kv LT Breakers.
- Install an SEL2515 Remote I/O Module in all new breakers to go via fiber cable to the STIP Communications panel BF15.
- Install standard SEL Auto bank relay panels for AT1 and AT2.

J. Rebuild the Bus Sec 4 Red & Yellow Lines (Buck Tie to Buck Steam Station Switch Yard) (0.29 Miles) w/bundled 2156kcmil ACSR

Work on the Bus Sec 4 Red & Yellow 100kV lines consists of rebuilding approximately 0.29 miles of transmission line on an existing right of way between Buck Tie and Buck Steam station in Rowan County, North Carolina. This work is required to increase the thermal and electrical capacity of the line. The line work will involve the following activities:

- Remove (3) HR type lattice steel towers.
- Install (3) 1AWL type lattice steel towers.
- Install (2) circuits of 2 bundle 2156 ACSR conductors with (2) 3/8” EHS OHGWs.

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K. Replace the existing 230/100kV 200MVA Auto Transformer #3 with a 448MVA unit @ Beckerdite Tie

In conjunction with the new connection of the Cooleemee switching station on the Marshall 230kV lines, it will be necessary to replace an existing 200MVA auto transformer with a new 448 MVA auto transformers at Beckerdite Tie 230kV station. The work will involve the following activities.

- Upgrade the existing bus to accommodate the higher MVA transformer.
- Replace one 200MVA 230/100kV auto transformer with a 448MVA 230/100kV unit
- Install a DDJB Termination Cabinet for the existing cables to wire into and then to the new transformer mechanism.
- It will also require relay setting changes.

L. Install 230kV Norman Lines Reactors in lieu of Replacing 230kV OD Breaker @ McGuire Nuclear Switching Station

With the addition of the proposed Rowan County generation the available fault current as seen at the McGuire switching 230kV station bus will be increased. Fault studies indicate that the 80kA 230kV breakers would be subject to interrupting current levels greater than their interrupting capability. In lieu of replacing the breakers, a set of phase reactors will be placed on each of the Norman lines that connect McGuire nuclear switching station to Riverbend Steam station.

- The work will consist of building a phase reactor containment area at Riverbend Steam station that isolates the reactors from the rest of the station.
- Install one 3 ohm, 100kV reactor per phase totaling six reactors to accommodate a maximum load of 560MVA per 3-phase line.

M. 100 kV Over-Duty Breaker Replacements @ Beckerdite Tie (8 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Beckerdite Tie 100 kV substation bus will be increased. Fault studies indicate that (8) eight, 63kA 100kV breakers (Linden Street Black & White, Winston Black & White, CBK 1&2&3, 52-51 SVC Yellow bus, 52-52 SVC Red bus, 100kV HT) would be subject to interrupting current levels greater than their interrupting capability.

- The work will consist of replacing eight 100kV breakers with higher rated breakers.
- The installation of new CVT’s on "A" phase of the line side of the Winston Black & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements and accommodate synchronization voltage requirements.
- The installation of new capacitors on the "B" and "C" phases of the line side of the Winston Black & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements.
- The installation of new capacitors on the bus side of Winston Blank & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements
- The installation of new capacitors on the line side and the bus side of all other breakers is necessary for the new breakers to accommodate the breaker TRV requirements.
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

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N. Install 100kV Bus Sec 4 Red & Yellow Lines Reactors in lieu of Replacing 100kV OD Breaker @ Buck Steam Station (7 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Buck Steam 100 kV station bus will be increased. Fault studies indicate that the 80kA 230kV Buck Bl, Grants Creek Bl & Wh, Salisbury Bl & Wh, Spencer Bl & Wh breakers would be subject to interrupting current levels greater than their interrupting capability. In lieu of replacing the breakers, a set of phase reactors will be placed on each of the Bus Sec 4 Red & Yellow lines that connect Buck Tie station to Buck Steam station.

- The work will consist of building a phase reactor containment area at Buck Steam station that isolates the reactors from the rest of the station.
- Install one 3 ohm, 100kV reactor per phase totaling six reactors to accommodate a maximum load of 560MVA per 3-phase line.

O. 230 kV Over-Duty Breaker Replacements @ Buck Tie (1 Breaker)

With the addition of the proposed Rowan County generation the available fault current as seen at the Buck Tie 100 kV substation bus will be increased. Fault studies indicate that the 43kA 230kV PCB17 breaker would be subject to interrupting current levels greater than its interrupting capability.

- The work will consist of replacing of the 230kV breaker with a higher rated breaker.
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

P. 100 kV Over-Duty Breaker Replacements @ Buck Tie (1 Breaker)

With the addition of the proposed Rowan County generation the available fault current as seen at the Buck Tie 100 kV substation bus will be increased. Fault studies indicate that the 63kA 100kV Bank 3 LT Yellow breaker would be subject to interrupting current levels greater than their interrupting capability.

- The work will consist of replacing the 100kV breaker with a higher rated breaker.
- The installation of a new CVT on "A" phase of the transformer side of the breaker is necessary for the new breaker to accommodate the breaker TRV requirements and accommodate synchronization voltage requirements.
- The installation of new capacitors on the "B" and "C" phases of the transformer side is necessary for the new breaker to accommodate the breaker TRV requirements.
- The installation of new capacitors on the bus side is necessary for the new breaker to accommodate the breaker TRV requirements.
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

Q. 100 kV Over-Duty Breaker Replacements @ Linden St. Switch Station (1 Breaker)

With the addition of the proposed Rowan County generation the available fault current as seen at the Linden St. 100 kV substation bus will be increased. Fault studies indicate that the 43kA 100kV Randleman Black breaker would be subject to interrupting current levels greater than its interrupting capability.

- The work will consist of replacing the 100kV breaker with a higher rated breaker.

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- The installation of a new CVT on "A" phase of the transformer side of the breaker is necessary for the new breaker to accommodate synchronization voltage requirements.
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

R. 230 kV Over-Duty Breaker Replacements @ Marshall Steam Station Switch Yard (7 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Marshall Steam 230 kV substation bus will be increased. Fault studies indicate that (7) seven, 63kA 230kV breakers (PCB9, PCB12, PCB16, PCB18, PCB19, PCB21, PCB24) would be subject to interrupting current levels greater than their interrupting capability.

- The work will consist of replacing eight 230kV breakers with higher rated breakers.
- The installation of new CVT's on "A" phase of the line side of the PCB9, PCB12, PCB18, PCB21, & PCB24 is necessary for the new breakers to accommodate the breaker TRV requirements and accommodate synchronization voltage requirements.
- The installation of new capacitors on the "B" and "C" phases of the line side of the PCB9, PCB12, PCB18, PCB21, & PCB24 breakers is necessary for the new breakers to accommodate the breaker TRV requirements.
- The installation of new CVT's on all three phases of the line side of the PCB16, PCB19 is necessary for the new breakers to accommodate the breaker TRV requirements
- The installation of new capacitors on the bus side of PCB9, PCB12, PCB16, PCB18, PCB19, PCB21, & PCB24 breakers is necessary for the new breakers to accommodate the breaker TRV requirements
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

S. 230 kV Over-Duty Breaker Replacements @ Winecoff Tie (2 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Winecoff Tie 230 kV substation bus will be increased. Fault studies indicate that (2) two, 33kA 100kV breakers (Dooley Black & White) would be subject to interrupting current levels greater than their interrupting capability.

- These breakers were identified by the SIS to become over duty after the Commercial Operation Date of June 1 2017. Since then the breakers have been scheduled for replacement under Duke's breaker replacement program with a completion date of December 12, 2012 and therefore will no longer be on the Over Duty list.

T. 100 kV Over-Duty Breaker Replacements @ Winecoff Tie (6 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Winecoff Tie 100 kV substation bus will be increased. Fault studies indicate that (6) six, 63kA 100kV breakers (Batte Black & White, Hopewell Black & White, Odell Black & White) would be subject to interrupting current levels greater than their interrupting capability.

- The work will consist of replacing six 100kV breakers with higher rated breakers.
- The installation of new CVT's on "A" phase of the line side of the Batte Black & White, Hopewell Black & White, Odell Black & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements and accommodate synchronization voltage requirements.

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- The installation of new capacitors on the "B" and "C" phases of the line side of the Batte Black & White, Hopewell Black & White, Odell Black & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements.
- The installation of new capacitors on the bus side of Batte Black & White, Hopewell Black & White, Odell Black & White breakers is necessary for the new breakers to accommodate the breaker TRV requirements
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

3. WORK SCOPE FOR REQUIRED NETWORK MODIFICATIONS FROM TABLE 3

(If the project queue ID 40577-01 is NOT built.)

NOTE: The following work scopes are in addition to the work scopes above if the queue project 40577-01 in not built

U. 100 kV Over-Duty Breaker Replacements @ Rural Hall Tie (2 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Rural Hall Tie 100 kV substation bus will be increased. Fault studies indicate that the 47kA 100kV Bank 3 LT Red, Bank 3 LT Yellow breakers would be subject to interrupting current levels greater than its interrupting capability.

- The work will consist of replacing both of the 100kV breakers with higher rated breakers.
- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

V. 230 kV Over-Duty Breaker Replacements @ Winecoff Tie (2 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Winecoff Tie 230 kV substation bus will be increased. Fault studies indicate that (2) two, 33kA 100kV breakers (Providence Black & White) would be subject to interrupting current levels greater than their interrupting capability.

- These breakers were identified by the SIS to become over duty after the Commercial Operation Date of June 1 2017. Since then the breakers have been scheduled for replacement under Duke's breaker replacement program with a completion date of December 12, 2012 and therefore will no longer be on the Over Duty list.

W. 100 kV Over-Duty Breaker Replacements @ Winecoff Tie (2 Breakers)

With the addition of the proposed Rowan County generation the available fault current as seen at the Winecoff Tie 100 kV substation bus will be increased. Fault studies indicate that (2) six, 63kA 100kV breakers (Briar Black, China Grove White) would be subject to interrupting current levels greater than their interrupting capability.

- The work will consist of replacing two 100kV breakers with higher rated breakers.
- The installation of new capacitors on the line side of the Briar Black, China Grove White breakers is necessary for the new breakers to accommodate the breaker TRV requirements.
- The installation of new capacitors on the bus side of Briar Black, China Grove White breakers is necessary for the new breakers to accommodate the breaker TRV requirements

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- A short Double Door Junction Box will be installed near the breaker to be used as an interface box and point of termination between the existing breaker control cables and the new breaker wiring.
- Install an SEL2515 Remote I/O Module in the breaker that goes back to the STIP panel via fiber for alarm indications.

4. SCHEDULE FOR NEWORK MODIFICATIONS

Appendix C 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 Duke 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 Duke 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.

CONNECTION REQUIREMENTS

1. GENERAL

General requirements as defined in IEEE 1109-1990 “IEEE Guide for the Interconnection of User-owned Substations to Electric Utilities” shall apply to this facility. This Facilities Study document is intended to provide a basic scope definition of facilities on which Duke has based its facilities study and cost estimates. It shall serve as the basis for the facilities that Duke proposes to design, build, and operate in connection with interconnection of Customer generation in the Rowan County NC area. Should there be differences between this document and IEEE 1190, this document shall take precedence.

All Facilities installed by Customer and connected to Duke's Network shall comply with Facility Connection Requirements dated August 5, 2001. This document shall supplement those requirements where necessary.

2. SHORT CIRCUIT WITHSTAND CAPABILITY

Duke assumes no responsibility for appropriately sizing the short circuit withstands capability of any equipment installed on the Customer’s Side of the IP. Duke 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. Duke bears no responsibility in the sizing decision. Available short circuit currents on Duke’s system can be in excess of 80 kA depending upon location and voltage.

3. EQUIPMENT RATINGS

Prior to finalizing specification of equipment necessary to interconnect to the power grid Customer shall consult with Duke 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.

4. INSULATION REQUIREMENTS

Duke’s standard requirements for equipment installed on the 525kV and 230 kV systems shall meet the following minimum (BIL).

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	525 BIL kV	230 BIL kV
Open Air	**1800**	**900**
Transformer Winding	**1675**	**900**

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

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.

This section is intended to provide a high level overview of some of the metering that shall be required by Duke's 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 Duke 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 Duke'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 Duke'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, Duke shall install metering equipment, compensated to the point of interconnection, prior to any operation of the Rowan County Combined Cycle Plant and shall own, operate, test and maintain such metering equipment. Duke reserves the right to witness meter calibration and testing.

Customer shall provide Duke 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. DUKE 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 in the table on page 23

d. Metering Equipment Requirements

A solid state meter shall be used to measure the real and reactive power interchange between the Duke Balancing Authority Area and the Rowan County Combined Cycle Plant. Three-element, three-phase, four-wire meters shall

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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 Duke's remote metering and data acquisition system.

e. 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

f. 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.

g. Loss Compensation

If the metering is not located at the Connection Point, then power transformer and/or line loss compensation shall be required. Duke 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.

h. 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

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i. 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.

j. 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.

k. Check Meters

Duke shall have the right to install, at its own expense, suitable metering equipment at any other Metering Point for the purpose of checking the meters installed by the Customer. Customer shall be responsible for providing terminations of the current and voltage circuits to a test block specifically for the check meter.

l. Meter Enclosure

For metering equipment that might be located in Customer's Facility, a suitable enclosure for mounting the Duke'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 Duke's metering equipment.

m. Meter Operations

1) 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).

2) Meter Verification / Audit

Customer will allow Duke 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.

3) Meter Configuration Changes

Changes to the metering configuration (i.e. program constants, instrument transformer tap settings, compensation calculation parameters, etc.) will be communicated to Duke's meter engineering at least 30 days in advance. Changes due to equipment failures must be communicated to Duke's meter engineering within one business day after the failure is identified. In all cases, Duke'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.

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DATA Use	Operation Functions						Billing & Generator Imbalance Calculations				
Data Source	For SOC/TCC Needs From Revenue Class Meter or Transducer Compensated to Interconnection Point						From Revenue Class Metering Devices For ET & Retail Billing				
AREA or DEVICE TO BE METERED	MW		MVARS				MW-Hours	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 Duke from Generator (Generator Operating at Lagging PF)
Del. Is defined as VARS consumed by generator off the system (Generator Operating at Leading PF)

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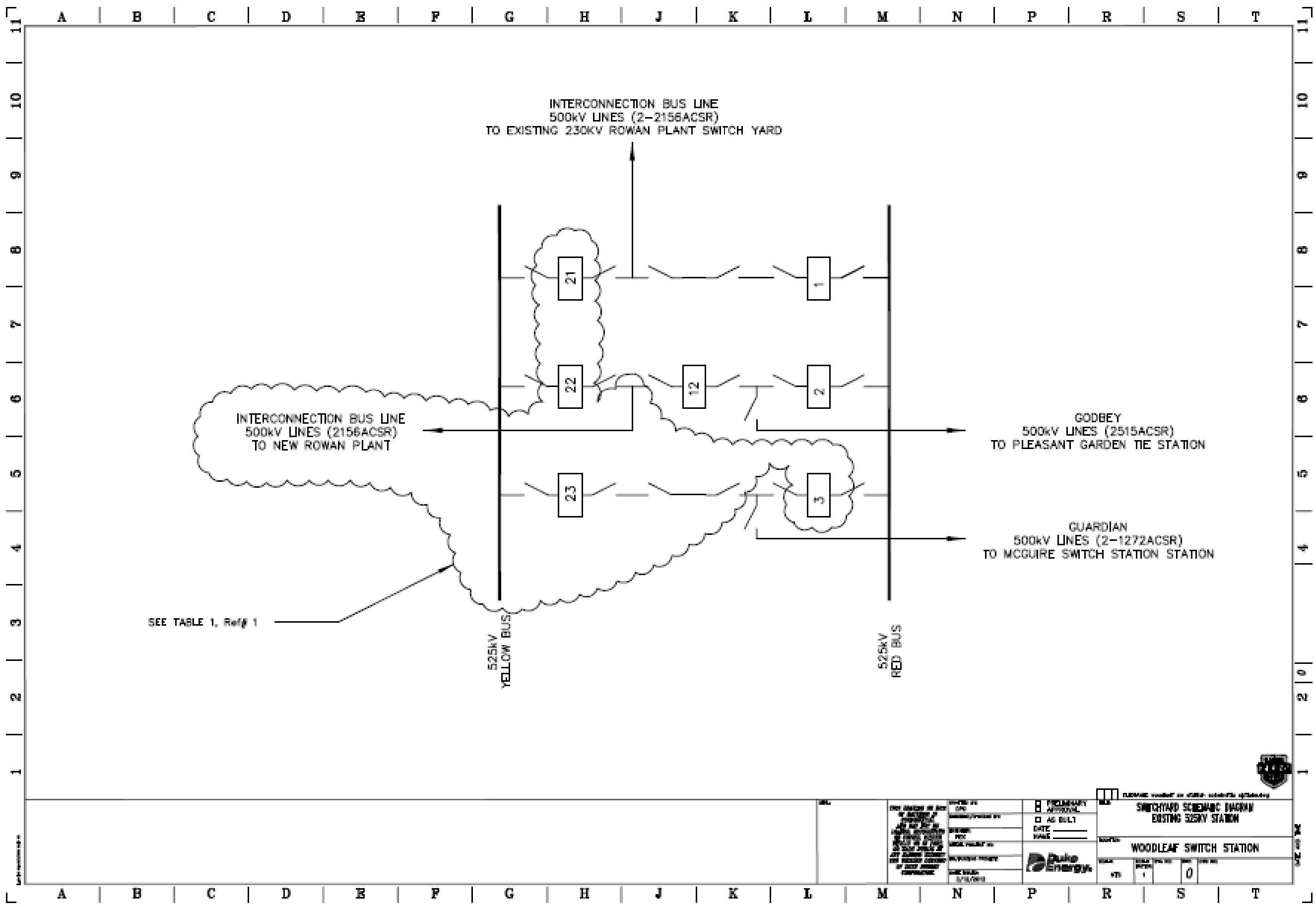
APPENDIX A –SCHEMATICS

Return to INTRODUCTION or

Return to WORK SCOPE DESCRIPTION FOR THE SWITCHING STATION

1. WOODLEAF 525kV SWITCHING STATION SCHEMATIC

Proposed Electrical One Line



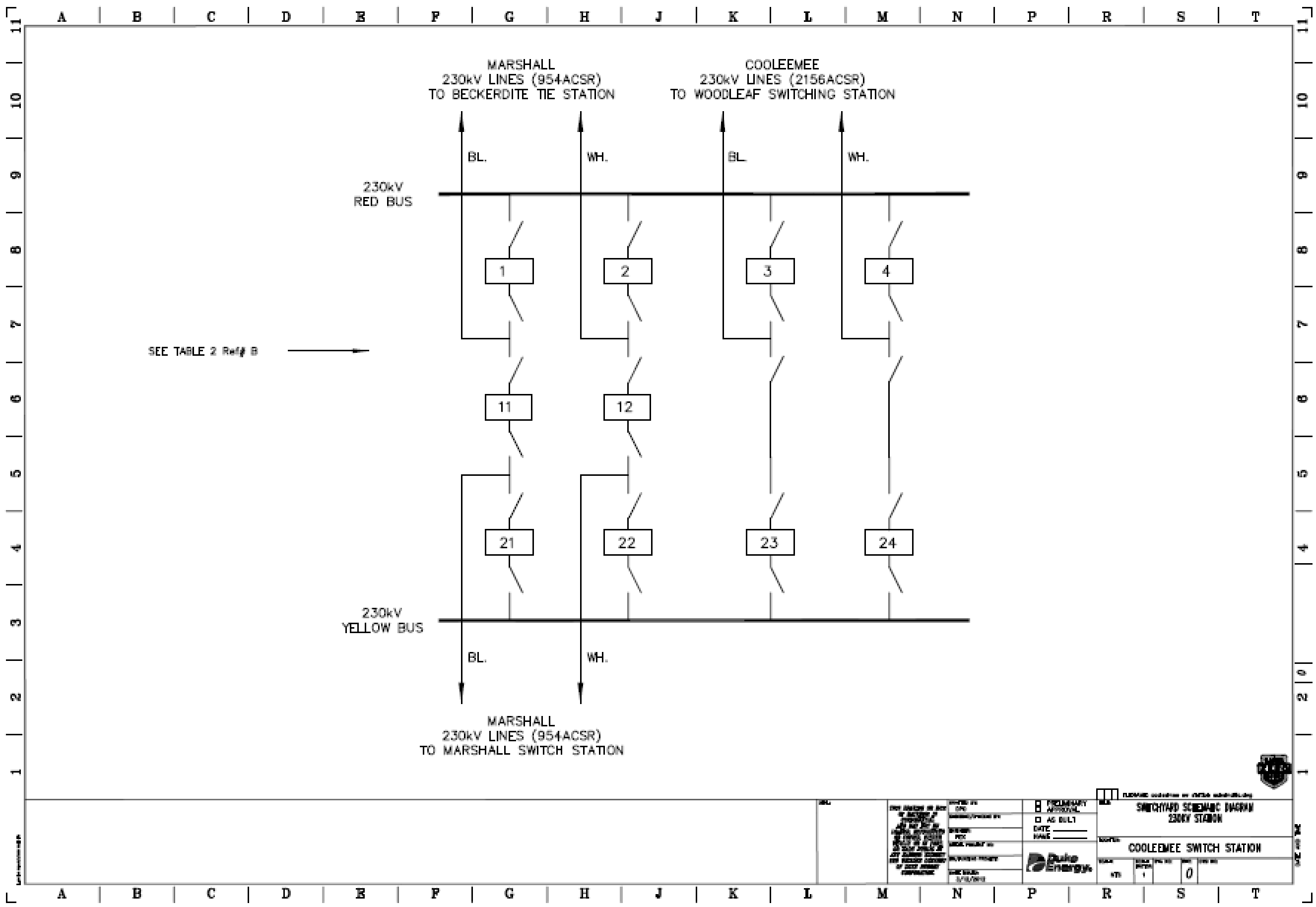
Return to INTRODUCTION

Return to: B. New Cooleemee 230kV Switching Station near Mt Vernon, NC

Return to WORK SCOPE DESCRIPTION FOR THE SWITCHING STATION

2. COOLEEMEE 230kV SWITCHING STATION SCHEMATIC

Proposed Electrical One Line



Return to INTRODUCTION or

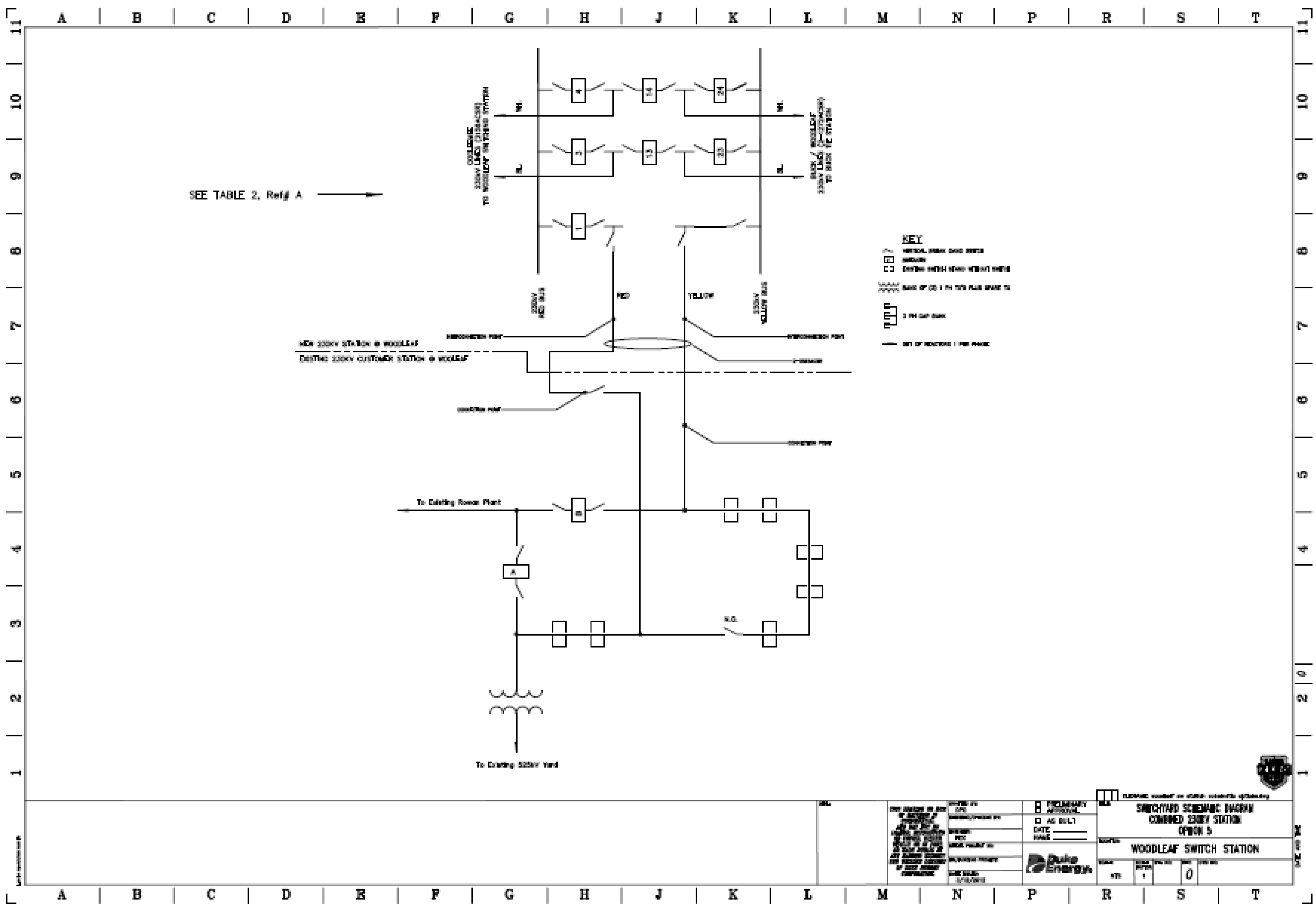
Return to WORK SCOPE DESCRIPTION FOR THE SWITCHING STATION

Return to: A. New Woodleaf 230kV Switching Station @ Rowan County CC Plant

Return to EXHIBIT C - Station Design and Construction Work Scope

3. WOODLEAF 230kV SWITCHING STATION SCHEMATIC

Proposed Electrical One Line

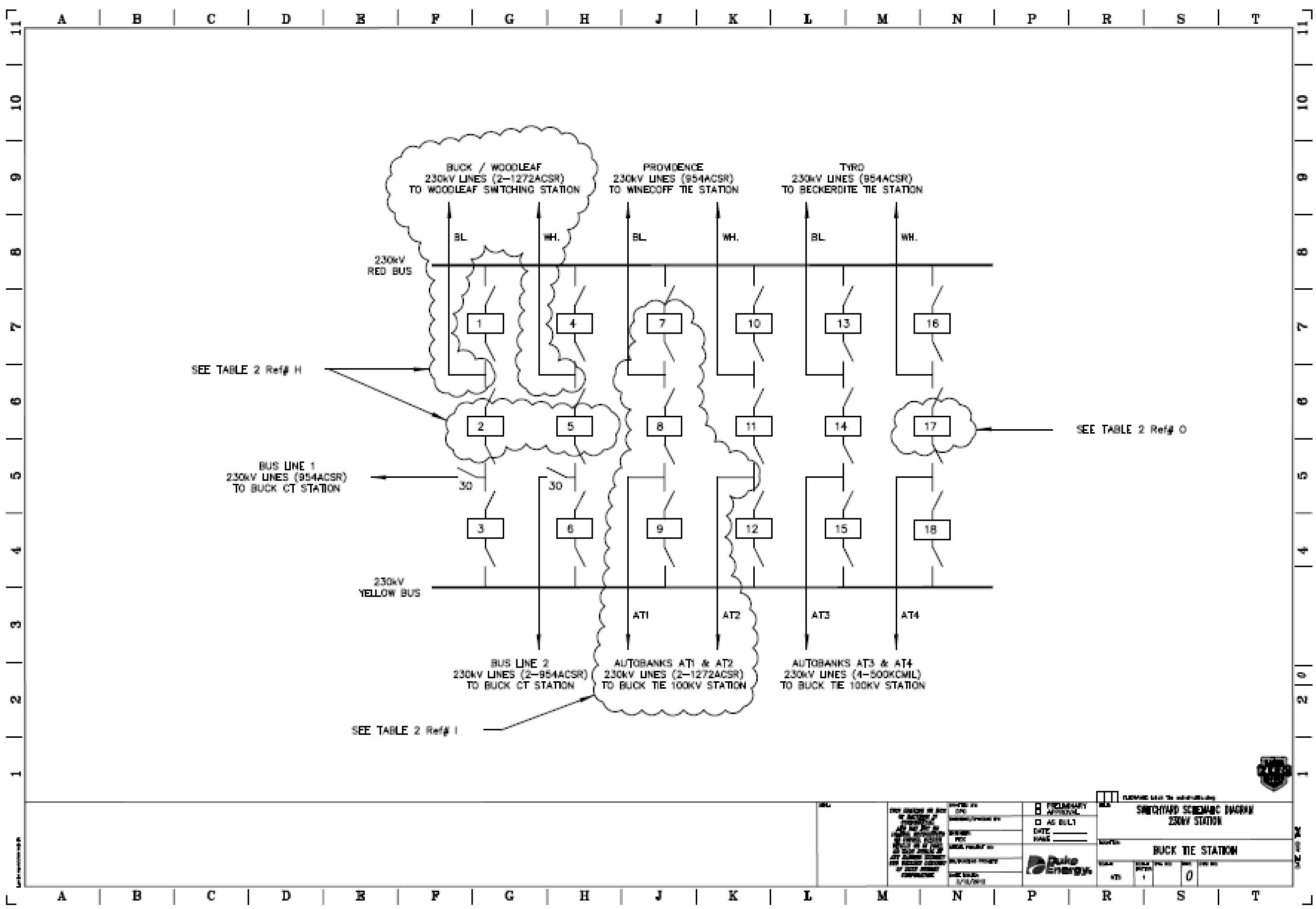


[Return to INTRODUCTION] or

[Return to WORK SCOPE DESCRIPTION FOR THE SWITCHING STATION]

4. BUCK TIE 230kV SWITCHING STATION SCHEMATIC

Proposed Electrical One Line

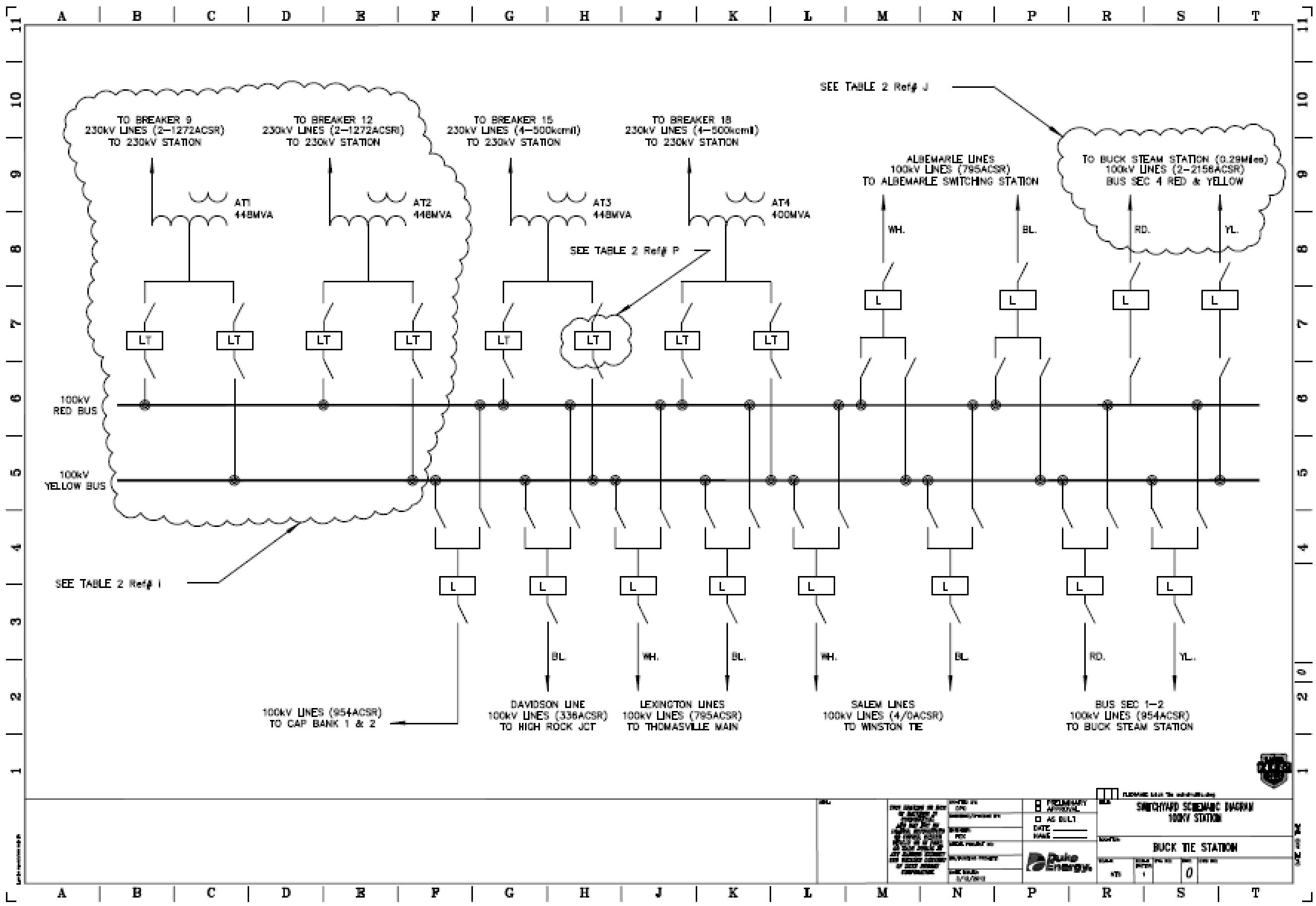


Return to INTRODUCTION or

Return to WORK SCOPE DESCRIPTION FOR THE SWITCHING STATION

5. BUCK TIE 100kV SWITCHING STATION SCHEMATIC

Proposed Electrical One Line



APPENDIX B – ASSOCIATED FACILITIES MILESTONES SCHEDULES

Return to SCHEDULE FOR THE ASSOCIATED FACILITES

Associated Facilities Milestone Schedule Requirements

Ref#	Facility	Time Prior to Rowan County CC In Service Date or Back Feed For Start of Activity
1	New Woodleaf 525kV Switching Station Interconnection Point @ Rowan County CC Plant	3 years

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APPENDIX C – NEWTWORK MODIFICATION SCHEDULES

Return to REQUIRED NETWORK MODIFICATIONS or

Return to SCHEDULE FOR NETWORK MODIFICATIONS

Network Modification Schedule Requirements

(If the project queue ID 40577-01 is built or is NOT built.)

Ref#	Required Network Modification	Time Prior to COD For Start of Activity
A	New Woodleaf 230kV Switching Station @ Rowan County CC Plant	3 years
B	New Cooleemee 230kV Switching Station near Mt Vernon, NC	3 years
C	Marshall 230 kV Line Fold-in @ New Cooleemee Switching Station (0.38 Miles) w/954kcmil ACSR	2 years
D	Marshall 230 kV Line Relay Upgrade @ Beckerdite Tie Station	1 years
E	Marshall 230 kV Line Relay Upgrade at Marshall Steam Station	1 years
F	New Double Circuit 230 kV Lines (Cooleemee to New 230kV Woodleaf Switching Station (5.8 Miles) w/2156kcmil ACSR	3 years
G	New Double Circuit 230kV Lines (Buck Tie to New 230kV Woodleaf Switching Station (15.7 Miles) w/2-1272kcmil ACSR	5 years
H	New Double Circuit Lines Terminals @ Buck Tie 230kV Switch Yard	2 years
I	Add (2) 230/100kV 448MVA Auto Transformers (AT1 & AT2) @ Buck Tie	3 years
J	Rebuild the Bus Sec 4 Red & Yellow Lines (Buck Tie to Buck Steam Station Switch Yard) (0.29 Miles) w/bundled 2156kcmil ACSR	1 years
K	Replace existing 230/100kV 200MVA Auto Transformer #3 with a 448MVA Unit @ Beckerdite Tie	2 years
L	Install 230kV Norman Lines Reactors @ Riverbend Steam Station (New)	3 years
M	Replace 100kV OD Breaker @ Beckerdite Tie (8 Breakers)	3 years
N	Install 100kV Bus Sec 4 Red & Yellow Lines Reactors in lieu of Replacing 100kV OD Breaker @ Buck Steam Station (7 Breakers)	3 years
O	Replace 230kV OD Breaker @ Buck Tie (1 Breaker)	1 years
P	Replace 100kV OD Breaker @ Buck Tie (1 Breaker)	1 years
Q	Replace 100kV OD Breaker @ Linden St Switch Station (1 Breakers)	1 years
R	Replace 230kV OD Breaker @ Marshall Steam Station (7 Breakers)	3 years
S	Replace 230kV OD Breaker @ Winecoff Tie (2 Breakers)	N/A
T	Replace 100kV OD Breaker @ Winecoff Tie (6 Breakers)	3 years

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Network Modification Schedule Requirements

(If the project queue ID 40577-01 is NOT built.)

Ref#	Required Network Modification	Time Prior to COD For Start of Activity
U	Replace 230kV OD Breaker @ Rural Hall Tie (2 Breakers)	1.5 years
V	Replace 230kV OD Breaker @ Winecoff Tie (2 Breakers)	N/A
W	Replace 100kV OD Breaker @ Winecoff Tie (2 Breakers)	1 years

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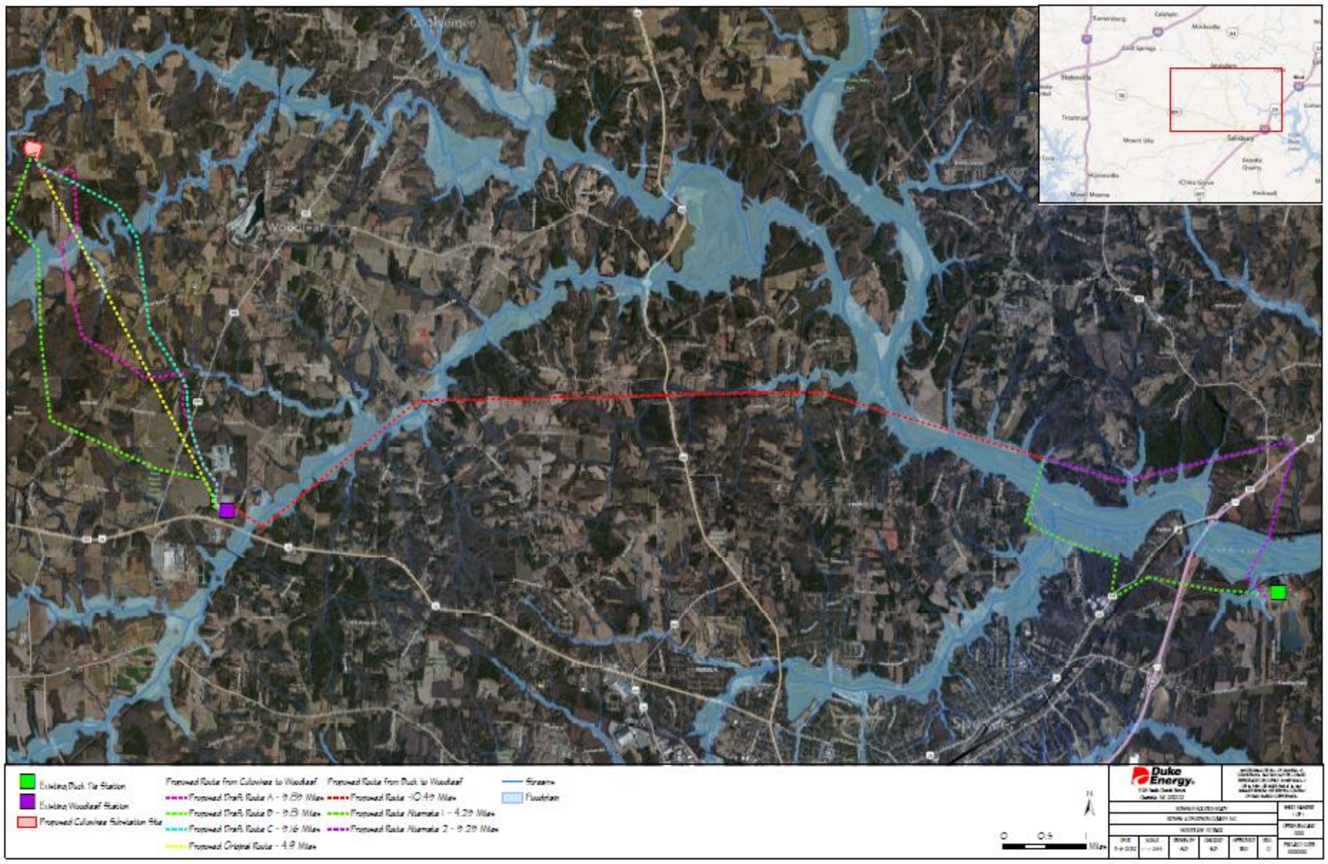
APPENDIX D - PICTORIALS

Return to BASELINE ASSUMPTIONS

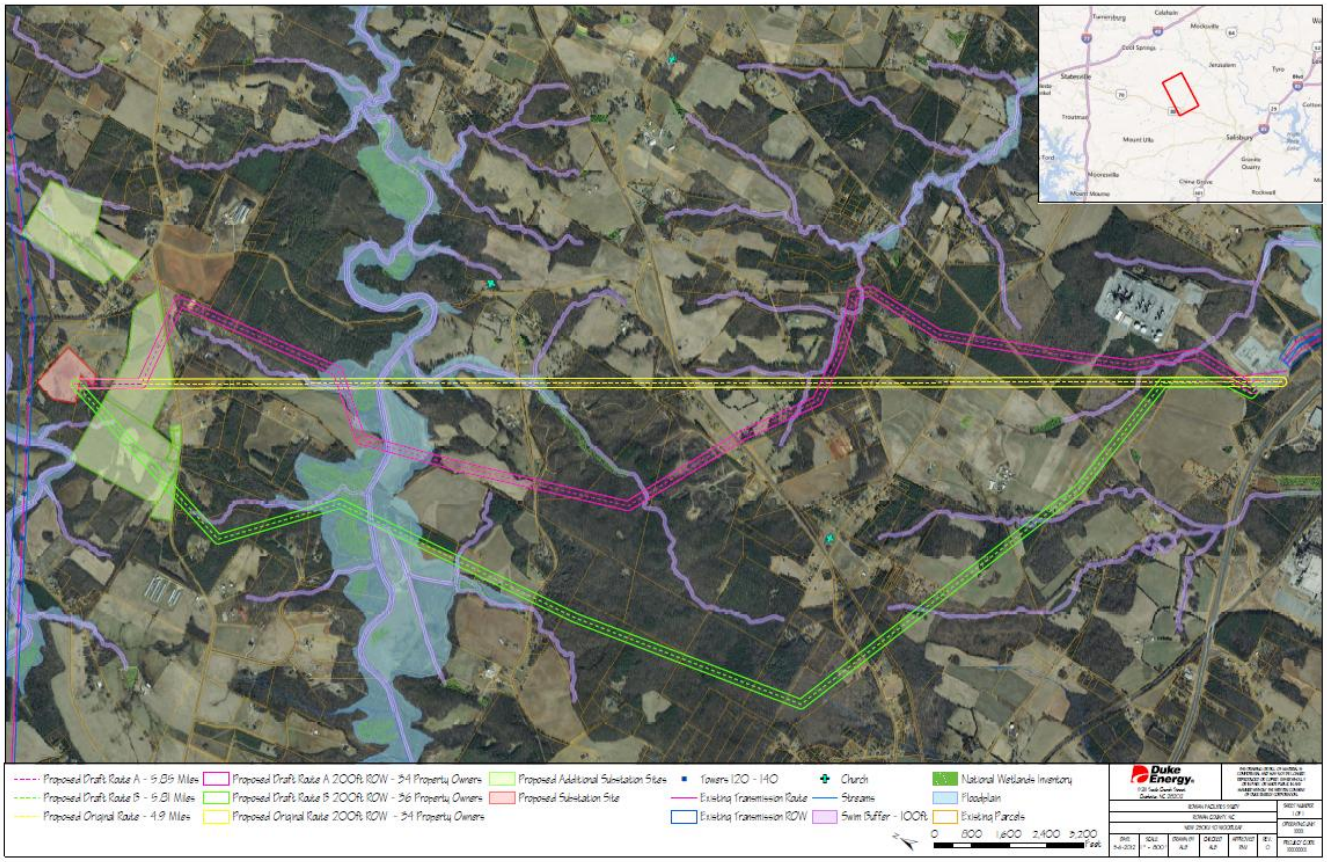
1. Pictorial Overview of 230kV Associated Facilities



Final

Return to BASELINE ASSUMPTIONS

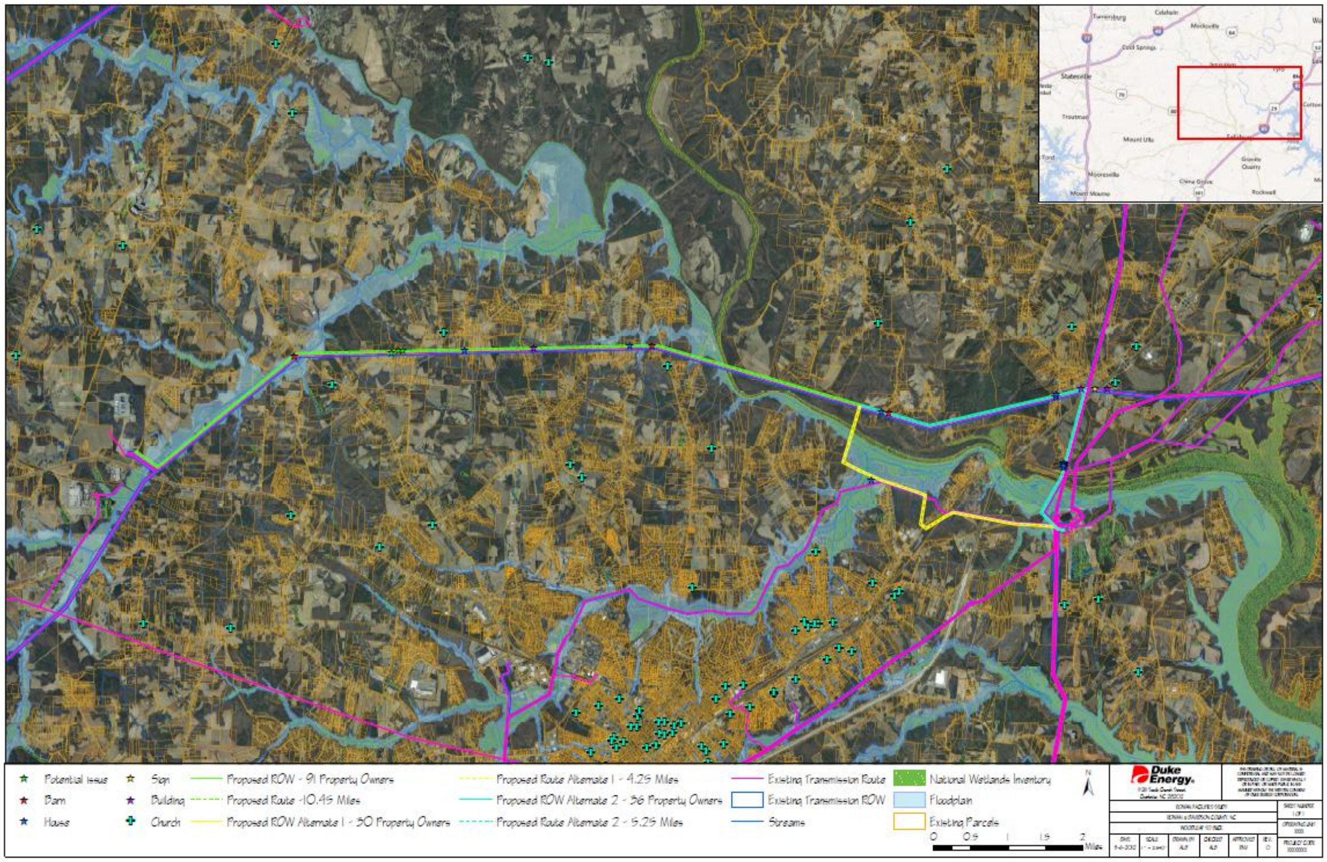
2. Pictorial of 230kV Double Circuit Transmission Lines (Cooleemee to Woodleaf)



Final

Return to BASELINE ASSUMPTIONS

3. Pictorial of 230kV Double Circuit Transmission Lines (Buck to Woodleaf)



Final

Return to BASELINE ASSUMPTIONS

4. Pictorial of New Proposed Site Location of the 230kV Woodleaf Switching Station

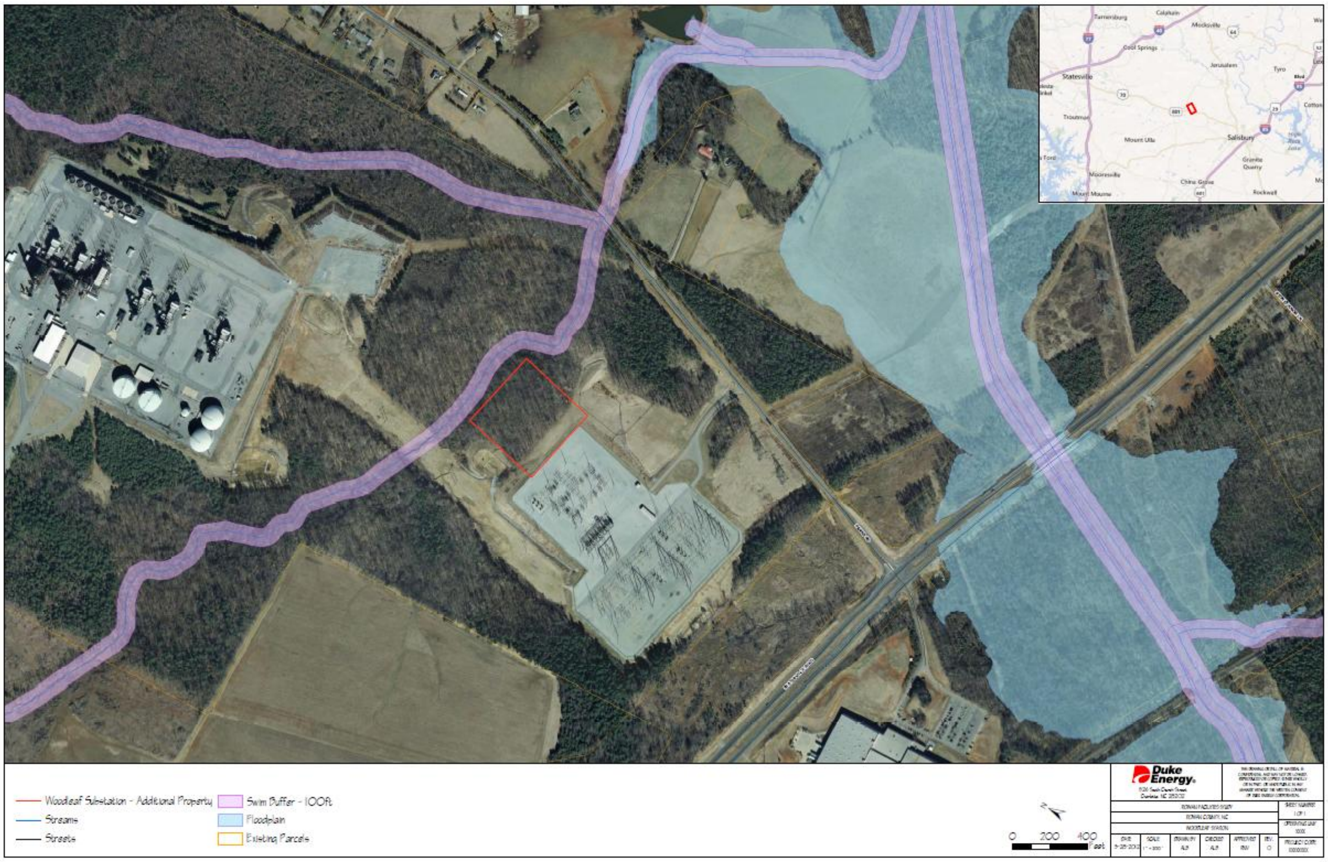


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EXHIBIT A – SUBSTATION SITE DEVELOPMENT GUIDELINES

Return to BASELINE ASSUMPTIONS

Substation Site Development Guidelines

Guidelines for Site Development of Duke Energy Substations

Revised 10/14/10

I. SITE PREPARATION:

1. Preparation of the project site shall include clearing and removing of all trees, stumps, and large rocks within the substation construction area limits.
2. Grubbing shall include the removal of any item that would interfere with the building of the substation, extending to a depth of approximately 36" below grade of the substation pad.
3. Sedimentation control, including re-vegetation and permitting, will be covered and required as per Federal, State, County, or City regulations. Customer will be responsible for obtaining on necessary permits for Site Preparation activities.
4. All utilities on Customer Site and all utility R/W's, roads, driveways, sewer lines, water lines, vision cable or any other overhead or underground facilities shall not parallel the center line within the road R/W limits and may cross at angle not less than 30 degrees with the center line and no closer than 25 feet to any Duke Energy structure.

II. GRADING:

1. The lot shall be crowned at the center of the pad. The pad should be graded at 1% to 2% to provide adequate drainage.
2. The lot shall be graded such that no storm water shall drain onto the substation pad from surrounding areas.
3. Backfill Requirements:
   a. The Customer shall employ an Independent Testing Agency to check the compaction of backfill. Recommended testing sequence:
      i. Each lift shall have at least one test performed for compaction.
      ii. One test shall be performed per 1,000 square yards of subgrade.
      iii. One test shall be performed per 500 cubic yards of embankment.
      iv. One test shall be performed per 100 linear feet of trench.
   b. Backfill material shall be composed of clean loose earth having moisture content such that the required density of the compacted material will be obtained with the compaction method used. Backfill material shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. Backfill material shall also be free of Johnson grass, nutgrass, bindweed and other noxious weeds.
   c. Backfill shall be deposited in layers not to exceed eight (8) inches in un-compacted thickness and mechanically compacted to at least 95 percent of the maximum density at +/- 2% of optimum moisture content as determined by ASTM D698.
   d. Density test should be completed & filed for evaluation and acceptance of Duke Energy.

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4. Excavation:
    a. Where rock is encountered within the indicated substation fence or with six (6) feet outside the fence perimeter, grade excavations shall be undercut to a minimum of 36" replaced with suitable fill materials. The purpose of the undercut is to aid in the construction of the substation foundations and grounding grid.

III. SEEDING:

1. Re-vegetation will be covered as required per Federal, State, County, or City regulations.
2. Soil surface stabilization measures will be completed immediately following the establishment of the substation pad. Seeding, mulching, matting, or other soil surface stabilization measures will be placed on all denuded areas following initial soil disturbance. Prior to seeding, all denuded surfaces shall be scarified to a depth of four to six inches to enhance seed germination and help impede storm water runoff.
3. Seeding mixtures will be tailored to site-specific conditions, steepness of slopes, climate, location, time of year, and elevation.
4. Mulch shall be applied to all seeded areas to aid in the establishment of vegetation and help impede soil erosion. Vegetative mulch, typically wheat or oat straw, shall be applied.
5. Erosion Control Matting shall be applied to slopes steeper than 2:1, diversion channels, and waterways, or problem areas to reduce erosion and aid in the establishment of a permanent vegetative ground cover.

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EXHIBIT B – SUBSTATION ACCESS ROAD GUIDELINES

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Substation Access Road Guidelines

Guidelines for Access Drives of Duke Energy Substations

Revised 10/14/10

I. GENERAL REQUIREMENTS:

1. Preparation of the road shall include clearing and removing of all trees, stumps, and large rocks within the Road Bed construction area limits. Grubbing shall include the removal of any item that would interfere with the building of the access road, extending to a depth of approximately 12" below grade.
2. Access road connection to the public roadway will be at a right angle for at least a minimum of 50', where possible. For access roads connections to the public roadway at less than a right angle, Duke Energy will require review and approval of the driveway entrance.
3. Stream crossing will be allowed only if proper permitting has been obtained. All stream crossings and crossings of ditches, swales, and other depressions shall have properly constructed and appropriately sized and placed reinforced concrete pipe per AASHTO M-170 with flared ends. The minimum culvert size will be 18" with 12" minimum compacted cover soil to handle axle loads. Intake and discharge of culverts shall be armored with properly designed energy dissipaters. Where practical, all crossings are to be crossed at right angles.
4. Structures, buildings, mobile homes and trailers, satellite signal receiver systems and equipment, swimming pools and associated equipment, human graves, billboards, signs, wells, septic tanks or septic systems, absorption pits, storage tanks both above and below ground, garbage, trash, rubble, flammable material, building material, junk, and wrecked or disabled vehicles are not allowed within the access road limits (shoulder to shoulder).
5. Other utilities R/W's, roads, driveways, sewer lines, water lines, vision cable or any other overhead or underground facilities shall not parallel the center line within the road limits (shoulder to shoulder), but may cross at angle not less than 30 degrees with the center line and no closer than 25 feet to any Duke Structure.
6. Access roads that cross Duke's transmission R/W's must adhere to all Transmission Line R/W restrictions (contact Duke Energy Transmission Line Engineering) as it pertains to angle of crossing, clearances to wire conductors, and permanents structures and fixtures.
7. Manholes and underground vaults within the road limits must be approved by Duke Energy before installation.
8. Fences shall not parallel the centerline within the road limits. Duke Energy reserves the right to grant or reject the Customer request to cross the access road with a fence. The fence may cross at any angle not less than 45 degrees with the centerline of the road. If a fence crosses the road, a minimum 16' galvanized steel farm gate with pressure treated 8x8 posts, shall be installed and maintained by the Customer per Duke Energy's specifications to allow free access required by Duke Energy's equipment, trucks, and personnel. All gates shall have a minimum ¼" link chain and Duke Energy issued lock. Fences shall not be attached to any Duke Energy pole or structure. Grading of the access road shall be at least 25' from any Duke Energy pole, structure, or tower leg. No vehicles or equipment will be allowed to be parked within the road limits.

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9. Material for backfill shall be composed of earth free of wood, grass, roots, broken concrete, large stones, trash, or debris of any kind. No tamped, rolled, or otherwise mechanically compacted soil backfill shall be deposited or compacted in water. All soil backfill material shall consist of loose earth having moisture content such that the required density of the compacted soil will be obtained with the compacting method used. Moisture content shall be distributed uniformly and water for the correction of moisture content shall be added sufficiently in advance so as proper moisture distribution and compacting will be obtained.
10. Final road grade elevation shall be established to effectively handle storm water run-off. Run-off shall be directed from the crown of the road bed to the outside perimeter of the ditch with a 2% slope to a point off the road bed which would minimize erosion and sedimentation damage. The Access Road Bed shall be graded such that no depressions shall be left within the access road that will hold water or prevent the proper drainage of the site. No ponding or the flooding of water within the road bed area shall occur.
11. Soil surface stabilization measures will be completed immediately following the establishment of the Road Bed. Seeding, mulching, matting, or other soil surface stabilization measures will be placed on the road shoulders and other denuded areas following initial soil disturbance. Prior to seeding, all denuded surfaces shall be scarified to a depth of four to six inches to enhance seed germination and help impede storm water runoff. Seeding requirements shall be followed as defined in Substation Site Development Guidelines.

II. WIDTH:

5. Access drive entrance - 28’ (minimum) – where access road meets the public road edge
6. 50’ from public road - 20’(minimum)
7. 80’ from public road at entrance gate – 18’ (minimum)
8. Curved sections after entrance gate – 20’ (minimum) – maintain minimum 55’ inside turning radius and 65’ outside turning radius

III. GEOMETRY:

1. Type “ABC” Crusher Run Gravel – Max Grade 8%
2. Heavy Duty Asphalt – Max Grade 10%
3. Maximum slope change – 2% (for abrupt changes, i.e. rail crossings, waterbars, etc.)
4. The access drive shall have a 3” inch crown when viewed in cross-section
5. The maximum side slope shall be 2% (for road shoulders)
6. Turning radius:
   a. Inside Wheels – 55’
   b. Outside Wheels – 65’
   c. Refer to Figure 1 below

IV. ROAD SURFACE AND COMPACTION REQUIREMENTS:

1. The Customer shall employ an Independent Testing Agency to check the subgrade compaction of the soil below the driveway and the aggregate for the driveway.
2. The existing subgrade, directly below the driveway and two (2) feet outside of the driveway, shall be mechanically compacted in the top 12” to at least 98 percent of the maximum density at optimum moisture content as determined by ASTM D698. All other subgrade shall be mechanically compacted to at least 95 percent of the maximum density at optimum moisture content as determined by ASTM D698
3. The driveway aggregate shall be mechanically compacted to at least 98 percent of the maximum density at optimum moisture content as determined by ASTM D1557. Thin layers of fine material shall not be added to the top layer in order to meet grade.
4. Access with grade less than 8% shall be paved with type “ABC” crusher run gravel.

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   a. The subgrade directly below the driveway shall be cut down approximately two (2) inches prior to placement of the stone aggregate.
   b. The minimum driveway aggregate thickness shall be 10” at the outside edges and 14” at the center / crown of the driveway. The aggregate shall be placed upon the subgrade in two compacted layers with a minimum lift of 4”. The driveway tolerance shall be plus or minus 0.5 inches.
   c. Stone depth shall be maintained at an 8” (minimum) throughout the life of the Facility.
   d. A paved apron shall be provided from the edge of the public road to the edge of the public right of way and shall consist of 8” type “ABC” crusher run gravel and 2-1/2” minimum, Type S 9.5A – 90% (NCDOT / SCDOT Standard), installed in 1” to 2” lifts. Apron pavement should be installed upon project completion.
5. Access with grade 8% or greater shall be paved with heavy duty asphalt
   a. The stone base course will consist of an 8” layer of Type “ABC” Crusher Run compacted to a maximum density of 95%.
   b. The binder course shall be 2-1/2” minimum, Type I 19.0 – Minimum Density Requirement of 92% (NCDOT Standard) installed in a single lift.
   c. The surface course shall be 1-1/2” minimum, Type S 9.5A – Minimum Density Requirement of 90% (NCDOT Standard) installed in a single lift.
   d. All materials to be used in this mixture shall conform in all respects to the provisions as set forth in NCDOT Section 610 Asphalt Concrete Plant Mix Pavements.
   e. Asphalt Pavement should be installed upon project completion.
6. Density tests should be completed & filed for evaluation and acceptance of Duke Energy.

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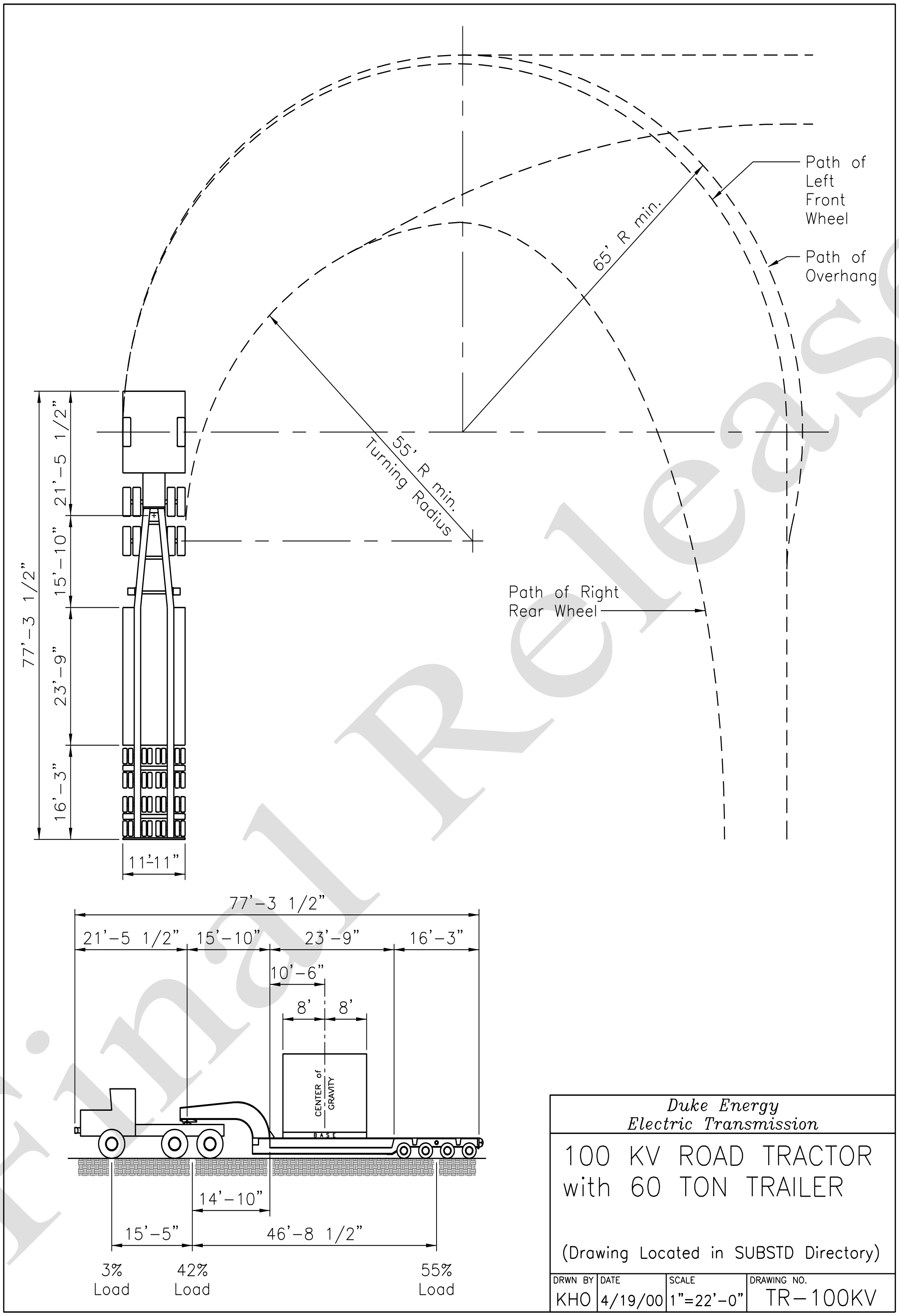

Figure 1 - Road Tractor w/ 60 Ton Trailer

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EXHIBIT C - Station Design and Construction Work Scope

Return to: A. New Woodleaf 230kV Switching Station @ Rowan County CC Plant

Return to: B. New Cooleemee 230kV Switching Station near Mt Vernon, NC

Cooleemee & Woodleaf 230kV Switching Stations:

a. General Description

The Cooleemee and Woodleaf 230kV switchyard shell leverage a breaker and a half bus design. Each will be designed to accommodate multiple 230kV transmission lines. *Refer to Appendix A.2 and Appendix A.3 respectively for initial build out requirements.*

The new switchyard will require a finished access road and substation pad prior to construction. The exact specifications which must be met in support of developing the access road and switchyard pad will be provided upon receiving the Customer's authorization to proceed with the interconnection.

The 230kV yard 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 Duke'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 group operated 3 phase disconnect switch shall be installed on the bus line entering the new substation from the Customer's facilities. It will be controlled by Duke. It will provide a means to physically and visibly isolate the Duke's System from the Customer.

Duke reserves the right to lock the switches in the open position:

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

It is standard for all bulk power switching stations to have two sources of station service power. One source of station service shall be derived from a high voltage power pot which will be installed in the switching station. The second source will be derived by connecting to Duke's distribution system.

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b. Relay, Controls and Communication

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:

Each of the 230kV lines will be protected by independently operated System “A” and System “B” relay schemes designed to clear a fault anywhere on the line. The schemes will be directional distance for multi-phase and phase-to-ground faults with both systems relaying operating with Permissive Over-reaching Transfer Trip pilot logic using two SEL421 relays per line. System “A” and System “B” relay schemes will have separate 125 volt DC systems.

The 230kV transmission line protective relay system is designed to provide a high level of reliability. The protective relaying provides for fast detection of faults and should the transmission line protective relays fail to clear the fault, adequate backup protection is available in the form of breaker failure relays.

All circuit breakers will have an external control switch or push button in the switchyard relay equipment enclosure for manual operation.

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

The 230kV switchyard breakers are protected by breaker failure relays with current supervision from separate instrument current transformers on the breaker. The breaker failure relays operate through a timing g 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 the bus side plus the associated line breakers.

The relay and electrical equipment to be installed consists of the following:

(a) **APPLIES TO COOLEEMEE 230kV SWITCHING STATION ONLY -** Both transmission line terminals to Beckerdite and both transmission line terminals to Marshall Steam station will consist of (2) SEL421 relays. System ‘A’ and system ‘B’ SEL-421’s will use a POTT scheme, using relay to relay communications. All the systems SEL-421 relays will have breaker failure schemes.

(b) **APPLIES TO COOLEEMEE 230kV SWITCHING STATION ONLY -** Both transmission line terminals to Woodleaf 230kV switching station will consist of (2) SEL421 relays. System ‘A’ and system ‘B’ SEL-421’s will use a POTT DTT pilot scheme, using relay to relay communications. All the systems SEL-421 relays will have breaker failure schemes.

(c) **APPLIES TO WOODLEAF 230kV SWITCHING STATION ONLY -** Both transmission line terminals to Cooleemee 230kV switching station will consist of (2) SEL421 relays. System ‘A’ and system ‘B’ SEL-421’s will use a POTT DTT pilot scheme, using relay to relay communications. All the systems SEL-421 relays will have breaker failure schemes.

(d) **APPLIES TO WOODLEAF 230kV SWITCHING STATION ONLY -** The existing 525/230kV auto transformer bus line will be extended to connect into the new 230kV station. The existing transformer differential (87T) relay scheme will be modified to encompass the entire bus line for protection.

(e) **APPLIES TO WOODLEAF 230kV SWITCHING STATION ONLY -** A new bus line will extend from the existing 230kV station and connect into the new main yellow bus in the new station. The new yellow bus differential (87B-2) relay scheme will encompass the entire bus line for protection.

(f) The station Serial to IP (STIP) communications and alarms will consist of (2) SEL-3610 Port Servers, (1) SEL2440 Automation Controller and (1) SEL3354 Computing Platform and Arbiter Satellite Clock.

(g) The station Human/Machine Interface (HMI) equipment will consist of (1) SEL3354 Computing Platform, Computer Monitor and specified software for control and monitoring.

(h) A Digital Fault Recorder (DFR) consisting of (1) Ametek unit for the 230kV equipment with approximately 32 analog channels and 20 digital points.

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(i) DC System: There will be (2) separate 125 volt DC systems to be sized per the calculated board load. Each system will have separate battery chargers with one spare standby charger. Each system will have separate load centers with non automatic type molded case switches.

(j) Install capacitor voltage transformers on each phase of all 230kV transmission lines entering the station including the Rowan County bus line and a capacitor voltage Transformer on each 230kV main bus, for line and bus voltage inputs to the relays.

(k) All DC power, control, CT & CVT cables to be 1000V shielded. All AC power cables to be 2000V shielded.

(l) Install on each circuit breaker (1) SEL-2515 Remote I/O Module for breaker alarms to go to the relay house via fiber optic cable to the SEL-3610 Port Servers.

c. Switchyard Relay Enclosure

A prefabricated relay house shall be installed to serve the needs of the switchyard. The projected size of this enclosure shall be approximately 16’ x 40’. The switchyard relay house shall house all switchyard batteries (both battery systems housed and appropriately ventilated) and be capable of accommodating up to twenty (20) twenty-six (26) inch standard metal relay/control panels which may be required for the ultimate size of this switchyard. Approximately twelve panel spaces will be used initially. A dual system heat pump is required to keep electronic equipment between 50 and 90 degrees F.

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