Facilities Study Report

For: [redacted] ("Customer")

Queue #: 41639-01

Service Location: Cleveland County, NC

Total Output: 452MW Summer Ratings & 501MW Winter Ratings

Customer Requested In-service Date: 4/1/2017

Commercial Operation Date: 2/7/2018

FINAL

Prepared by:
Don Dickens / Steve Mc Clure / Roger Hurst

Table of Contents

1.0 Introduction 3
2.0 Baseline Assumptions 4
3.0 Facilities Directly Associated with Customer's Interconnection 8
3.1 Cost Estimates 8
3.2 Work Scope 8
3.2.1 General Description of The Company's Interconnection Facilities 8
3.2.2 Relay, Controls and Communications 10
3.2.3 Control House 11
3.2.4 Line Structure(s) - 44kV Line Relocation 11
3.3 Schedule 11
4.0 Required Network Modifications 12
4.1 Cost Estimate 12
4.2 Work Scope 13
4.3 Schedule 15
5.0 Connection Requirements 15
5.1 General 15
5.2 Short Circuit Withstand Capability 15
5.3 Equipment Ratings 16
5.4 Insulation Requirements 16
5.5 Instrument Transformer Requirements 16
5.6 Metering 16
6.0 Appendixes 22
6.1 Appendix A – SCHEMATICS 22
6.1.1 Proposed One Line of a new 230kV Interconnection Switching Station 22
6.2 Appendix B – ASSOCIATED FACILITIES MILESTONES SCHEDULES 22
6.3 Appendix C – NETWORK MODIFICATION SCHEDULES 23
6.4 Appendix D – PICTORIALS 24
6.4.1 Pictorial – Proposed Kings Mountain CC Plant & Interconnecting Switching Station 24
6.4.2 Pictorial – Proposed 44kV Kings Mountain Line Relocation 24
7.0 Exhibits 25
7.1 Exhibit A – SUBSTATION SITE DEVELOPMENT GUIDLINES 25
7.2 Exhibit B – SUSTATION ACCESS ROAD GUIDELINES 27

1.0 Introduction

The Customer has proposed to install new generation in the control area owned and operated by Duke Energy Carolinas, LLC ("Company"). The Customer's requested interconnection point will require a new interconnection substation and the modification of an existing switching station located on property in Cleveland 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 Kings Mountain Energy Center ("KMEC"), shall be a Combined Cycle Plant capable of generating 452MW of power (summer rating at 35 degrees C) & 501MW of power (winter rating at 0 degree C). The Customer has a requested commercial operation date of February 7, 2018.

This Facilities Study interconnection request (Queue # 41639-01) 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, May 19, 2014 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 switching station adjacent to the new combined cycle plant.
- Fold-In of the existing 230kV Sampson Lines.
- Kings Mountain 44kV Line Relocation.

The Customer has requested that the Kings Mountain 44kV Line Relocation be complete prior to October 1, 2015 to support their mobilization of construction for all customer related construction efforts.

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 April 1, 2017.

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 452MW summer 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 Out of Step Relay Protection on their generators.

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. No provisions have been made for temporary work in the estimates 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. To support this interconnection the following must be provided by the Customer:

- The Customer shall provide a graded substation lot to the Company as outlined in the "Duke Energy Substation Site Development Guidelines"- *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 400' x 400'.
- The Customer shall provide a substation access road to the Company as outlined in the "Duke Energy Substation Access Road Guidelines"-*Exhibit B.*

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 7.1 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.

The Company has determined that the construction of the Kings Mountain 44kV Line Relocation can meet the requested Customers completion date of October 1, 2015 if the following occurs:

- The Company receives a deposit from the Customer in the amount of $322,300 for early design and procurement activities by December 15th, 2014.
- The Customer communicates the requested route for the 44kV line by December 15th, 2014.
- The Customer acquires all environmental permits for the 44kV line relocation.
- The Customer has the land for the 44kV line relocation cleared and ready for construction by August 1, 2015.

The Company has determined that all construction of new facilities and network modifications necessary for start up of the Customers new generation facilities can meet the requested in-service (back feed) date of April 1, 2015 if the following occurs:

- The Company receives a Letter of Credit to fund the project by April 1, 2015.
- The Customer takes ownership of the land on April 1, 2015.

Upon receipt of the Customer's notice to proceed along with a deposit of $322,300, the Company will develop appropriate work plans and initiate certain design and procurement activities. The Customer will be responsible for all costs incurred by the Company associated with those efforts.

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	New 230kV CC Interconnection Switching Station	$9,611,597
B	Sampson 230kV Line Fold-In	$1,933,389
C	Sampson Line Terminal Upgrade at Riverbend Switching Station	$289,487
D	Sampson Line Relay Upgrade at Ripp Switching Station	$311,530
E	King Mountain 44kV Line Relocation (1 Mile) w/556kcmil ACSR	$1,109,046
	TOTAL	**$13,255,049**

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 develop a new 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 2/7/2018. 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 proposed interconnection switching station will be designed for an ultimate four bay breaker and a half bus configuration. There will be multiple bays to accommodate the required transmission line loops, and the generator bus line. The minimum design requirements for the 230kV switchyard configuration shall include four incoming line terminals, one generator bus line terminal, and adequate space to accommodate three future line terminals. Interconnecting to the transmission grid will be realized by the looping in of the Sampson double circuit 230kV lines. The Sampson 230kV lines currently provide a connection between Ripp Switching Station and Riverbend Switching Station. The switch yard will require the installation of eight 242kV, 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 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 lines are protected by independent distance relay schemes designed to clear a fault anywhere on the line. The scheme for the 230kV Sampson lines are directional distance for multi-phase and phase-to-ground faults. The primary and secondary relay schemes have separate 125 volt DC systems.

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.

The eight new 230kV 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 both sides of the failed breaker.

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

(a) Both transmission line terminals to Riverbend Switching Station will consist of (2) SEL421 relays. The primary and secondary SEL421's will use a permissive overreach transfer trip ("POTT") and direct transfer trip ("DTT") pilot scheme using relay to relay communications. SEL351 relays will be used for breaker failure and automatic reclosing.

(b) Both transmission line terminals to Ripp Switching Station will consist of (2) SEL411L relays. The primary and secondary SEL411L relays will use a current differential and DTT pilot schemes using relay to relay communications. SEL351 relays will be used for breaker failure and automatic reclosing.

(c) The single Kings Mountain CC bus line will be a line current differential and overcurrent scheme using (2) SEL411L relays. This will require fiber connections between the plant facility and the new interconnection switching station. The Customer will be responsible for installing the required number of single mode fiber strands from the Kings Mountain CC plant facility to the new interconnection switching station per Company guidelines. SEL351 relays will be used for breaker failure and automatic reclosing.

(d) The station Serial to IP ("STIP") communications and alarms will consist of (1) SEL33XX series Computing Platform, (1) SEL2440 Automation Controller, (2) SEL3610 Port Servers and an Arbiter Satellite Clock.

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

(f) Install (1) digital fault recorder (DFR) consisting of (1) Ametek unit for the 230kV equipment with approximately 32 analog channels and 20 digital points.

(g) Install capacitor voltage transformers on all three phases of all line terminals and one on each of the red and yellow buses, for line and bus voltage inputs to the relays.

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

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

(j) Relay setting adjustments will be required at both Riverbend and Ripp Switching stations in conjunction with the new Sampson line protection schemes.

3.2.3 Control House

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 (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.

3.2.4 Line Structure(s) - 44kV Line Relocation

An existing 44kV line known as the Kings Mountain line currently runs through the Customers property of which by their request must be relocated before construction of any other associated facilities can begin. It has been determined that approximately one mile of line will be shifted toward the south and will require crossing beneath the existing 230kV Sampson lines and follow its right of way to a point where it will cross the Sampson lines a second time. *Appendix D - Propsed 44kV Kings Mountain Line Relocation provides a pictorial of the proposed routing of the Kings Mountain line.*

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.

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

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. Table 2 summarizes the required modifications along with the associated costs related with this [redacted] queued project 41639-01 with a Commercial Operation Date of 2/7/2018. Table 3 summarazies the modifications along with the associated costs that would also be required of [redacted] should the higher queued project 40633-01 (355MW combustion turbine facility in Cleveland County, NC be constructed. Table 4 summarizes the modifications along with the associated costs that would also be required of [redacted] should the higher queued project 40639-01 (937MW combined cycle facility in Cleveland County, NC) be constructed.

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.

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 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. The Company will work closely with the Customer to establish mutually agreeable critical clearing times to effectively mitigate instability 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 no temporary facilities will be required to support construction efforts.

Table 2

Ref	Required Network Modification	Date Required	Estimated Cost
A	230kV OD Breakers @ Ripp Switching Station (12 Breakers)	April 1, 2017	$7,419,936
	TOTAL		**$7,419,936**

Table 3

(* - If either higher queued projects 40633-01 (355 MW combustion turbine facility in Cleveland County, NC)is constructed.

Ref	Required Network Modification	Date Required	Estimated Cost
*B	230kV OD Breakers @ Ripp Switching Station (15 Breakers)	April 1, 2017	$8,282,087
	TOTAL		**$8,282,087**

Table 4

(- If higher queued project 40639-01 (937 MW combined cycle facility in Cleveland County, NC) is constructed.)**

Ref	Required Network Modification	Date Required	Estimated Cost
**B	230kV OD Breakers @ Ripp Switching Station (15 Breakers)	April 1, 2017	$8,282,087
**C	Rebuild the Sampson 230kV Lines (Riverbend Switching Station to the Proposed Cleveland County Combined Cycle Switching Station) (28.2 Miles) w/1533kcmil ACSS	April 1, 2017	$67,492,696
**D	Upgrade Sampson Line Terminals at Riverbend Switching Station	April 1, 2017	$351,628
	TOTAL		**$76,126,411**

4.2 Work Scope

A. 230kV OD Breaker @ Ripp Switching Station (12 Breakers)

With the addition of the proposed KMEC Combined Cycle generators, the available fault current as seen at the Ripp Switching Station 230kV bus will be increased. Fault studies indicate that the PCB 1, PCB 2, PCB 3, PCB 4, PCB 5, PCB 6, PCB 21, PCB 22, PCB 23, PCB 24, PCB 25, & PCB 26 breakers would be subject to interrupting current levels greater than their interrupting capability. This will require the following activities:

- Replace twelve 230kV breakers with new 80kA rated gas breakers.
- Replace all (33) existing capacitor voltage transformers connected to the line terminals of all (11) lines connected to the station with 15kV pfd units to accommodate the new breaker TRV requirements.
- Install (18) 12.5k pfd capacitors on both 230kV main red and yellow buses to accommodate the new breaker TRV requirements.
- 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.
- Install an SEL2515 Remote I/O Module in the breaker mechanisms of all twelve 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.
- Salvage three breakers to be returned to Duke Stock.

B. 230kV OD Breaker @ Ripp Switching Station (15 Breakers)

With the addition of the proposed KMEC Combined Cycle generators and either of queued projects 40633-01 or 40639-01, the available fault current as seen at the Ripp Switching Station 230kV bus will be increased. Fault studies indicate that the PCB 1, PCB 2, PCB 3, PCB 4, PCB 5, PCB 11, PCB 12, PCB, 13, PCB 14, PCB 15, PCB 21, PCB 22, PCB 23, PCB 24, & PCB 25 breakers would be subject to interrupting current levels greater than their interrupting capability. This will require the following activities:

- Replace fifteen 230kV breakers with new 80kA rated gas breakers.
- Replace all (30) existing capacitor voltage transformers connected to the line terminals of all (10) lines connected to the station with 15kV pfd units to accommodate the new breaker TRV requirements.
- Install (18) 12.5k pfd capacitors on both 230kV main red and yellow buses to accommodate the new breaker TRV requirements.
- 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.
- Install an SEL2515 Remote I/O Module in the breaker mechanisms of all fifteen 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.

C. Rebuild the Sampson 230kV Lines (Riverbend Switching Station to Proposed Cleveland County Combined Cycle Switching Station) (28.2 Miles) w/1533kcmil ACSS

Work on the Sampson 230kV line consists of rebuilding approximately 28.2 miles of transmission line on an existing right of way between Riverbend Switching Station and the Proposed 937MW Combined Cycle queued project 40936-01 in Cleveland County, NC. This work is required only if both queued projects 40936-01 and this queued project 41639-01 are constructed to increase the thermal and electrical capacity of the line. The line work will involve the following activities:

- Replace approximately (92) existing 2A series tangent towers with 2N series tangent towers.
- Replace approximately (28) existing 2A series strain towers with 2Q series strain towers.
- Replace (1) existing 1/2” overhead ground wire with (1) new 48 strand overhead optical fiber/ground wire.
- Replace the existing horizontal bundled 795ACSR 26/7 phase conductors with new 1533 ACSS/TW 54/19.
- Keep the existing fiber optic ground wire in-service at all times during construction.

D. Upgrade Sampson 230kV Line Terminals @ Riverbend Switching Station

It has been determined necessary to increase the thermal and electrical capacity of Riverbend Switching Station's line terminals as part of the Sampson 230kV line rebuild only if both queued projects 40936-01 and this queued project 41639-01 are constructed This will also require relay setting changes.

- Both transmission line terminal relay upgrades at Riverbend Switching Station will consist of (2) SEL421 relays per line. The primary and secondary SEL421's will use a permissive overreach transfer trip (POTT) and direct transfer trip (DTT) pilot scheme using relay to relay communications. SEL351 relays will be used for breaker failure and automatic reclosing.
- Replace the Sampson White Line gang switch & associated bus.

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 Cleveland 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 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)

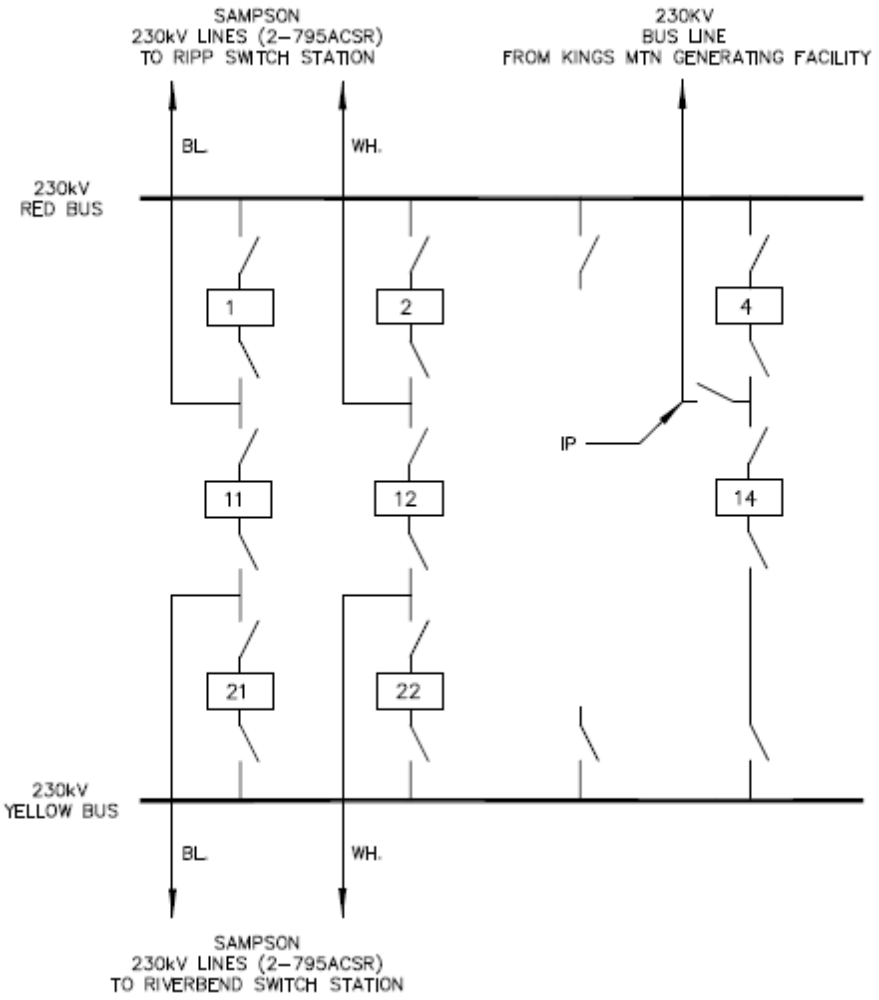
Del. Is defined as VARS consumed by generator off the system (Generator Operating at Leading PF)

6.0 Appendixes

6.1 Appendix A – SCHEMATICS

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

6.1.1 Proposed One Line of a new 230kV Interconnection Switching Station



6.2 Appendix B – ASSOCIATED FACILITIES MILESTONES SCHEDULES

Return to SCHEDULE

Ref	Associated Facilities	Time Prior to Back Feed For Start of Activity
A	New 230kV CC Interconnection Switching Station	2 years
B	Sampson 230kV Line Fold-In	1.5 Years

C	Sampson Line Relay Upgrade at Riverbend Switching Station	1 year
D	Sampson Line Relay Upgrade at Ripp Switching Station	1 year
E	King Mountain 44kV Line Relocation (1 Mile) w/556kcmil ACSR	9.5 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

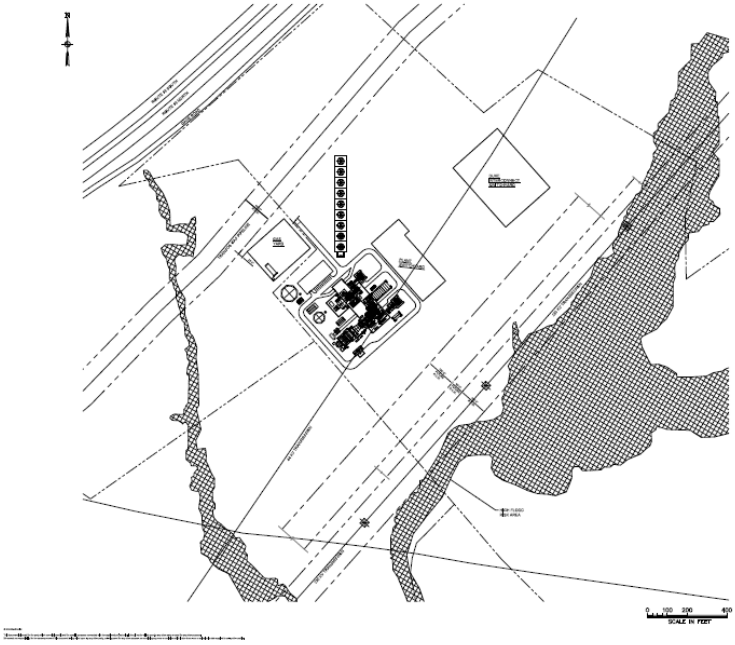
(* - If either higher queued projects 40633-01 (355 MW combustion turbine facility in Cleveland County, NC) or 40639-01 (937 MW combined cycle facility in Cleveland County, NC) is built.)
(- If higher queued project 40639-01 (937 MW combined cycle facility in Cleveland County, NC) is built.)**

Ref	*Required Network Modification*	Time Prior to Back Feed For Start of Activity
A	230kV OD Breakers @ Ripp Switching Station (12 Breakers)	1.5 years
*B	230kV OD Breakers @ Ripp Switching Station (15 Breakers)	2 years
**C	Rebuild the Sampson 230kV Lines (Riverbend Switching Station to Propsed Cleveland County Combined Cycle Switching Station) (28.2 Miles) w/1533kcmil ACSS	6 years
**D	Sampson Line Relay Upgrade at Riverbend Switching Station	1 year

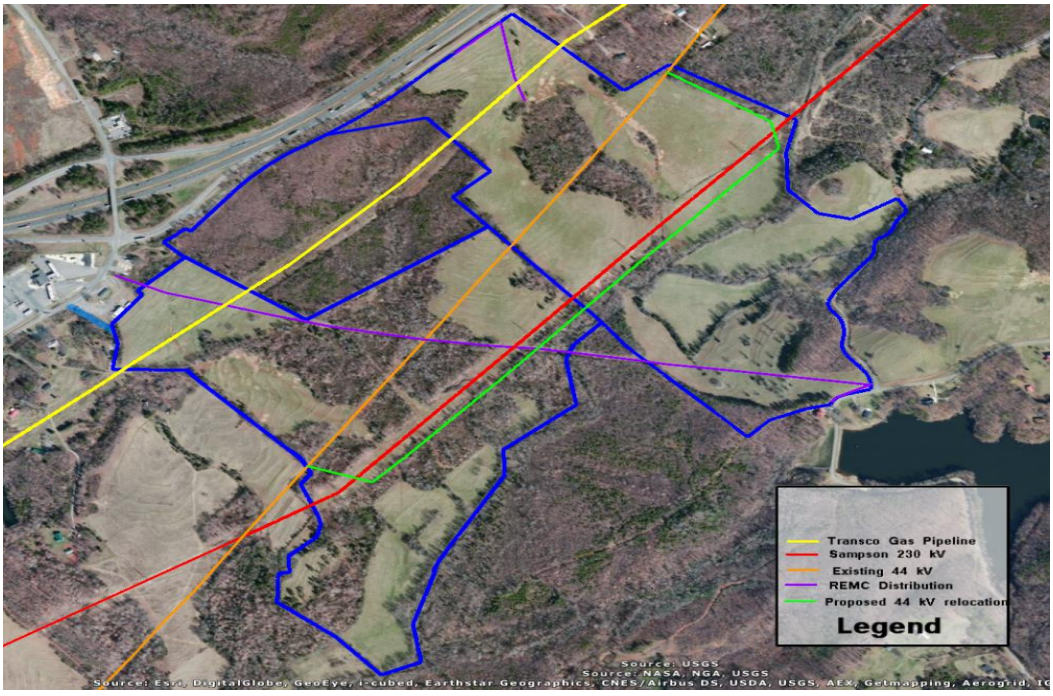
6.4 Appendix D – PICTORIALS

Return to INTRODUCTION or
Return to REQUIRED NETWORK MODIFICATION

6.4.1 Pictorial – Proposed Kings Mountain CC Plant & Interconnecting Switching Station



6.4.2 Pictorial – Proposed 44kV Kings Mountain Line Relocation



7.0 Exhibits

7.1 Exhibit A – SUBSTATION SITE DEVELOPMENT GUIDLINES

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.

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.

Return to BASELINE ASSUMPTIONS

7.2 Exhibit B – SUSTATION ACCESS ROAD GUIDELINES

Return to BASELINE ASSUMPTIONS

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.

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.
   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.

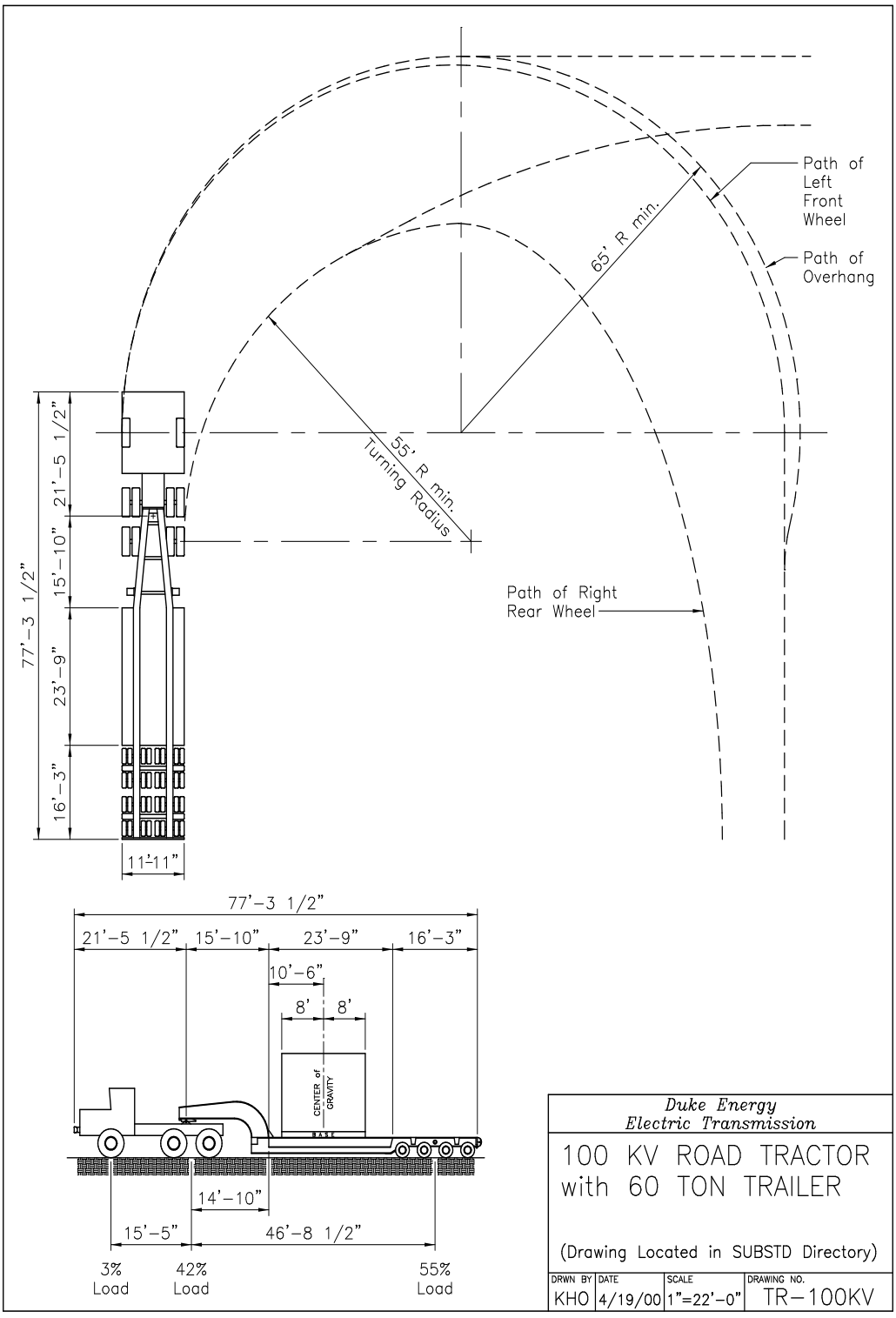


Figure 1 - Road Tractor w/ 60 Ton Trailer

Return to BASELINE ASSUMPTIONS