Facilities Study Report

For: [redacted]

Interconnection Request Jurisdiction: FERC

Queue #: 42893-01

Service Location: Lancaster County, SC

Total Output: 10 MW

Requested In-Service Date: 3/1/2019

Estimated In-Service Date: TBD

Prepared by:
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[redacted]

Date: *May 16, 2018*

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1.0 Introduction

[redacted] ("**Customer**") has proposed to install new generation in the Balancing Authority area owned and operated by Duke Energy Carolinas, LLC ("**Company**"). The Customer's requested interconnection will require the Company to design and construct a new interconnection station ("**Interconnection Station**") within a parcel located on Old Hickory Rd, Lancaster, SC. *Appendix A - Schematic 6.1.1* provides a representative schematic of the Interconnection Station. The Customer's proposed facility shall be a photovoltaic ("**PV**") array generating facility ("**Generating Facility**")capable of producing 10 MW. The Customer has requested an In-Service Date of March 1, 2019, the requested date upon which the Company's facilities would be initially energized so that commissioning may begin. The Estimated In Service Date (**Back-feed Date**) will be determined when the Final Interconnection Agreement is drafted.

This Facilities Study Report provides details on the Interconnection Facilities and the System Upgrades required to permit interconnection of the Generating Facility compliant with the Interconnection Request having Queue Number 42893-01.

At the request of the Customer, the Company performed and delivered to the Customer an Interconnection System Impact Study ("**SIS**"). The SIS, dated, December 7, 2017 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 Point of Interconnection.

The Point of Interconnection ("**POI**") between the Company and the Customer shall be the point where the Company's new Interconnection Station 44 kV Tap Line attaches to the existing Van Wyck 44 kV Retail Tap line which runs between Van Wyck Retail, Van Wyck Tie and Lancaster Main (Line Index #4V1133).

The Delivery Point ("**DP**") or Point of Change of Ownership, shall be the point where the Customer's bus line entering the Company's Interconnection Station attaches on the line termination structure.

Upon execution of the Interconnection Agreement, the payment of any upfront charges, and the delivery of a security instrument that is reasonably acceptable to the Company, 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.

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 Interconnection Station and network modifications could potentially accommodate energy flows greater than the requested 10 MW 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 specified Interconnection Facilities and System Upgrades in conjunction with a 44 kV interconnection of the Customer Facilities.

The interconnection voltage at the POI and the DP will be a nominal value of 44 kV Delta configured.

Any required outages necessary to support construction of the Company's 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 at the Customer's cost to maintain integrity of the grid. There have been no temporary work requirements identified or included in this Facilities Study.

The protection schemes installed by the Company at its Interconnection Facilities, including a direct transfer trip ("**DTT**")scheme as well as standard protection schemes, are intended to protect the Company's Network from the Customer's Facilities.

Electrical protection schemes for the Customer's generation facilities shall be the responsibility of the Customer. The Customer's protection scheme shall be coordinated with the Interconnection Station's protection schemes.

All metering will be handled under a FERC jurisdictional process.

Any required communications and control circuits between the Interconnecting Station and the Generating Facility shall be the responsibility of the Customer. The demarcation points will be mutually determined by the Customer and the Company during the detailed design phase.

The SIS had delineated network upgrades that would have provided a complete fiber communication path to communicate to all required Customer and Company facilities through the use of optical fiber composite overhead ground wire ("**OPGW**"). This Facilities Study reflects the scope and estimating for the recommended OPGW communication path.

All telemetry circuits and the associated equipment ("**Customer Communication Scheme**") that provide the Generation facility, Interconnection Station, Van Wyck Tie, and Lancaster Main operational and billing data to the Company's Energy Control Center ("**ECC**") will be the responsibility of the Customer pursuant to Section 5.6.

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 the Company being able to perform work during normal business hours with minimum overtime or weekend work.

At the time this study was performed, no other generation projects appear to have any pending upgrades which would impact the ability of the Customer to interconnect.

3.0 Required Interconnection Facilities Directly Associated with Customer's Interconnection

3.1 Cost Estimates

The following good faith estimates are provided.

Table 1

Ref	Interconnection Facilities	Estimated Cost	Monthly Interconnection Facilities Charge
A	New 44 kV Interconnection Station	$1,831,942	
B	New [redacted] Solar 44 kV Tap Line Conductor: 954kcmil ACSR	$319,102	
	TOTAL	**$2,151,044**	

3.2 Work Scope

Interconnection Station Design and Construction Work Scope

3.2.1 General Description of the Company's Interconnection Facilities

The scope of the Interconnection Facilities which are required to support this interconnection are addressed by this section of the Facilities Study.

The Customer's PV Generation Facility will connect to the 44 kV transmission system beginning at a "44 kV Tap Point" on the property with Parcel Number 711090 which will consist of a 4-Pole Bent structure in line with the Van Wyck Retail Tap line. A tap line will be constructed from the 4-Pole Bent structure utilizing (1) Concrete Pole H-Frame with 954 ACSR conductors and (1) 48 fiber OPGW and extend to the Interconnection Station catch-off structure.

The Company will develop a new 44 kV Interconnection Station on property with Parcel Number 711090, which will operate at the Customer's requested interconnection voltage. *Appendix D* provides a pictorial view of the site for the proposed Interconnection Station location.

The Interconnection Station will leverage a single circuit switcher configuration. The compliment of isolating switches will consist of single pole single throw type manual hand operated switches. Refer to *Appendix A - Schematic 6.1.1* for a representative one line schematic of the proposed 44 kV Interconnection Station.

The 44 kV yard shall have a nominal continuous current rating of 1200 A. The circuit switcher fault interrupt rating shall be 25 kA. The open air Basic Impulse Insulation Levels (BIL) shall be 250 kV.

The Interconnection Station structures shall be a lattice steel design. Structural loadings will align with the Company's standard design practice for 44 kV switchyards.

The scope of work shall include but not be limited to the following major tasks in the Interconnection Facilities (44 kV Interconnection Station):

- 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 disconnect switches shall be installed on the bus line entering the new Interconnection Station from the Customer's facility. 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(s) in the open position:

- If it is necessary for the protection of maintenance personnel when working on de-energized circuits.
- If Customer or the Company equipment presents a hazardous condition.
- If Customer or the Company equipment interferes with the operation of the Company transmission network system.
- If the 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 relay and electrical equipment to be installed at the new Interconnection Station consists of the following:

- Two SEL451-5 relays will be installed for over current and over/under voltage protection and a Direct Transfer Trip (DTT) scheme via the Company and Broadplex Fiber Networks back to RFL IMUX2000 Multiplexers and SEL351S relays at Van Wyck Tie and Lancaster Main stations
- One RFL IMUX2000 Multiplexer for communications with the DTT pilot scheme
- One SEL2506 Remote I/O Module to pass data between the SEL451 relay and Customer interface
- One SEL351S relay will be installed for switching pilot DTT schemes to the proper remote station breaker from which the new Interconnect station is connected

- One SEL351A synchrophasor relay
- 44 kV capacitor voltage transformers on all three phases on the Company side of the circuit switcher for line voltage inputs to the relays
- 44 kV current transformers on all three phases on the Company side of the circuit switcher line current inputs to the relays
- 44 kV voltage transformers and current transformers on all three phases on the Customer side of the circuit switcher for metering
- A 44 kV, 100 kVA distribution transformer on the Company side of the circuit switcher for 240/120V, single phase auxiliary power
- SEL3555, SEL2440, 2730U and SEL3610 communications equipment for SCADA.
- Install one communication interface cabinet.

3.2.3 Relay House/Enclosure

A prefabricated relay house shall be installed to serve the needs of the Interconnection Station. The projected size of this enclosure shall be approximately 12' wide x 32' long and will accommodate twenty six (26) inch standard metal relay/control panels.

A battery bank and charger shall be installed inside the relay house. The projected size of the battery bank will be 100 amp hour and 125 volts.

3.3 Schedule

Appendix B provides the cycle time which will be required to implement the design and construction of the Interconnection Station. The cycle time represents the time activities must start relative to the Estimated In-Service Date. Coordination between the Company and Customer will be required when the Interconnection Agreement is drafted to establish the Estimated In-Service Date.

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.

4.0 Required Network Upgrades

The SIS identified different System Upgrades that would permit the addition of the Customer's Generating Facility. The SIS delineated the costs of the required upgrades. Table 2 summarizes the required System Upgrades along with the associated costs.

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

4.1 Cost Estimates

The following good faith estimates are provided.

Table 2

Ref	Required Network Upgrades	Estimated Cost
A	Modify Relay and Communication Equipment @ Van Wyck Tie	$76,520
B	Modify Relay and Communication Equipment @ Lancaster Main	$42,435
C	Upgrade Van Wyck 44 kV Line and Van Wyck Retail Tap Line to allow OPGW to be installed on line structures	22,820,000
	TOTAL	**$22,938,955**

4.2 Work Scope

A. Modify Relay and Communication Equipment @ Van Wyck Tie (STA1725)

In conjunction with the installation of a new Interconnection Station and the connection to the Van Wyck Retail Tap line, the relay and communication equipment at Van Wyck Tie will need to be modified to meet system protection requirements. This will require the following activities:

- Install an new SEL351S/RFL IMUX panel in position 11R consisting of :
  - One SEL351S-6
  - One RFL IMUX2000 Multiplexer
- Telecommunications will configure the IMUX modules for the DTT pilot scheme from Van Wyck Tie to Lancaster Main.

B. Modify Relay and Communication Equipment @ Lancaster Main (STA1227)

In conjunction with the installation of a new Interconnection Station and the connection to the Van Wyck Retail Tap line, the relay and communication equipment at Lancaster Main will need to be modified to meet system protection requirements. This will require the following activities:

- Install an RFL DA-291B (front module) and an RFL MA-420A (rear module) in the existing RFL IMUX2000 multiplexer in relay panel 12R.
- Telecommunications will configure the IMUX modules for the DTT pilot scheme from Lancaster Main to [redacted] Solar.

C. Upgrade Van Wyck 44 kV Line and Van Wyck Retail Tap Line to Allow OPGW

In conjunction with the installation of a new Interconnection Station and the connection to Van Wyck Tie and Lancaster Main, the Van Wyck 44 kV transmission line and Van Wyck Retail Tap line will need to be modified to allow for OPGW to be installed on this line. This will require the following activities:

- Remove OHGW and install 48 Fiber OPGW on the Cureton 100KV Line Install approximately 3000' of 48 fiber OPGW from "Unit 5 Switch Yard" to "Unit 1 - 4 Switch Yard" at Cliffside Steam Station.

- Rebuild and add 48 Fiber OPGW to the Van Wyck 44KV Line and to the Van Wyck 44kV Retail Tap Line

4.3 Schedule

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 Estimated In-Service Date. Coordination between the Company and Customer will be required when the Interconnection Agreement is drafted to establish the Estimated In-Service Date.

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 as specified in the Interconnection Agreement.

5.0 Connection Requirements

5.1 General Requirements in IEEE 1109-1990

This Facilities Study Report 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 the Customer's Generating Facility in the Rutherford County NC area.

5.2 Compliance with NERC Reliability Standard and required inspections

Subsequent to the requirements and preparation listed in this document 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 the 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 Estimated In-Service Date not yet determined.

5.3 Duke Electric Transmission Facility Connection Requirements

All Facilities installed by Customer and connected to the Company's Network should be in accordance with the *Duke Electric Transmission Facility Connection Requirements* ("**FCR**") document dated October 1, 2017. This document shall supplement those requirements where necessary.

5.4 Protection Scheme & Communications Requirements (IEEE 1547/PRC-024)

A. Overview

The Customer Communication Scheme will utilize fiber optic circuits. The Company is not in complete control of the reliability, latency, etc. of this system and must therefore incorporate layers of protection within the logic for the associated protective relay scheme to ensure that there are no gaps of protection or unacceptable risk(s).

There are remote transmission sites related to this project that requires communication back to the [redacted] Solar PV Site. They are Van Wyck Tie (STA1725) and Lancaster Main (STA1227).

The Company owns the settings discussed below and reserves the right to modify the settings as necessary.

B. Protection Scheme – PRC-024 and IEEE 1547

The DTT scheme utilized in this application requires constant communication between the interconnected devices. The DTT scheme logic will follow PRC-024 requirements when the equipment is operating normally.

If OPGW is utilized, any complete loss of communication shall result in immediate restricted over/under voltage/frequency settings to follow previously established IEEE-1547 recommended set-points that enhance the detection of islanding conditions within the Company-owned protective relay.

The design of the customer's site (transformer type, central processor programming requirements for PRC-024, etc.) shall not adversely impact the UL certification associated with the anti-islanding functions of the inverter(s). There may be temporary conditions defined by the Company (such as relay failure) where the inverter(s) is required to be transitioned from PRC-024 back to IEEE-1547 either automatically or manually within a specified time frame in order to maintain connection to the grid during the temporary condition (maximum time allowed to be determined by the Company)

C. Full loss of Communication

If 3rd party fiber is utilized, a full loss of communication between the Interconnection Station, Van Wyck Tie or Lancaster Main (other basis/reasons may also be applicable) will result in disconnecting the Customer Generating Facility from the grid until such time that communication returns to normal.

D. Latency

Unacceptable latency within the Customer Communication Scheme shall result in tripping the generation site.

Portions of the Company's logic are time dependent. The communication path and its effect on these time dependent elements are fixed and constant for all Company applications. The Customer line could have portions of the communication that could be re-routed in the future which may introduce a delay for one mirrored bit channel and no delay for the other mirrored bit channel. If this increased latency (time) was excessive, it could disable that portion of the protective logic.

The Company will monitor the latency of each connection and alarm and/or trip when it goes outside a specified acceptable time range. This will ensure that future switching does not surface on this fiber path and negatively impact the trip logic.

The latency check for the communication paths shall occur on a daily basis to validate that the response time from either grid connection is not delayed more than 6 cycles (12 cycles round trip) than that of the other grid connection.

The Company shall monitor the SEL provided elements RBADA and RBADB (could vary from 1 second up to 60 seconds pending continuing design). The trigger for these elements is derived by internal SEL firmware logic.

E. Quality of Communication

The PV site logic also has monitoring capabilities in the automation logic that will collect data regarding the quality of the communication channel.

This logic will record:

1) the total number of times that each communication channel was determined to be absent within a specified period of time.
2) the total number of times that the communication channel was absent for greater than 60 seconds.
3) the cumulative time (minus testing time) of communication loss for each channel since the last reset.

This information will have a threshold that will trigger alarms and potentially issue a trip depending upon severity.

F. Outage Restoration

Assignment of ownership (Company, or Customer) for individual communication outages aligns with the responsibility for equipment specified in Section 5.6.

G. Required Supporting Information

- The Customer shall provide a map of the fiber routing to the Company's Protection & Controls group for review once it has been determined.

5.5 Relay Settings

All relay settings for the circuit switcher at the Interconnecting Station will be the responsibility of the Company. For those breakers or circuit switchers 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.

5.6 Communication Scheme

The Customer Communication Scheme currently proposed by the Customer is currently being developed. The Customer Communication Scheme shall be reviewed by the Customer and Company and must be approved by the Company.

The roles and responsibilities for the assignment of ownership (Company or Customer) of the Customer Communication Scheme and for individual communication outages or latency violations are itemized in the scenario below:

Scenario: [redacted] Solar site to ECC, Van Wyck Tie to ECC and Lancaster Main to ECC

The responsibility for all telemetry circuits that provide the Generating Facility's operational and billing data to the Company's ECC will be divided at the demarcation

points, which will be mutually determined by the Customer and the Company during the detailed design phase. The Customer shall have responsibility for all network fiber and equipment between the demarcation points at each site. The Company shall have procurement, installation, and maintenance responsibly for all circuits and equipment from the demarcation point to the Company's relaying equipment, except the Customer shall bear the cost.

The Company shall be responsible for the leased T1 circuit used for the Company's SCADA, except the Customer shall bear the cost.

Return to 2.0 Baseline Assumptions

5.7 Operating Requirements

The Customer shall be required to comply with voltage range, a voltage schedule, reactive power output schedule or to comply with instructions from the Company's system operator. If the Customer fails to comply with such schedule(s) or instructions, the Company shall have the right to discontinue service and suspend purchases until the Customer is in compliance.

5.8 Plant Level Controller

A plant level controller with the capability of limiting the total MVA output at the POI may be required. Customer to confirm Company requirements during the design phase of this project. If required, documentation, in the form of an operation guide, letter from inverter manufacturer, etc., must specifically state that the desired control mode is achievable.

5.9 Short Circuit Withstand Capability

The Company assumes no responsibility for appropriately sizing the short circuit withstand capability of any equipment installed on the Customer's Side of the POI. 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 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.

5.10 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 Agreement and the *Duke Electric Transmission Facility Connection Requirements*. Specific parameters shall include but are not limited to available transformer taps and short circuit withstand capabilities.

5.11 Insulation Requirements

The Company's standard requirements for equipment installed on the 44 kV systems shall meet the following minimum (BIL).

	44 kV BIL
Open Air	250
Transformer Winding	250

5.12 Metering

The Company will furnish, install, own, and maintain a four-quadrant, six channel revenue meter at the delivery point.

The revenue meter will have an available RJ45 output connection. The Company will make real time meter data available to the Customer at the meter data point, which will be located in an interface box provided and installed by the Customer adjacent to the Company's Interconnection Station fence. The Company will be responsible for installing the communication link between the meter and the interface box. The Customer will be responsible for procuring and implementing the data collection system and installing the communication link between the interface box and the data collection system.

The Company will make reasonable efforts to ensure data availability, but shall not be liable for failure to supply data due to any failure or malfunction of either the Company's equipment or the Customer's equipment. The Customer shall be responsible for troubleshooting any future technical issues past the RJ45 data point (demarcation point).

If at any time the Company reasonably determines that the data services provided are detrimental to the Company's metering or other practices, the Company shall have the right to discontinue the service upon written notice to the Customer.

5.13 Power Quality Monitoring

Inverter-based generation resources will require power quality monitoring instrumentation installed by Duke Energy Carolinas to provide monitoring of harmonics and other power quality issues. The power quality metering will include communications infrastructure for remote data acquisition.

5.14 Phasor Measurement Unit (PMU)

A phasor measurement unit ("**PMU**") or synchrophasor is a device which measures the electrical waves on an electricity grid, using a common time source for synchronization. Time synchronization allows synchronized real-time measurements of multiple remote measurement points on the grid. In power engineering, these are also commonly referred to as synchrophasors and are considered one of the most important measuring devices in the future of power systems.

The Company's standard requirements for PMU equipment for generators connected to the 44 kV system shall meet the following:

Two SEL351A relays will be installed, one on each side of the Customer's Generation Step Up transformer. The Company will provide the PMU and GPS clock on the high side of

the Generation Step Up transformer. The Customer will provide the PMU and GPS clock on the low side of the Generation Step Up transformer. Each SEL351A will work in conjunction with a GPS clock. The synchrophasor device will be capable of providing 30 samples/second to the Duke Energy Phasor Data Concentrator (PDC) system of the following parameters:

- Phase (A,B,C) voltage magnitude and angle.
- Phase (A,B,C) current magnitude and angle.
- Frequency.
- Change in frequency/change in time (df/dt).
- Positive sequence voltage magnitude and angle.
- Positive sequence current magnitude and angle.

5.15 Ride-Through Trip Settings

The Customer's inverters must be set up using extended ride-through voltage and frequency trip settings for desired operation during faults.

5.16 Substation Lot and Substation Access Road

The construction of facilities and system upgrades cited 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 and a substation access road outside of the transmission right of way to the Company as outlined in the "Design Requirements for Transmission Interconnection Facilities" document- *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 130' x 130'. *Refer to Appendix D for an overview depicting the proposed Interconnection Station location- the exact pad location has yet to be determined.*

5.17 44 kV Tap Line and Tap Line Access Road

The construction of facilities and system upgrades cited 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 an approved graded route for a 44 kV tap line from the existing Company transmission line to the substation site and an access road to the 44-kV line structures outside of the transmission right of way to the Company as outlined in the "Design Requirements for Transmission Interconnection Facilities"- *Exhibit A.*
- The site development of the proposed tap line route shall include clearing of trees, maintaining required buffers, grading, storm water development, etc.

5.18 Right of Way

The Customer shall enable the Company to acquire a 68-foot right-of way plus danger tree rights along the entire route of the proposed 44 kV tap line.

5.19 Commissioning

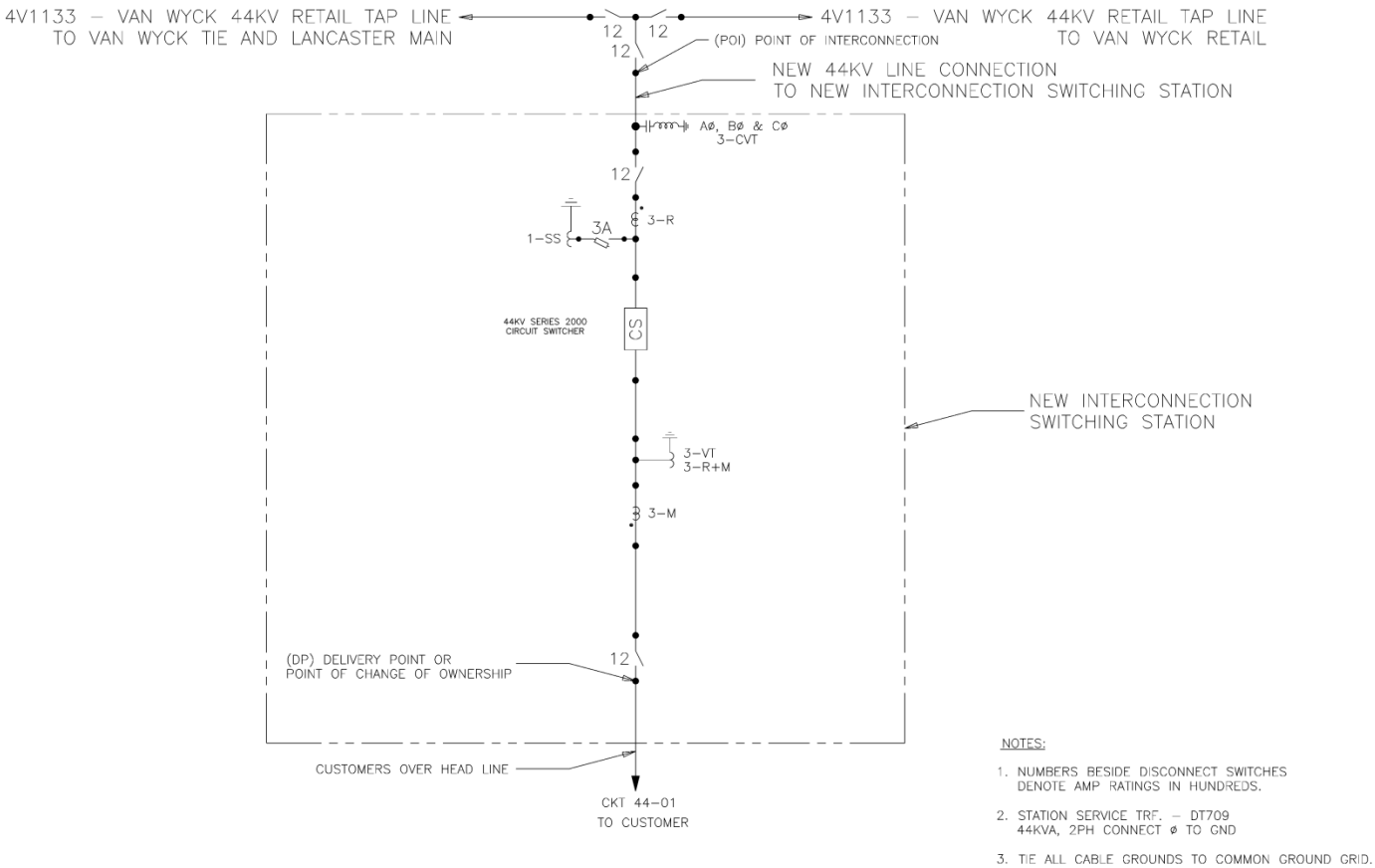
The Company maintains all rights for the commission testing of any substation facility that it owns. The Company reserves the right to inspect and witness commission testing of any switchyard, transmission line, or other facility constructed on behalf of the Customer for the purpose of interconnecting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

6.0 Appendices

6.1 Appendix A – SCHEMATICS & ONE LINES

Return to 1.0 Introduction or
Return to 3.2.1 General Description of the Company's Interconnection Facilities

6.1.1 Proposed Schematic for a new 44 kV Interconnection Station



6.2 Appendix B – INTERCONNECTION FACILITIES MILESTONES SCHEDULE

Return to 1.0 Introduction or
Return to 3.2.1 General Description of the Company's Interconnection Facilities
Return to 3.3 Schedule

Ref	Interconnection Facilities	Time Prior to the Estimated In Service Date for Start of Activity
A	New 44 kV Interconnection Switching Station	2 Years
B	New [redacted] Solar 44 kV Tap Line Conductor: 954kcmil ACSR	1 Year

6.3 Appendix C – NETWORK UPGRADES MILESTONES SCHEDULE

Return to 1.0 Introduction or
Return to 4.0 Required Network Upgrades or
Return to 4.3 Schedule

Network Upgrades Schedule Requirements

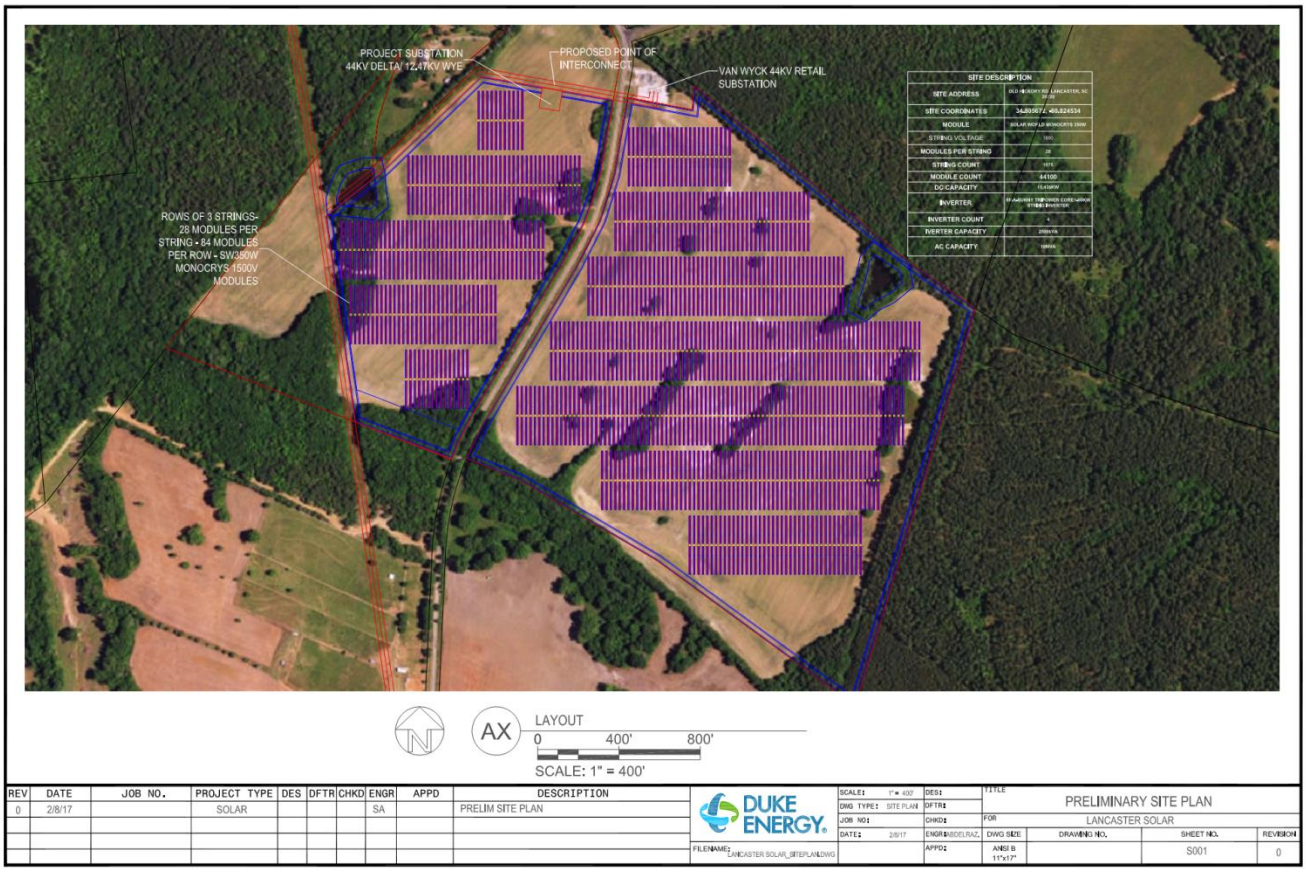
Ref	Required Network Upgrades	Time Prior to Estimated In Service Date for Start of Activity
A	Modify Relay and Communication Equipment @ Van Wyck Tie	1 Year
B	Modify Relay and Communication Equipment @ Lancaster Main	1 Year
C	Upgrade Van Wyck 44 kV Line and Van Wyck Retail Tap Line to allow OPGW to be installed on line structures	3 Years

6.4 Appendix D – PICTORIALS

6.4.1 Pictorial - Proposed Interconnection Switching Station Location

At the time of this report, the most recent site plan file was named Lancaster_Site Plan_2.8.17.pdf

Return to 1.0 Introduction
Return to 3.2.1 General Description of the Company's Interconnection Facilities
Return to 5.16 Substation Lot and Substation Access Road



7.0 Exhibits

7.1 Exhibit A – Design Requirements for Transmission Interconnection Facilities (Duke Energy Carolinas – revised 6/30/2016)

(27 pages below)

Return to 5.16 Substation Lot and Substation Access Road

Design Requirements for Transmission Interconnection Facilities

Duke Energy Carolinas

Revised 6/30/2016

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SECTION 1: INTERCONNECTION SUBSTATION LAYOUT GUIDELINES

INTERCONNECTION SUBSTATION LAYOUT GUIDELINES

Tapping the Utility's Transmission Line

1) The Customer is required to provide a clear Point of Interconnect (POI) in their Interconnection Request Application Form and on their site plan. The Customer must provide relevant pole or tower numbers. The Utility prefers interconnection at mid-span, but will accept interconnection at an existing tower location (provided however that the tower or pole may have to be replaced).
2) The Customer shall site a right-of-way easement for the Utility's new transmission line from the POI to the Utility's substation pad. See 'Duke Energy Electric Transmission Right-of-Way Guidelines and Restrictions' for requirements.
3) The Customer shall adhere to the grading restrictions presented in Section 3 of 'Duke Energy Electric Transmission Right-of-Way Guidelines and Restrictions'.

Utility Substation

4) Required Utility substation pad dimensions are shown in Figures 1-4 in the 'Interconnection Substation Standard Reference Drawings' document
5) Lines must enter from the Utility's transmission system and exit to the Customer's substation on opposite sides of the Utility's substation. No 90 degree turns within the Utility's substation are permitted. Reference Figures 2a-2d in 'Interconnection Substation Standard Reference Drawings' for acceptable line configurations.
6) The Customer's substation can be adjacent to the Utility substation, but there must be a fence separating the two. There can be no shared access.
7) The Customer's ground grid can be shared with the Utility's ground grid.
8) Closest distance the Utility's substation can be to the transmission line Right-of-Way is shown in Figures 2a-2d in 'Interconnection Substation Standard Reference Drawings'

Access Road to the Utility's Substation

1) The Utility will allow a shared access road to the customer's substation and to the Utility's substation, but will require separate entrances into each substation. The access road for the Utility's substation cannot pass through the Customer's substation or vice versa.

2) The Customer's site plan must show the ability to access transmission line structures on the Customer's site. A permanent access road isn't required, but a clear means of access must be shown on the site plan and approved by the Utility.
3) The on-site access roads can cross the Utility's transmission line, pursuant to the limitations and requirements in Section 7.b of the 'Duke Energy Electric Transmission Right-of-Way Guidelines and Restrictions'
4) Access Road to Substation from the public access road should avoid any 180 degree turns or sharp 90 degree

General Notes

1) Conceptual site plan providing general layout for substation, access road and drainage plan should be submitted for Substation Engineering review prior to detail design execution.
2) It is recommended to get Substation Engineering input prior to requesting Geotechnical services. A copy of Geotechnical report (PE Stamped in applicable states) should be provided to Substation Engineering.

SECTION 2: INTERCONNECTION SUBSTATION STANDARD REFERENCE DRAWINGS

INTERCONNECTION SUBSTATION STANDARD REFERENCE DRAWINGS

Figure 1:

Figure 1 illustrates the required overall view of the substation outline. The outlines (Figures 1A - 1E) on the left side of the page indicate the overall 145X145 cleared site (no vegetation), the actual station pad 130X130, and finally the station fence, which is 125X125. Also present is the station steel within the fence and the relay control house measurements.

Figure 2:

Figure 2 shows 100kV (Figures 2A & 2C) and 44 kV (Figures 2B & 2D) scenarios. The difference being the requirement of a GOAB pole for 100kV. With or without the presence of a GOAB, the distance from center of the transmission line to the catch-off point is 150' minimum but only 106' from the transmission line to the station fence (subtracting the 44' from the catch-off steel within the station to the fence). If a GOAB is present then it sits in the center of this 150' with 75' minimum on either side.

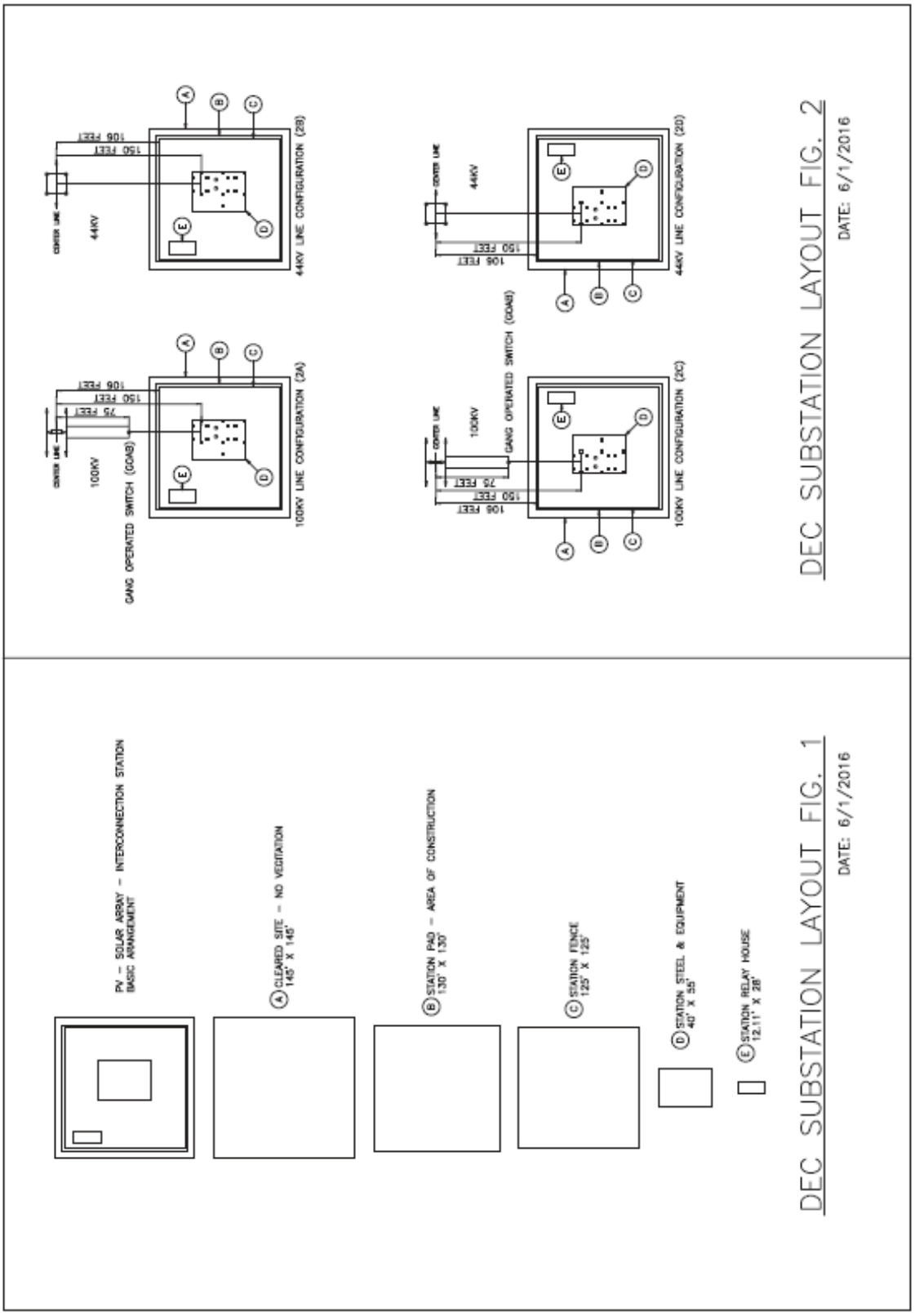
Figures 3 & 4:

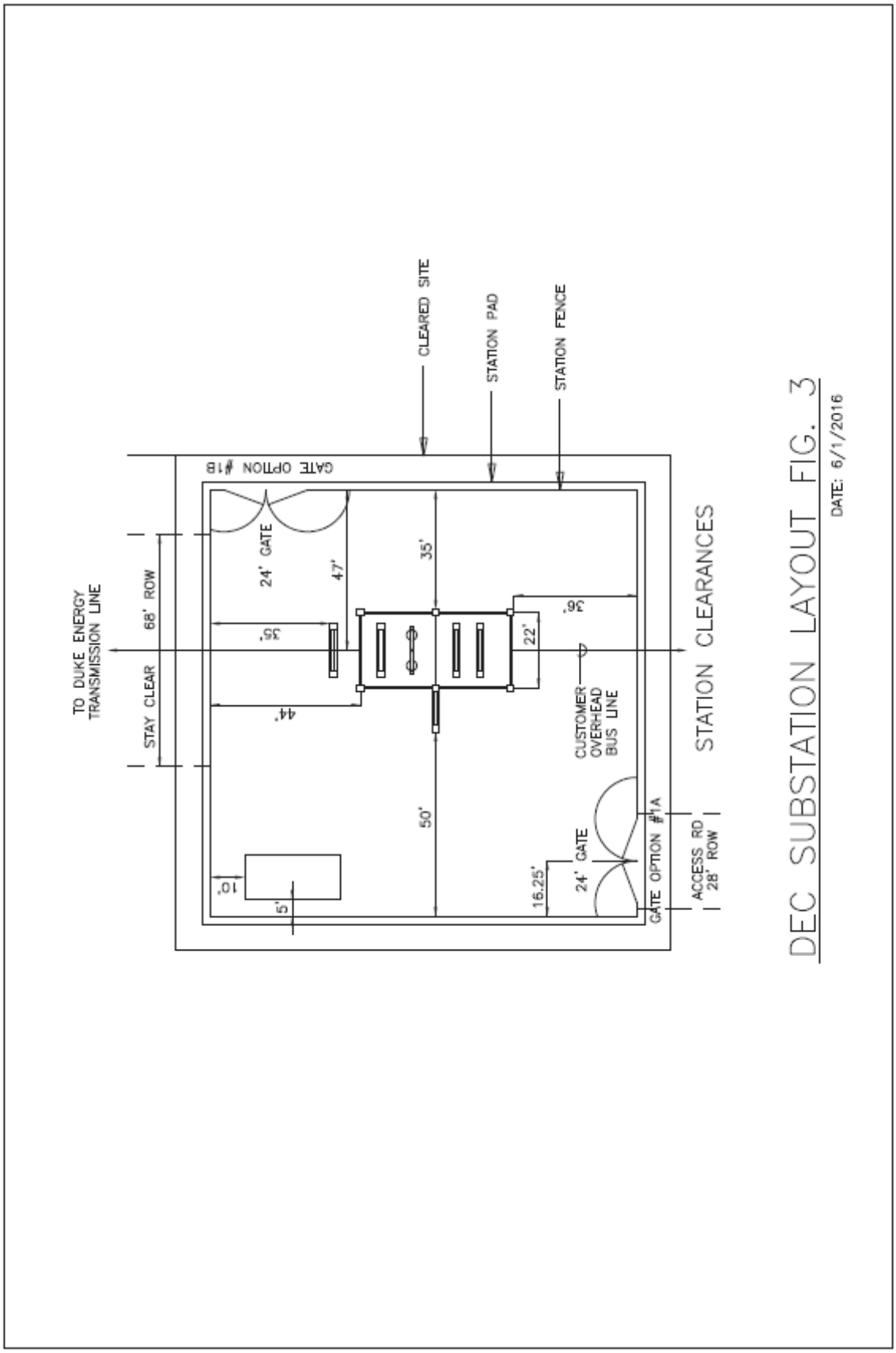
Figures 3 and 4 illustrate the station configuration so that the customer can pinpoint where the line will come off to meet their steel. The difference in Figures 3 and 4 is the location of the control house and, subsequently, the gate entrances. There are two different gate entrances the customer can choose from. These entrances are based on the delivery and potential maintenance/replacement of the control house. Gate entrances will always need at least a 4' gap between the corner of the fence and the gate post.

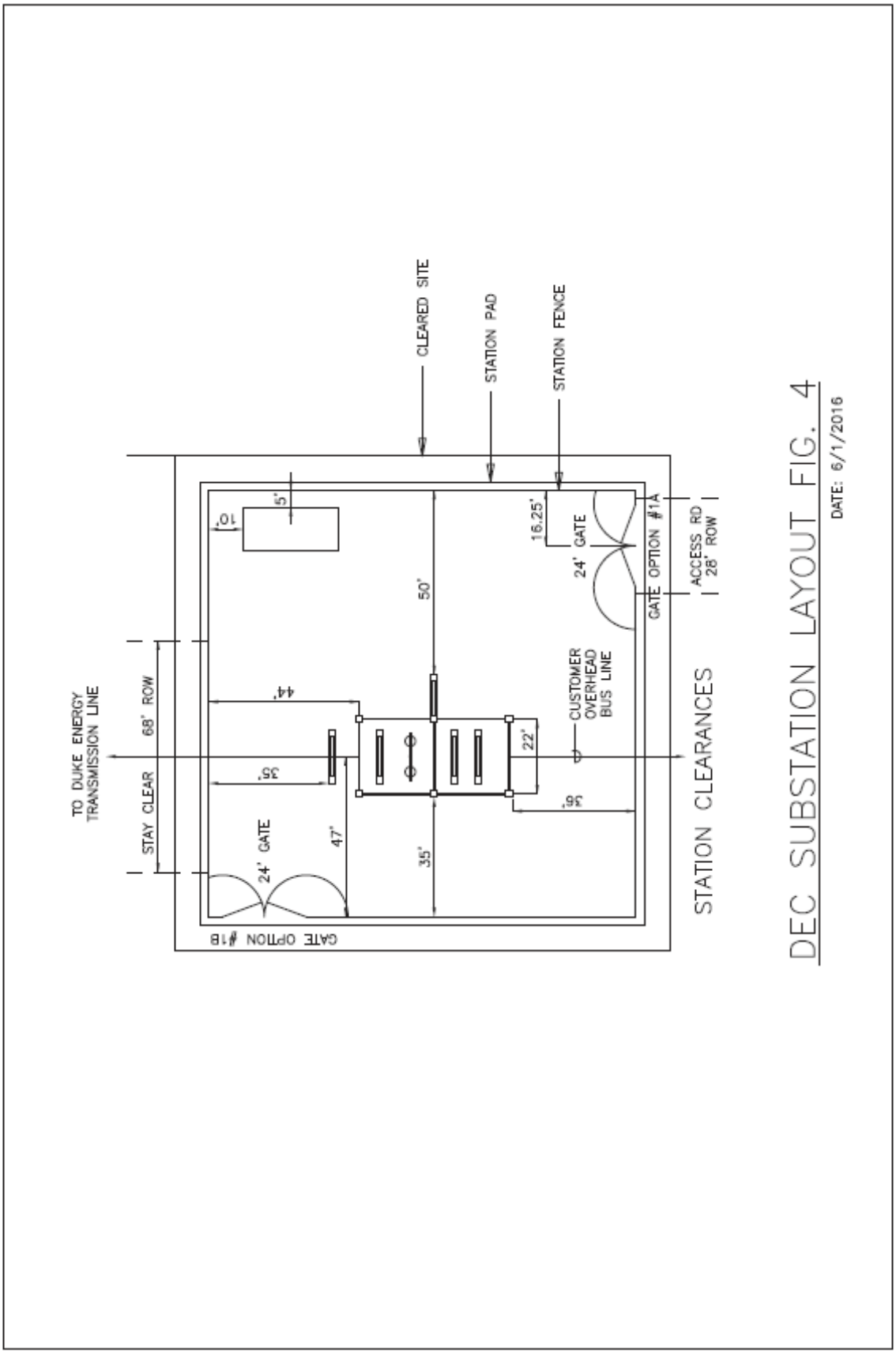
For substations containing a control house, all chain link fence installation and structure erection should be coordinated with Control House installation. In general due to space constraints, the control house is set first prior to erecting access road, side fence, and other foundations/structures installation

***Gate entrances cannot be shared between the two stations.

***Transmission's line entering station needs 68' ROW total or 34' either side of center line.


DEC SUBSTATION LAYOUT FIG. 1
DATE: 6/1/2016
PV – SOLAR ARRAY – INTERCONNECTION STATION BASIC ARRANGEMENT
A CLEARED SITE – NO VEGITATION 145' X 145'
B STATION PAD – AREA OF CONSTRUCTION 130' X 130'
C STATION FENCE 125' X 125'
D STATION STEEL & EQUIPMENT 40' X 55'
E STATION RELAY HOUSE 12.11' X 28'
DEC SUBSTATION LAYOUT FIG. 2
DATE: 6/1/2016
44KV LINE CONFIGURATION (2B)
100KV LINE CONFIGURATION (2A)
GANG OPERATED SWITCH (GOAB)
44KV LINE CONFIGURATION (2D)
100KV LINE CONFIGURATION (2C)
CENTER LINE
44KV
100KV
75 FEET
150 FEET
106 FEET


DEC SUBSTATION LAYOUT FIG. 3
DATE: 6/1/2016
STATION CLEARANCES
CLEARED SITE
STATION PAD
STATION FENCE
GATE OPTION #1B
24' GATE
47'
35'
50'
68' ROW
STAY CLEAR
TO DUKE ENERGY TRANSMISSION LINE
55'
44'
22'
96'
CUSTOMER OVERHEAD BUS LINE
GATE OPTION #1A
24' GATE
16.25'
ACCESS RD 28' ROW
10'
5'


DEC SUBSTATION LAYOUT FIG. 4
DATE: 6/1/2016
STATION CLEARANCES
CLEARED SITE
STATION PAD
STATION FENCE
ACCESS RD
28' ROW
GATE OPTION #1A
GATE OPTION #1B
24' GATE
16.25'
50'
5'
10'
CUSTOMER
OVERHEAD
BUS LINE
22'
44'
35'
47'
TO DUKE ENERGY
TRANSMISSION LINE
68' ROW
STAY CLEAR

SECTION 3: CUSTOMER SP – GENERAL SUBSTATION REQUIREMENTS

Customer Substation Guidelines

Duke Energy Substations

Revised 2/4/14

To ensure safe and reliable electric service, a list of **Substation Guidelines** for Transmission-served Customers is outlined below. This list does not intend to cover all possible situations. Seek additional guidance if anything planned is not specifically addressed.

I. SUBSTATION LOT:

1. The Customer shall provide a graded substation lot to Duke Energy as outlined in the "Duke Energy Substation Site Development Guidelines".
2. The substation lot size shall be determined by the transmission voltage that will serve the substation and the number of circuit exits required by the Customer. The lot size shall be provided to the Customer by Duke Energy. Consideration will be given to the present and prospective electric power load of the Customer.
3. Duke Energy will obtain a perpetual lease of the substation lot from the Customer.
4. Duke Energy will make the final determination of the suitability of the substation lot.
5. During the life of the lease, no construction or maintenance may be performed above or below the ground surface by the Customer within the defined leased lot.

II. ACCESS DRIVE:

1. The Customer shall provide and maintain an all-weather access drive to the substation lot as outlined in the "Duke Energy Substation Access Road Guidelines".
2. The access drive shall be designed and constructed in accordance with the "Duke Energy Substation Access Road Guidelines" prior to delivery of the Substation transformers. Delivery dates shall be coordinated between the Customer and Duke Energy.
3. A temporary all-weather access drive shall be provided at all times during substation construction. Temporary access should be a minimum 18' wide, have an all-weather surface, and be accessible without restriction from other onsite construction activities.

III. CUSTOMER SECURITY FENCING:

1. The Customer shall not attach fencing, guardrails, chains, metallic objects, or any other objects to the substation fencing without specific approval of Duke Energy Substation Engineering.
2. Customer fencing, guardrails, chains, and metallic objects shall be clearly designated on site plans provided to Duke Energy with full descriptions of heights, materials, and components. Duke Energy reserves the right to require isolated fence sections and/ or common grounds to ensure safety of the public. Duke Energy reserves all rights to the final determination of the suitability of the grounding of all metallic components.
3. Any security fence sections that block the access drive will have a minimum gate width of 24 feet, installed to Duke Energy's minimum guide lines.
4. Security fences shall be located no closer than 80 feet to the edge of the public road to allow the truck operator of heavy haul truck and trailer to park and unlock the security gate without the end of the trailer protruding into the public road.
5. Duke Energy employees must have 24/7/365 access to the property; appropriate accommodations must be made for securing the gate with Duke Energy issued lock.

IV. DELIVERY POINT:

1. For overhead service from a substation that has a designated load of 6,000 amperes or less:
   a. Duke Energy will install the following
      - A delivery structure outside the substation fence, as close to the fence as feasible;
      - One disconnect switch per phase on the delivery structure;
      - The necessary overhead service conductors from the substation bus to the line side of the three disconnect switches;
   b. The Customer will furnish and install all connectors and connecting cables to make connections to the load side pads (NEMA Standards) of Duke Energy disconnect switches.
2. For overhead service from a substation that has a designated load exceeding 6,000 amperes:
   a. Duke Energy will install a rigid bus to the substation fence. The end may extend as much as two (2) feet beyond the substation fence line as mutually agreed to between Duke Energy and the Customer;
   b. The Customer will furnish and install all connectors and connecting cables to make connections to the ends of Duke Energy's rigid bus.
3. For underground service from a substation:
   a. Duke Energy will install underground conductor and conduit to a designated delivery point outside the substation, as close to the fence as feasible.
   b. The Customer will coordinate the design, location, and installation of all underground service from the delivery point with Duke Energy Transmission and Distribution Engineering.

V. CONTAMINATION LIMITATIONS:

1. The substation lot and transmission line right-of-way shall be located in an area that is free from contamination of insulators by smokestacks, water cooling towers, plant exhausts, dust, etc.
2. When a substation must be located in an area where the problem or industrial contamination exists, the following procedure shall be adhered to:

a. When it becomes necessary to clean insulators either in a substation or on a transmission line to lessen the possibility of an electrical flashover and service interruptions due to contamination from the Customer's processes, the Customer is responsible for the cost incurred by Duke Energy to clean the insulators.

b. In the event that the Customer is unable or is unwilling to take a scheduled service interruption for cleaning contaminated insulators, Duke Energy will contact recognized cleaning service companies and jointly, with the selected cleaning service, determine the feasibility of performing the cleaning operation with the substation energized. If it is deemed feasible, the Customer will pay the cleaning costs and relieve Duke Energy, from any liabilities if a service interruption occurs as a result of performing the insulator cleaning operation.

Return to 5.15 Substation Lot and Substation Access Road

SECTION 4: CUSTOMER SP – SITE DEVELOPMENT GUIDLINES

Substation Site Development Guidelines

Guidelines for Site Development of Duke Energy Substations

Revised 2/3/14

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 minimum depth of 36" below grade of the substation pad.
3. Sedimentation control, including re-vegetation and permitting, will be covered and required as per Federal, State, or Local regulations. Customer will be responsible for obtaining and abiding by all required permits for Site preparation activities.
4. Refer to "Duke Energy Substation Access Road Guidelines" for all access road requirements.

II. **GRADING:**

1. Where feasible, the lot shall be crowned at the center of the pad. The pad should be graded outward from the crown 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, nut grass, 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 +/- 3% 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 leased lot area grade excavations shall be undercut to a minimum of 36" and replaced with suitable fill materials compacted per Section II.3.c. 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, or Local 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, with the exception of the substation fenced area. 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 5.15 Substation Lot and Substation Access Road

SECTION 5: CUSTOMER SP – SUBSTATION ACCESS ROAD GUIDLINES

Substation Access Road Guidelines

Guidelines for Access Drives of Duke Energy Substations

Revised 1/31/14

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 / disturbance 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 final grade.
2. Access road connection to the public roadway will be at a right angle and without obstruction for a minimum of 80', where possible. For access roads connections to the public roadway that cannot meet this requirement, 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 centerline and no closer than 25 feet to any Duke Energy pole, structure, or tower leg.
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 / Asset Protection) 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.

9. Grading of the access road shall be at least 25' from any Duke Energy pole, structure, or tower leg.
10. No vehicles or equipment may be parked within the road limits.
11. 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.
12. 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.
13. 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:

1. Access drive entrance - 28' (minimum) – where access road meets the public road edge
2. 50' from public road - 20'(minimum)
3. 80' from public road at entrance gate – 18' (minimum)
4. Curved sections after entrance gate – 20' (minimum) – maintain minimum 55' inside turning radius and 65' outside turning radius

III. **GEOMETRY:**

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

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 ASTMD698. 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 ASTMD1557. Thin layers of fine material shall not be added to the top layer in order to meet grade.
4. Access with grade equal to or 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 Customer's Facility.
   d. A paved apron shall be installed upon project completion and provided from the edge of the public road to the edge of the public right of way and shall consist of either:
   e. 8"type "ABC" crusher run gravel surfaced with 2-1/2" minimum, Type S 9.5A –90% (NCDOT / SCDOT Standard), installed in 1" to 2" lifts.
      - 8" type "ABC" crusher run gravel surfaced with 6" 4,000 psi concrete reinforced with 6x6x10/10welded wire mesh
5. Access with grade 8% or greater shall be paved with heavy duty asphalt or concrete
   a. The stone base course will consist of an 8" layer of Type "ABC" Crusher Run compacted to a maximum density of 95%.
   b. Asphalt:
      - 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.
      - 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.
      - 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.
      - Asphalt Pavement should be installed upon project completion.
   c. Concrete:
      - 6" thick 4,000 psi concrete.
      - Reinforcement shall be minimum6x6x10/10welded wire mesh located in the bottom one third of the pour.
      - Concrete shall cure a minimum of 3 days during typical weather conditions prior being placed into service. For abnormal weather conditions, Duke Energy Transmission Engineering shall be contacted.
      - Concrete shall be placed upon project completion.
   d. Density tests should be completed & filed for evaluation and acceptance of Duke Energy.

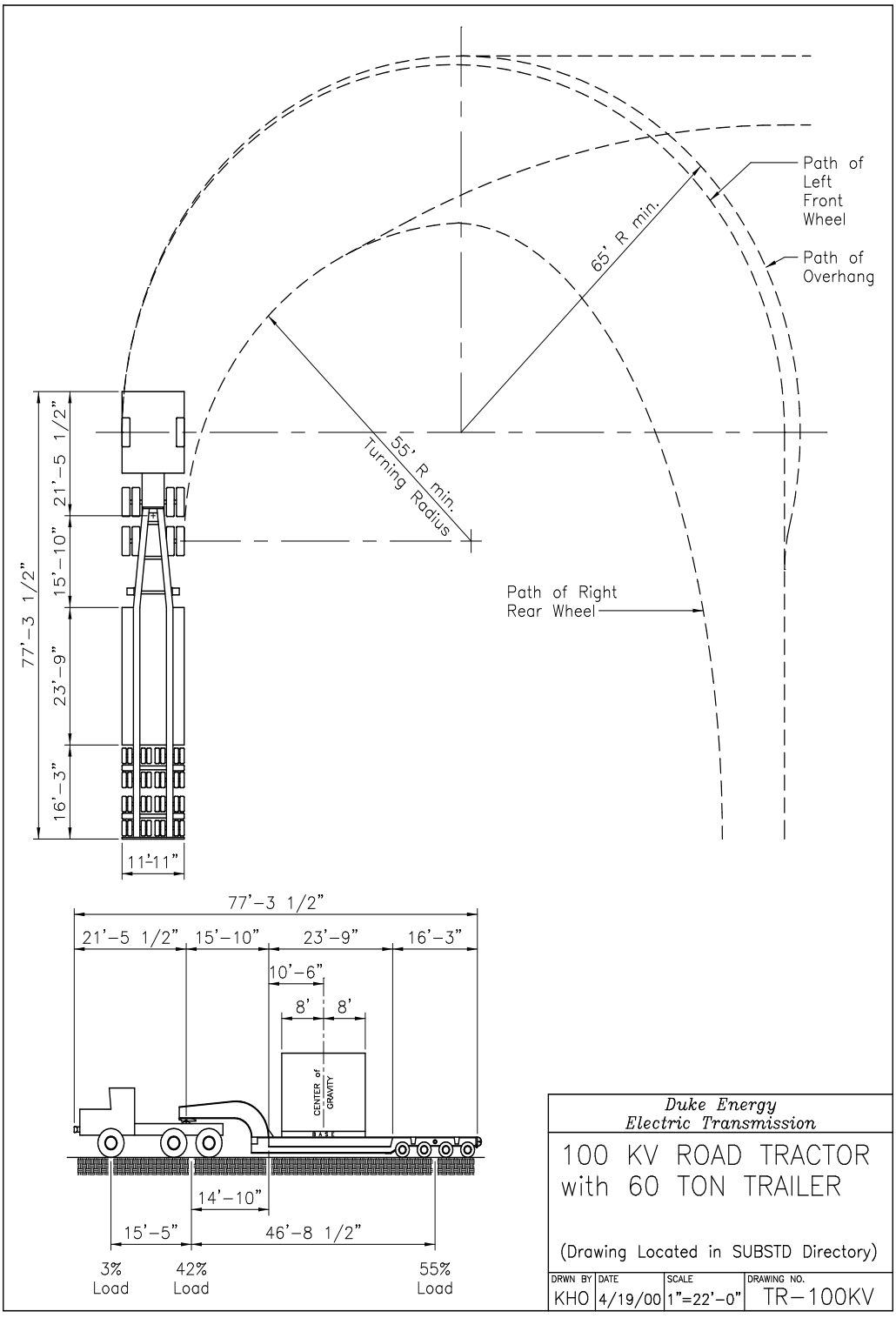


Figure 1 - Road Tractor w/ 60 Ton Trailer

Return to 5.15 Substation Lot and Substation Access Road

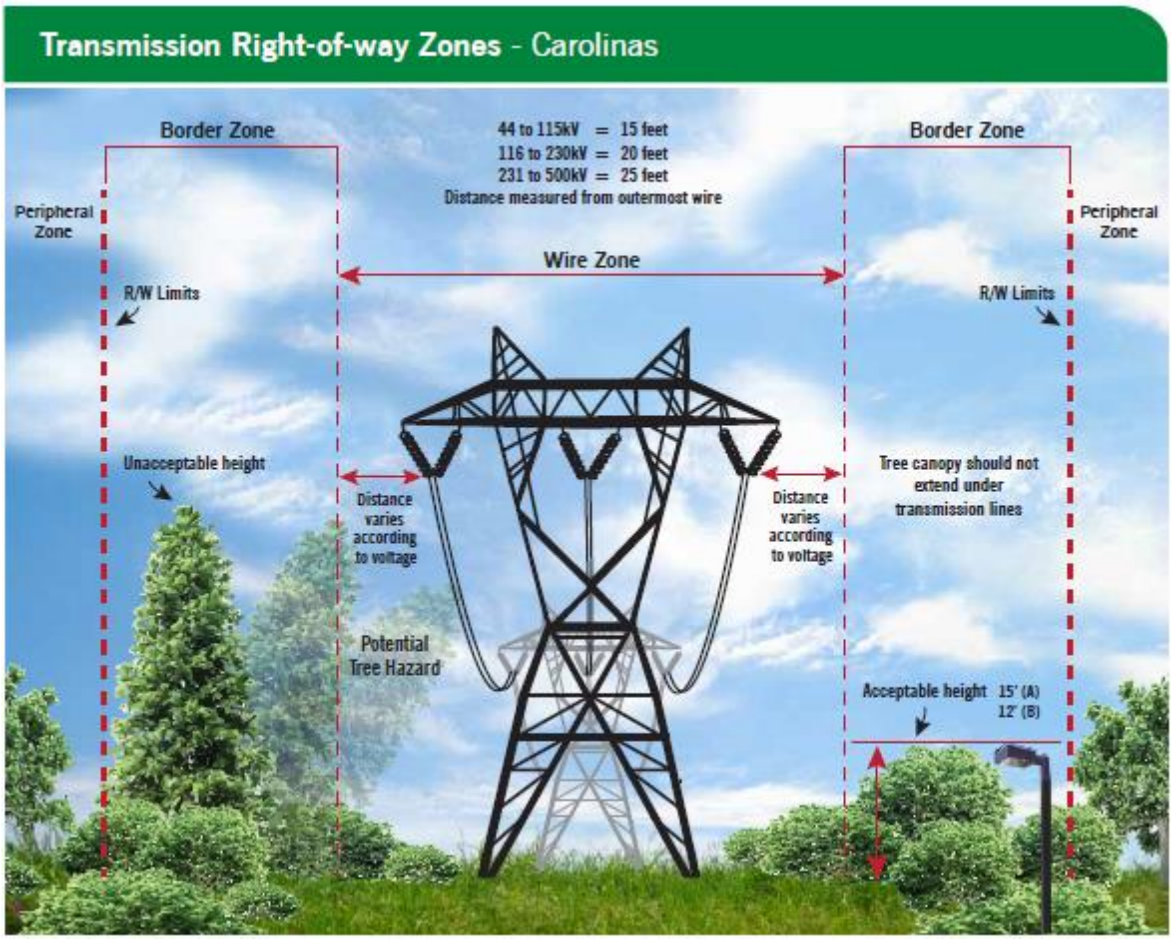
SECTION 6: DUKE ENERGY ELECTRIC TRANSMISSION RIGHT-OF-WAY GUIDELINES AND RESTRICTIONS

DUKE ENERGY ELECTRIC TRANSMISSION RIGHT-OF-WAY GUIDELINES/RESTRICTIONS VALID FOR NORTH CAROLINA AND SOUTH CAROLINA (Revised 11/20/2014)

This list of right-of-way restrictions has been developed to answer the most frequently asked questions about property owner use of Duke Energy's electric transmission rights of way. This list does not cover all restrictions or all possible situations. You should contact the Asset Protection right-of-way specialist if you have additional concerns about the rights of way. This list of restrictions is subject to change at any time and without notice. Duke Energy reserves all rights conveyed to it by the right-of-way agreement applicable to the subject property. All activity within the rights of way shall be reviewed by an Asset Protection right-of-way specialist to obtain prior written approval. Engineering plans may be required. Compliance with the Duke Energy Right-of-Way Guidelines/Restrictions or approval of any plans by Duke Energy does not mean that the requirements of any local, county, state or federal government or other applicable agency with governing authority have been satisfied.

1. **Structures, buildings, manufactured/mobile homes, satellite systems, swimming pools (any associated equipment and decking), graves, billboards, dumpsters, signs, wells, deer stands, retaining walls, septic systems or tanks (whether above or below ground), debris of any type, flammable material, building material, wrecked or disabled vehicles and all other objects (whether above or below ground) which in Duke Energy's opinion interfere with the electric transmission right of way are not allowed within the right-of-way limits. Transformers, telephone/cable pedestals (and associated equipment) and fire hydrants are not allowed. Manholes, water valves, water meters, backflow preventers and irrigation heads are not permitted.**
   Attachments to Duke Energy structures are prohibited.
2. **Fences and gates shall not exceed 10 feet in height and shall be installed greater than 25 feet from poles, towers and guy anchors. Fences shall not parallel the centerline within the rights of way but may cross from one side to the other at any angle not less than 30 degrees with the centerline. If a fence crosses the right of way, a gate (16 feet wide at each crossing) shall be installed by the property owner, per Duke Energy's specifications. The property owner is required to install a Duke Energy lock on the gate to ensure access. Duke Energy will supply a lock.**
3. **Grading (cuts or fill) shall be no closer than 25 feet from poles, towers, guys and anchors (except for parking areas; see paragraph 7) and the slope shall not exceed 4:1. Grading or filling near Duke Energy facilities which will prevent free equipment access or create ground-to-conductor clearance violations will not be permitted. Storage or stockpiling of dirt or any other material is prohibited. Sedimentation control, including re-vegetation, is required per state regulations.**
4. **Streets, roads, driveways, sewer/water lines, other utility lines or any underground facilities shall not parallel the centerline within the right of way but may cross, from one side to the other, at any angle not less than 30 degrees with the centerline. No portion of such facility or corresponding easement shall be located within 25 feet of Duke Energy's facilities. Roundabouts, culdesacs and intersections (such as roads, driveways and alleyways) are not permitted.**
5. **Any drainage feature that allows water to pond, causes erosion, directs stormwater toward the right of way or limits access to or around Duke Energy facilities is prohibited.**
6. **Contact Duke Energy prior to the construction of lakes, ponds, retention or detention facilities, etc.**
7. **Parking may be permitted within the right of way, provided that:**
   a. **Prior to grading, concrete barriers shall be installed at a minimum of 9 feet from the Duke Energy facilities. During construction, grading shall be no closer than 10 feet to any Duke Energy facility.**
   b. **After grading/paving activity is complete, a Duke Energy-approved barrier sufficient to withstand a 15-mph vehicular impact shall be erected 9 feet from any Duke Energy facility.**
   c. **Any access areas, entrances or exits shall cross (from one side to the other) the right of way at any angle not less than 30 degrees with the centerline and shall not pass within 25 feet of any structure. Parking lot entrances/exits cannot create an intersection within the right of way.**
   d. **Lighting within the right-of-way limits must be approved by Duke Energy before installing. Due to engineering design standards, lighting is not allowed in the "Wire Zone." Where lighting is approved ("Border Zone"), the total height may not exceed 15 feet in Area A and 12 feet in Area B. See map on back of this page for Areas. Contact your Asset Protection right-of-way specialist as the "Wire Zone" varies for the different voltage lines.**
8. **Duke Energy will not object to certain vegetation plantings as long as:**
   a. **They do not interfere with the access to or the safe, reliable operation and maintenance of Duke Energy facilities.**
   b. **With prior written approval, Duke Energy does not object to low-growing shrubs and grasses within the "Wire Zone." Tree species are not allowed within the "Wire Zone." Trees that are approved in the "Border Zone" may not exceed, at maturity, 15 feet in Area A and 12 feet in Area B. See map on back of page for areas. Contact the Asset Protection right-of-way specialist for "Wire Zone"/"Border Zone" definitions.**
   c. **For compliant mature height species, refer to plants.ces.ncsu.edu/ for reference.**
   d. **Engineering drawings must indicate the outermost conductor.**
   e. **Vegetation that is not in compliance is subject to removal without notice.**
   f. **Duke Energy may exercise the right to cut "danger trees" outside the right-of-way limits as required to properly maintain and operate the transmission line.**

We hope this is useful information. If you have additional questions or plan any activity not mentioned above, please contact the Asset Protection right-of-way specialist for your area (see map).



Wire Zone: Extends beyond the outermost conductor on both sides.
(See diagram above.)
Permitted within the Wire Zone: Low-growing plants, shrubs and grasses.
Not permitted within the Wire Zone: Tree species of any kind.

Border Zone: Extends from the edge of the Wire Zone to the outside edge of the Right of Way.
Permitted within the Border Zone: Lighting structures and plantings within the Right of Way that do not exceed a vertical height of 15 feet in Area A and 12 feet in Area B. (See Asset Protection Map for location of geographic areas) For compliant mature height species, refer to **plants/ces.ncsu.edu/**.

Not permitted within the Border Zone: Any object that exceeds vertical height restrictions. These restrictions are based on flat ground elevations. If the ground elevations differ, no object at any time may exceed the outermost conductor's ground elevation.

Peripheral Zone: Outside the Right of Way and adjacent to Border Zones.
Permitted within the Peripheral Zone: Trees may be planted in the Peripheral Zone. Duke Energy recommends customers exercise caution selecting and planning trees in this zone.
Not permitted in the Peripheral Zone: Trees with canopies are subject to routine trimming and possible removal.

In all zones:

When an outage risk is identified, Duke Energy will attempt to notify the affected customer. However, the company may need to take immediate action if trees
cannot be pruned to appropriate levels. This may include trees and shrubs that are within 20 feet of the power line at the maximum peak load or during weather
conditions that create line sag and sway.

Written approvals by Duke Energy are required for all plans.

We hope this is useful information. If you have additional questions on line voltages or plan any activity not mentioned above, please contact the Asset Protection Specialist for your area. (See Map)

*Right of Way is intended to reference the easement rights granted to Duke Energy. Actual zone size may vary based upon the particular Right of Way.

SECTION 7: COMMUNICATIONS REQUIREMENTS FOR TRANSMISSION CONNECTED DISTRIBUTED ENERGY RESOURCES

Communications Requirements for Transmission Connected Distributed Energy Resources

Duke Energy Carolinas (DEC) Transmission Protection and Controls (P&C) reviews all Transmission connected distributed energy resource requests on a case-by-case basis to determine the P&C requirements. If it is determined that a communications dependent protection solution is required to protect DEC assets, the preferred medium for communications is Optical Ground Wire (OPGW) or a functionally equivalent form of direct fiber (e.g. fiber in duct bank or All-Dielectric Self-Supporting under-build). Transmission P&C has also determined 3rd party networked fiber is acceptable in lieu of OPGW if minimum requirements are met. The use of any communications channel using metallic conductors greater than 50 ft. in length (e.g. copper) between sites is strictly prohibited. The required communications latency must be less than 6 cycles (0.1 seconds) in order to meet protection coordination requirements. The inherent communications monitoring within SEL relays will activate for a loss of communication after a duration of ¾ cycle (ROKA @ 9600 baud rate). All communications proposals by the customer are subject to approval by the DEC Telecommunications department and Transmission P&C.

DEC Transmission P&C reserves the right to modify or change the requirements that are described within this document at any point in the future.

Return to 5.15 Substation Lot and Substation Access Road