CAROLINAS TRANSMISSION COORDINATION ARRANGEMENT (CTCA)

2024 SUMMER PEAK/SHOULDER/WINTER PEAK CAROLINAS WIND STUDY

FINAL

September 9, 2013

STUDY PARTICIPANTS

Prepared by: **CTCA Power Flow Studies Group (PFSG)**

Representative	**Company**
Brian D. Moss, Chair	Duke Energy Carolinas
Bob Pierce	Duke Energy Carolinas (Alternate)
Lee Adams	Duke Energy Progress
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Ricky Thornton	South Carolina Public Service Authority

Reviewed by: **CTCA Steering Committee (SC)**

Representative	**Company**
Samuel Waters, Chair	Duke Energy
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PURPOSE OF STUDY

The purpose of this study is to assess the North Carolina Transmission Planning Collaborative ("NCTPC") and South Carolina Regional Transmission Planning ("SCRTP") companies' transmission systems' reliability and quantify the transmission system impacts of various wind injection sites along the Carolinas' coast. The NCTPC is being represented by Duke Energy Carolinas ("Duke") and Duke Energy Progress ("Progress"). The SCRTP is being represented by South Carolina Electric and Gas ("SCEG"), and South Carolina Public Service Authority ("SCPSA"). The wind injection sites to be tested will be determined based on the latest available data and studies of off-shore wind along the Carolinas' coast.

The NCTPC and SCRTP stakeholder group members will have the opportunity to provide input on all the study scope elements as the study activities progress.

OVERVIEW OF THE STUDY PROCESS

The scope of the proposed study process will include the following steps:

1. **Study Assumptions**
   - Study assumptions selected (MW injection levels, sinks, sink allocation, study years, load levels, etc.)
2. **Study Criteria**
   - Establish the criteria by which the study results will be measured
3. **Case Development**
   - Develop the models needed to perform the study based on wind injection sites and study assumptions)
4. **Study Methodology**
   - Determine the methodologies that will be used to carry out the study
5. **Technical Analysis and Study Results**

   Perform the technical analysis and produce the study results. Power flow analyses will be performed based on the assumption that thermal and voltage limits will be the controlling limits for system reliability. This study will be performed as a high-level screening analysis, with additional, more detailed, analysis required if a request for interconnection is made. Any additional analyses required in response to an interconnection request will be performed in accordance with the interconnecting company's interconnection procedures.
6. **Assessment and Problem Identification**
   - Evaluate the results to identify problems/issues
7. **Solution Development**
   - Identify potential solutions to the identified problems/issues
   - Perform a financial analysis (e.g., cost, cash flow, present value) for each proposed solution to enable a cost comparison between the various wind injection sites

8. **Report on the Study Results**
   - Combine the study scope and assessment results into a report

STUDY ASSUMPTIONS

- The year to be studied (study year) will be 2024. A 2024 summer peak, 2024/25 winter peak, and 2024 shoulder case will be used to evaluate the impact of various wind injection sites.
- Generation will be dispatched for each Participant in the study cases to meet that Participant's peak and shoulder load in accordance with the designated dispatch order. Participants will also provide generation down scenarios for their resources, as requested (e.g., generation outage with description of how generation will be replaced, such as by that Participant's dispatch orders).
- PSS/E and/or MUST will be used for the study.
- Load growth assumptions will be in accordance with each Participant company's practice.
- Generation, interchange, and other assumptions will be coordinated between the Participant companies as needed. The 2013 series LTSG cases for 2024 summer and 2024/25 winter will be used as the starting points for study cases and interchange development.
- A shoulder peak is defined as 70-80% of summer peak load conditions. Each Participant company will determine the appropriate load and generation dispatch to represent their system.
- The study team will use the three coordinated study cases and any requested generation down cases to analyze the existing transmission systems to determine if any reliability criteria violations are created due to the various wind injection sites at the tested MW levels. The results of this analysis will be included in the study report.

STUDY CRITERIA

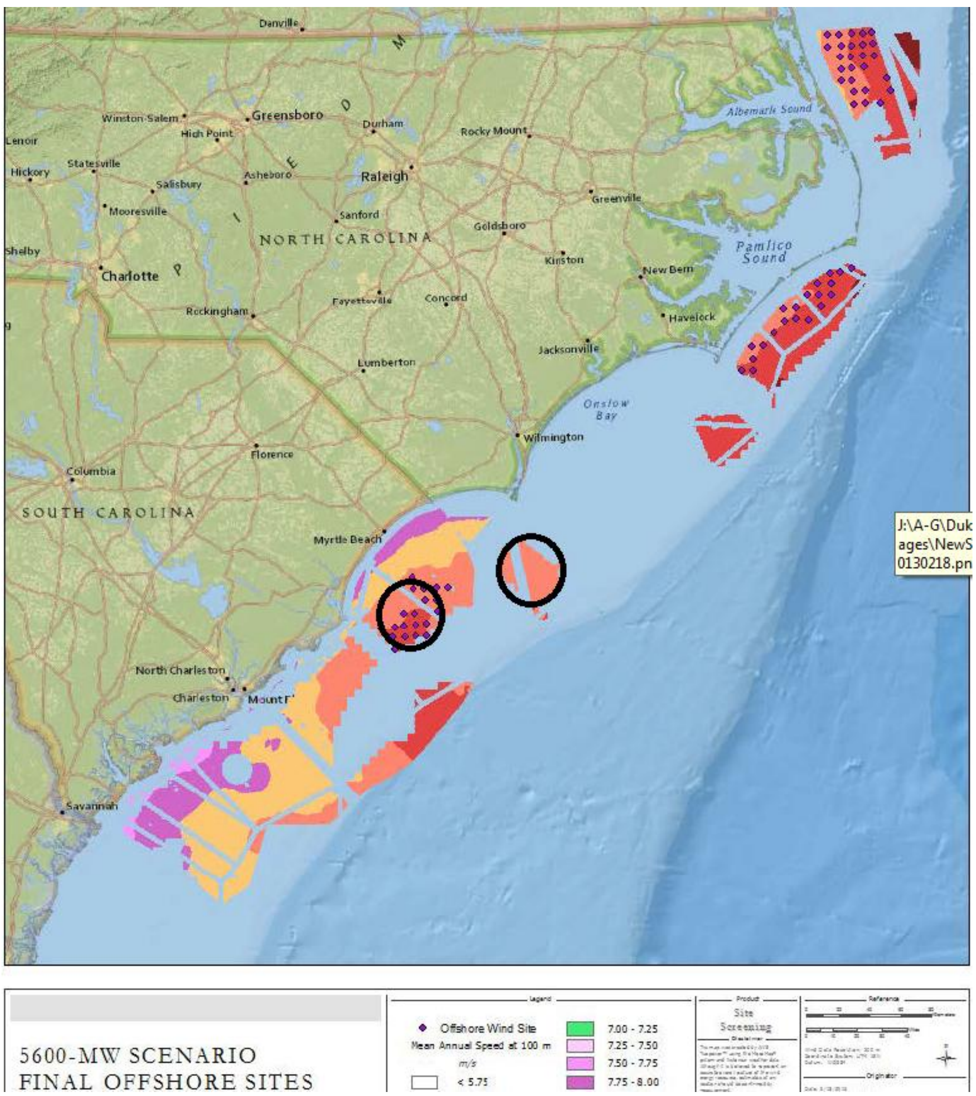
The study criteria with which results will be evaluated will be established, promoting consistency in the planning criteria used across the systems of the Participants, while recognizing differences between individual systems. The study criteria will include the following reliability elements:

- NERC Reliability Standards
- Individual company criteria (voltage, thermal, stability, short circuit and phase angle)

CASE DEVELOPMENT

- The latest LTSG models will be used as a starting point for the study cases to be used by the study team in their analyses. Systems external to Duke, Progress, SCEG, and SCPSA will come directly from the LTSG model.

- The study cases will include the detailed internal models for Duke, Progress, SCEG, and SCPSA and will include transmission additions planned to be in-service for the given year (i.e. in-service by 2024 summer and 2024/25 winter). The detailed internal models will be based on the latest publicly available data for each system, i.e., data that has been included in the annual FERC 715 filing.
- The Participants will coordinate interchange which will include all confirmed long term firm transmission reservations with roll-over rights applicable to the study year(s).
- Duke, Progress, SCEG, and SCPSA will each create any requested generation down cases from the coordinated study cases and share the relevant cases with each other.
- Wind source locations will be assumed to be in the locations identified on the map below, designated as the Wilmington offshore site (easternmost site) and the Myrtle Beach offshore site (westernmost site). The onshore collection points will be determined by the participants and identified from existing system substations and lines. ***Facilities required to deliver energy from the wind turbines to the onshore collection point identified by the participants will not be included or identified as part of this study.***



Scenarios to be Studied

Table 1 will provide the basis for the amount of power delivered to the alternative onshore collection points. In all cases, it will be assumed that 2000 MW of nameplate wind capacity will be injected into the onshore collection sites, as shown in Table 1.

Scenario	Onshore Collection Site	Nameplate MW into Collection Site	Sink	Nameplate MW	Sink	Nameplate MW	Description
1	Wilmington	1000	DUKE	600	PROGRESS	400	All output sinks
	Myrtle Beach	1000	SCEG	500	SCPSA	500	in host state
2	Wilmington	2000	DUKE	940	PROGRESS	620	All wind connects
	Myrtle Beach	0	SCEG	220	SCPSA	220	in NC
3	Wilmington	0	DUKE	940	PROGRESS	620	All wind connects
	Myrtle Beach	2000	SCEG	220	SCPSA	220	in SC

Table 1

Each scenario will address an amount of power delivered from the installed wind capacity in the summer peak, winter peak, and shoulder seasons. The amount of power actually delivered in each case will be the nameplate capacity at the site multiplied by the capacity adjustment factors shown in Table 2.

	Summer Peak	Winter Peak	Shoulder
Wilmington	30%	50%	100%
Myrtle Beach	33%	56%	100%

Table 2

The shoulder case will assume 70-80% of annual peak demand. The percentages above are based on the Carolinas Wind Integration Case Study (COWICS), Table 7, page 28, with the Wilmington site capacity adjustment modified slightly downward from the Myrtle Beach values. The Wilmington site was not included in the COWICS study.

A more detailed description of the scenarios to be studied is provided below.

Scenario 1: Independent Site Development

- The 1000 MW (nameplate capacity) from the offshore wind resources at each site, as modified to reflect seasonal capacity adjustments in Table 2, is injected at NC1 substation (DEP's Sutton North 230 kV bus) and SC1 substation (SCPSA's Red Bluff 230 kV bus) and transmitted to the respective states.
- The sink location(s) of the delivered MW of wind energy from each wind site will sink into the state loads of the state in which the wind energy is delivered, in proportion to the load ratio share of the study participants in that state. For example, NC and SC will each receive the output of 1000 MW of nameplate wind capacity, with the SC MW being delivered 50% each to SCPSA and SCEG, while the

equivalent output of 1000 MW of nameplate capacity delivered to NC will be split 60% to Duke, and 40% to Progress.

Scenario 2: Receipt of all output in NC

- The combined 2000 MW of nameplate wind capacity from the offshore wind resources as modified to reflect seasonal capacity, will be injected at NC1 substation (DEP's Sutton North 230 kV bus) and transmitted to participants' systems.
- The sink location(s) of the 2000 MW of nameplate capacity wind energy will be split among the four participants' systems according to overall load ratio share, 47% to Duke, 31% to Progress, and 11% each to SCPSCA and SCEG. The 22% share for SCPSA and SCEG will be reflected as firm interchange between the NC and SC systems.

Scenario 3: Receipt of all output in SC

- The combined 2000 MW of nameplate wind capacity from the offshore wind resources as modified to reflect seasonal capacity, will be injected at SC1 substation (SCPSA's Red Bluff 230 kV bus) and transmitted to participants' systems.
- The sink location(s) of the 2000 MW of nameplate capacity wind energy will be split among the four participants' systems according to overall load ratio share, 47% to Duke, 31% to Progress, and 11% each to SCPSCA and SCEG. The 78% share for Duke and Progress will be reflected as firm interchange between the SC and NC systems.

STUDY METHODOLOGY

- Initially, power flow analyses will be performed based on the assumption that thermal and voltage limits will be the controlling limits for the reliability plan. This study will be performed as a high-level screening analysis, with additional, more detailed, analysis required if a request for interconnection is made. Any additional analyses required in response to an interconnection request will be performed in accordance with the interconnecting company's interconnection procedures.
- Duke, Progress, SCEG, and SCPSA will exchange contingency and monitored element files so that each can test the impact of the other systems' contingencies on its transmission system.

TECHNICAL ANALYSIS AND STUDY RESULTS

The technical analysis will be performed in accordance with the study methodology. Results from the technical analysis will be reported throughout the study area to identify transmission elements approaching their limits such that all Participants are aware of potential issues and appropriate steps can be identified to correct these issues, including the potential of identifying previously undetected problems.

Duke, Progress, SCEG, and SCPSA will report results throughout the study area based on:

- Thermal loadings greater than 90%.
- Voltages less than individual company criteria.

ASSESSMENT AND PROBLEM IDENTIFICATION

Duke, Progress, SCEG, and SCPSA will each run their own assessments using their own internal planning processes. Each Participant's reliability criteria will be used for their transmission facilities. Duke, Progress, SCEG, and SCPSA will each document the reliability problems resulting from their assessments. These results will be reviewed and discussed with NCTPC and SCRTP stakeholder group members for feedback.

POTENTIAL SOLUTION DEVELOPMENT

- The study team will develop potential solution alternatives to the identified reliability problems. Potential joint solutions will also be discussed and evaluated as needed.
- Duke, Progress, SCEG, and SCPSA will test the effectiveness of any potential joint solution alternatives using the same cases, methodologies, assumptions and criteria described above.
- The study team will compare alternatives and select the preferred solution alternatives that provide a reliable and the most cost effective transmission solution while prudently managing the associated risks.
- Duke, Progress, SCEG, and SCPSA will develop rough, planning-level cost estimates for the preferred solution alternatives.
- The preferred solution alternatives developed by the study team will be reviewed and discussed with the NCTPC and SCRTP stakeholder group members for feedback.

REPORT ON STUDY RESULTS

The study team will compile the study scope and assessment results into a report for review and discussion with the NCTPC and SCRTP stakeholder group members to solicit their input. The final report will include a comprehensive summary of all the study activities as well as the recommended potential transmission improvements including estimates of costs. Study results will be made available through posting on the respective NCTPC and SCRTP websites.

Company	Wind Scenario Cost Comparison		
	Wind Scenario 1	Wind Scenario 2	Wind Scenario 3
Duke Energy Progress	$ 10,000,000	$ 60,000,000	$ 20,000,000
Duke Energy Carolinas	$ 125,000	$ 12,325,000	$ 13,540,000
SCEG	$ 0	$ 0	$ 0
SCPSA	$ 0	$ 33,000,000	$ 15,200,000
Total Costs ($2013)	**$ 10,125,000**	**$ 105,325,000**	**$ 48,740,000**

Table 3

Reminder: Facilities required to deliver energy from the wind turbines to the onshore collection point identified by the participants are not included or identified as part of this study.

Duke Energy Progress (DEP)

$10,000,000 was added to cover the cost of the Sutton North 230kV Switching Station as an injection point for Wind Scenarios 1 and 2. This switching station was established by looping in 3 existing 230kV transmission lines. For Wind Scenario 2, a new 50-mile 230kV transmission line would be required from the Sutton North 230kV Switching Station to the Jacksonville 230kV Substation. For Wind Scenario 3, a new 30-mile 230kV transmission line would be required from the Florence 230kV Substation to the Marion 230kV Substation.

Duke Energy Carolinas (DEC)

Due to the remote study year, fictitious generation is included in the DEC control area to support the creation of DEC's generator maintenance cases for analysis in DEC's internal planning processes. Lee and Buck CC generation were selected as the most likely sites for future generation on the DEC system based on recent generator interconnection requests and study results. Both CCs are 2x1 configurations each with a total output of 776 MW. In this study, these fictitious generators are positioned at the bottom of DEC's dispatch order, not fully dispatched unless required to create some of the larger generator maintenance cases. If these CCs were actually developed, they would be much higher in the dispatch order and most likely be fully dispatched in the summer peak base case. The presence of these fictitious generators provides a level of uncertainty in the study results for facilities (Toxaway/Clinton/Fiber 100 kV lines, Shady Grove/Central 230/100 kV transformers, etc.) in the local areas around DEC's Buck Tie and Lee Steam stations.

South Carolina Electric and Gas (SCEG)

No Projects Required

South Carolina Public Service Authority (SCPSA)

Study results indicated potential transformer loading issues in the vicinity of Red Bluff under certain 230 kV contingencies. An additional 230 kV line between the Red Bluff and Carolina Forest substations was added to alleviate the transformer loading. Results also indicated potential loading issues between the Kingstree and Hemingway 230 kV substations under certain contingencies. A second Kingstree-Hemingway 230 kV line was added to alleviate this loading. These 230 kV facilities are not in Santee Cooper's current construction plan.

The study case includes the Red Bluff-Marion 230 kV line currently planned for completion in 2015.

TABLE A
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS1

	Element	Contingency	Potential Issue	Potential Solution ($2013)
P01S	Marion-Dillon Tap 115 kV Line 1 (Weatherspoon Plant-Marion)	Brunswick 1 Gd (TRM) Whiteville-Brun EMC Chadbourn Peacock and Whiteville-Industrial Tap 230 kV Lines	Loading (90.0 %)	Existing Operating Procedure [2032] Opens Weatherspoon Terminal

TABLE B
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
P01S	Marion-Dillon Tap 115 kV Line 1 (Weatherspoon Plant-Marion)	Brunswick 1 Gd (TRM) Whiteville-Brun EMC Chadbourn Peacock and Whiteville-Industrial Tap 230 kV Lines	Loading (90.0 %)	Existing Operating Procedure [2032] Opens Weatherspoon Terminal

TABLE C
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
P01S	Marion-Dillon Tap 115 kV Line 1 (Weatherspoon Plant-Marion)	Brunswick 1 Gd (TRM) Whiteville-Brun EMC Chadbourn Peacock and Whiteville-Industrial Tap 230 kV Lines	Loading (111.3 %)	Existing Operating Procedure [2024] Opens Weatherspoon Terminal
P02S	West End-Central EMC Center Church 230 kV Line 1 (Cape Fear-West End)	Harris Gd (TRM) Cumberland-Richmond 500 kV Line 1	Loading (102.1 %)	Existing Operating Procedure [2024] Opens West End Terminal
P03S	Florence-Latta SS 230 kV Line 1	Brunswick 1 Gd (TRM) Marion-Marion (SCPSA) 230 kV Lines 1 and 2	Loading (91.4 %)	Construct Florence-Marion 230 kV Line [2026]

TABLE D
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE E
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
P01H	Ind057-Ind059 230 kV Line 1 (Sutton-Sutton North)	Robinson 2 Gd (TRM) Lee-Mt Olive 230 kV and Lee-Friendship 115kV Lines	Loading (110.5 %)	Construct Jacksonville-Sutton North 230 kV Line 2 [New Project - 2024]
P02H	Wallace-Ind056 230 kV Line 1 (Sutton North-Wallace)	Cumberland-Wake 500 kV Line 1	Loading (103.5 %)	Construct Jacksonville-Sutton North 230 kV Line 2 [New Project - 2024]
P03H	Sutton North-Ind036 230 kV Line 1 (Jacksonville-Sutton North)	Cumberland-Wake 500 kV Line 1	Loading (101.2 %)	Construct Jacksonville-Sutton North 230 kV Line 2 [New Project - 2024]
P04H	Delco-Four County EMC Kelly 230 kV Line 1 (Cumberland-Delco)	Cumberland-Wake 500 kV Line 1	Loading (93.1 %)	Construct Jacksonville-Sutton North 230 kV Line 2 [New Project - 2024]

TABLE E (continued)
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
P05H	Warsaw Tap-Four County EMC Blind Bridge 230 kV Line 1 (Clinton-Wallace)	Cumberland-Wake 500 kV Line 1	Loading (90.6 %)	Construct Jacksonville-Sutton North 230 kV Line 2 [New Project - 2024]

TABLE F
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE G
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE H
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE I
DUKE ENERGY PROGRESS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE J
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE K
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
D01S	Lee-Toxaway 100 kV Lines 1 and 2 (Toxaway)	Lee 3 Gm Central-Lee Black and White 100 kV Lines 1 and 2 (Central)	Loading (97.3 %)	5% Reactors on Fiber 100 kV Lines [2026] Accelerated 20 Years $1,415,000 (Full Cost)
D02S	Bush River-Laurens EC 30 White 100 kV Line 1 (Clinton)	Lee 3 Gm Bush River-Clinton-Laurens Black 100 kV Line with Clinton Tie Throwover (Clinton)	Loading (91.3 %)	12.99 miles 2/0 Cu Reconductor [2030] Accelerated 15 Years $5,184,000 (Full Cost)
D03S	Anderson-Toxaway 100 kV Line 2/1 (Fiber)	Lee 3 Gm Anderson-Toxaway 100 kV Line 1/2 (Fiber)	Loading (98.3 %)	5% Reactors on Fiber 100 kV Lines [2033] Accelerated 12 Years $804,000 (Full Cost)
D04S	Shady Grove 230/100 kV Transformer 1	Lee 3 Gm Shady Grove 230/100 kV Transformer 2	Loading (92.9 %)	New Shady Grove Transformer Capacity [2031] Accelerated 15 Years $1,593,000 (Full Cost)

TABLE K (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
D05S	Greenville-North Greenville White 100 kV Line 1 (Verner)	Lee 3 Gm Greenville-North Greenville Black 100 kV Line 2 (Verner)	Loading (95.8 %)	2.15 miles 954 ACSR Reconductor [2027] Accelerated 6 Years $512,000
D06S	Tiger-BMW Delivery 1 Tap White 100 kV Line 1 (Taylors)	Lee 3 Gm Tiger-East Greenville Black 100 kV Line 1 (Taylors)	Loading (96.0 %)	2.68 miles 477 ACSR Reconductor [2027] Accelerated 4 Years $370,000
D07S	Central 230/100 kV Transformer 1	Lee 3 Gm Central 230/100 kV Transformer 3	Loading (101.1 %)	New Central Transformer Capacity [2025] Accelerated 3 Years $520,000

TABLE L
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
D01S	Lee-Toxaway 100 kV Lines 1 and 2 (Toxaway)	Lee 3 Gm Central-Lee Black and White 100 kV Lines 1 and 2 (Central)	Loading (97.7 %)	5% Reactors on Fiber 100 kV Lines [2026] Accelerated 20 Years $1,415,000 (Full Cost)
D02S	Bush River-Laurens EC 30 White 100 kV Line 1 (Clinton)	Lee 3 Gm Bush River-Clinton-Laurens Black 100 kV Line with Clinton Tie Throwover (Clinton)	Loading (98.3 %)	12.99 miles 2/0 Cu Reconductor [2026] Accelerated 19 Years $7,085,000 (Full Cost)
D03S	Anderson-Toxaway 100 kV Line 2/1 (Fiber)	Lee 3 Gm Anderson-Toxaway 100 kV Line 1/2 (Fiber)	Loading (98.3 %)	5% Reactors on Fiber 100 kV Lines [2033] Accelerated 12 Years $804,000 (Full Cost)
D04S	Shady Grove 230/100 kV Transformer 1	Lee 3 Gm Shady Grove 230/100 kV Transformer 2	Loading (92.0 %)	New Shady Grove Transformer Capacity [2032] Accelerated 8 Years $1,464,000 (Full Cost)

TABLE L (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
D05S	Greenville-North Greenville White 100 kV Line 1 (Verner)	Lee 3 Gm Greenville-North Greenville Black 100 kV Line 2 (Verner)	Loading (94.9 %)	2.15 miles 954 ACSR Reconductor [2028] Accelerated 5 Years $413,000
D06S	Tiger-BMW Delivery 1 Tap White 100 kV Line 1 (Taylors)	Lee 3 Gm Tiger-East Greenville Black 100 kV Line 1 (Taylors)	Loading (95.8 %)	2.68 miles 477 ACSR Reconductor [2027] Accelerated 4 Years $370,000
D07S	Central 230/100 kV Transformer 1	Lee 3 Gm Central 230/100 kV Transformer 3	Loading (100.9 %)	New Central Transformer Capacity [2025] Accelerated 3 Years $520,000
D08S	Monroe-Roughedge-Mini Ranch White 100 kV Line 1 (Monroe)	Harris Gd (TRM) Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line 1 (Sandy Ridge)	Loading (101.9 %)	14.71 miles 2/0 Cu Reconductor [2024] Accelerated 3 Years $1,871,000

TABLE M
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS1

	Element	Contingency	Potential Issue	Potential Solution ($2013)
Y01H	High Rock-Tuckertown 100 kV Line (Yadkin Facility)	Belews Creek 1 Gm Woodleaf-Godbey Reactor-Pleasant Garden 500 kV Line (Godbey)	Loading (104.9 %)	Existing Operating Procedure [2024] Accelerated 2 Years
Y02H	Badin-Tuckertown 100 kV Line (Yadkin Facility)	Belews Creek 1 Gm Woodleaf-Godbey Reactor-Pleasant Garden 500 kV Line (Godbey)	Loading (93.3 %)	Existing Operating Procedure [2029] Accelerated 4 Years
D01H	Lawsons Fork-Pinewood B/W 100 kV Line 1 (Pinewood)	Oconee 1 Gm Lawsons Fork-West Spartanburg W/B 100 kV Line 1 (Pinewood)	Loading (91.1 %)	1.08 miles 477 ACSR Reconductor [2030] Accelerated 4 Years $125,000

TABLE N
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
Y01H	High Rock-Tuckertown 100 kV Line (Yadkin Facility)	Belews Creek 1 Gm Woodleaf-Godbey Reactor-Pleasant Garden 500 kV Line (Godbey)	Loading (102.5 %)	Existing Operating Procedure [2024] Accelerated 2 Years
D02H	Allen 230/100 kV Transformer 6	Allen 5 Gm Allen 230/100 kV Transformer 2	Loading (90.1 %)	New Allen Transformer Capacity [2032] Accelerated 10 Years $1,464,000 (Full Cost)
D03H	McGuire-Riverbend B/W 230 kV Lines 1/2 (Norman)	Cliffside 5 Gm McGuire-Riverbend W/B 230 kV Lines 2/1 (Norman)	Loading (91.9 %)	5.61 miles 1272 ACSR Reconductor [2030] Accelerated 5 Years $1,267,000

TABLE O
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
Y01H	High Rock-Tuckertown 100 kV Line (Yadkin Facility)	Belews Creek 1 Gm Woodleaf-Godbey Reactor-Pleasant Garden 500 kV Line (Godbey)	Loading (107.6 %)	Existing Operating Procedure [2024] Accelerated 2 Years
Y02H	Badin-Tuckertown 100 kV Line (Yadkin Facility)	Belews Creek 1 Gm Woodleaf-Godbey Reactor-Pleasant Garden 500 kV Line (Godbey)	Loading (95.7 %)	Existing Operating Procedure [2027] Accelerated 6 Years
D04H	Great Falls-Wateree B/W 100 kV Lines 1/2 (Wateree)	Fishing Creek Gm Great Falls-Wateree W/B 100 kV Lines 2/1 (Wateree)	Loading (124.7 %)	Existing Operating Procedure [2024] Accelerated 27 Years
D05H	Bush River-Laurens EC 30 White 100 kV Line 1 (Clinton)	Oconee 1 Gm Bush River-Clinton-Laurens Black 100 kV Line with Clinton Tie Throwover (Clinton)	Loading (101.4 %)	19.78 miles 2/0 Cu Reconductor [2035] Accelerated 23 Years $5,116,000 (Full Cost)

TABLE O (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
D06H	Monroe-Roughedge-Mini Ranch White 100 kV Line 1 (Monroe)	Harris Gd (TRM) Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line 1 (Sandy Ridge)	Loading (97.4 %)	14.71 miles 2/0 Cu Reconductor [2026] Accelerated 8 Years $3,854,000
D07H	Mini Ranch-Lancaster-Red Rose White 100 kV Line 1 (Monroe)	Harris Gd (TRM) Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line 1 (Sandy Ridge)	Loading (110.8 %)	8.94 miles 2/0 Cu Reconductor [2024] Accelerated 1 Year $402,000

TABLE P
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE Q
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE R
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE S
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE T
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE U
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE V
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE W
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE X
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE Y
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE Z
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE AA
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE AB
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS1

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C01S	Georgetown-Campfield 115 kV Line	Base Case Winyah-Campfield 230 kV Line	Loading (95.0 %)	Existing Operating Procedure [2024] Open Winyah 230/115 kV Transformer

TABLE AC
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C01S	Georgetown-Campfield 115 kV Line	Base Case Winyah-Campfield 230 kV Line	Loading (107.0 %)	Existing Operating Procedure [2024] Open Winyah 230/115 kV Transformer
C02S	Kingstree-Hemingway 230 kV Line	Base Case Marion-Red Bluff 230 kV Line	Loading (93.0 %)	Kingstree-Hemingway 230 kV Line 2 [New Project 2024] $33,000,000

TABLE AD
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SUMMER PEAK - WS3

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE AE
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS1

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE AF
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS2

Element	Contingency	Potential Issue	Potential Solution ($2013)
No Issues Found	-	-	-

TABLE AG
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 SHOULDER - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C01H	Red Bluff 230/115 kV Transformers	Base Case Red Bluff-Carolina Forest 230 kV Line	Loading (128.0 %)	Red Bluff-Carolina Forest 230 kV Line 2 [New Project 2024] $15,200,000

TABLE AH
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS1

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C01W	Red Bluff 230/115 kV Transformers	Base Case Red Bluff-Carolina Forest 230 kV Line	Loading (96.0 %)	Red Bluff-Carolina Forest 230 kV Line 2 [New Project 2024] $15,200,000

TABLE AI
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS2

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C02W	Georgetown-Campfield 115 kV Line	Base Case Winyah-Campfield 230 kV Line	Loading (104.0 %)	Existing Operating Procedure [2024] Open Winyah 230/115 kV Transformer

TABLE AJ
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2024 WINTER PEAK - WS3

	Element	Contingency	Potential Issue	Potential Solution ($2013)
C01W	Red Bluff 230/115 kV Transformers	Base Case Red Bluff-Carolina Forest 230 kV Line	Loading (113.0 %)	Red Bluff-Carolina Forest 230 kV Line 2 [New Project 2024] $15,200,000

FIGURE A
POTENTIAL PROJECTS - WIND SCENARIO 1 (24S/24H/24W-WS1)

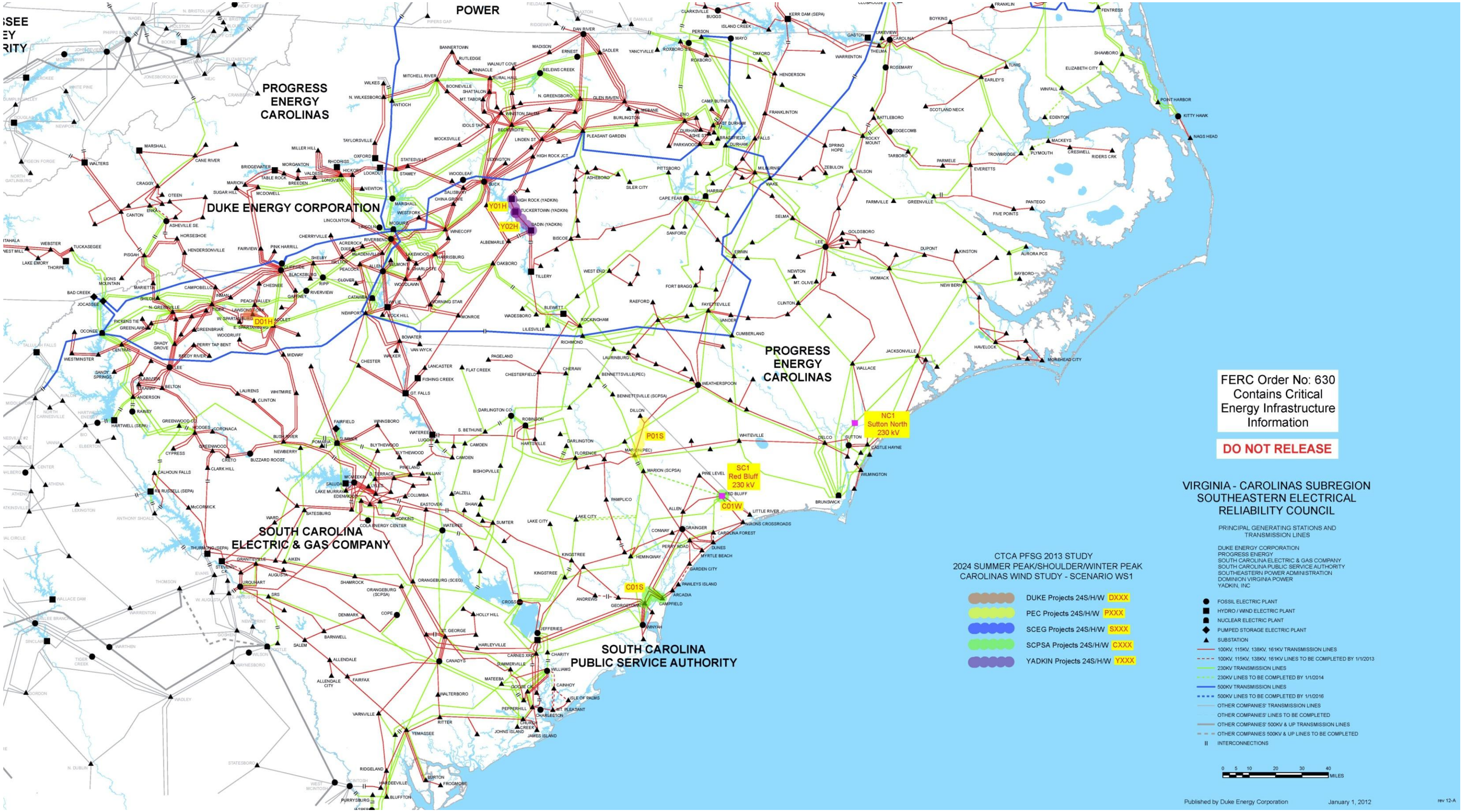


FIGURE B
POTENTIAL PROJECTS - WIND SCENARIO 2 (24S/24H/24W-WS2)

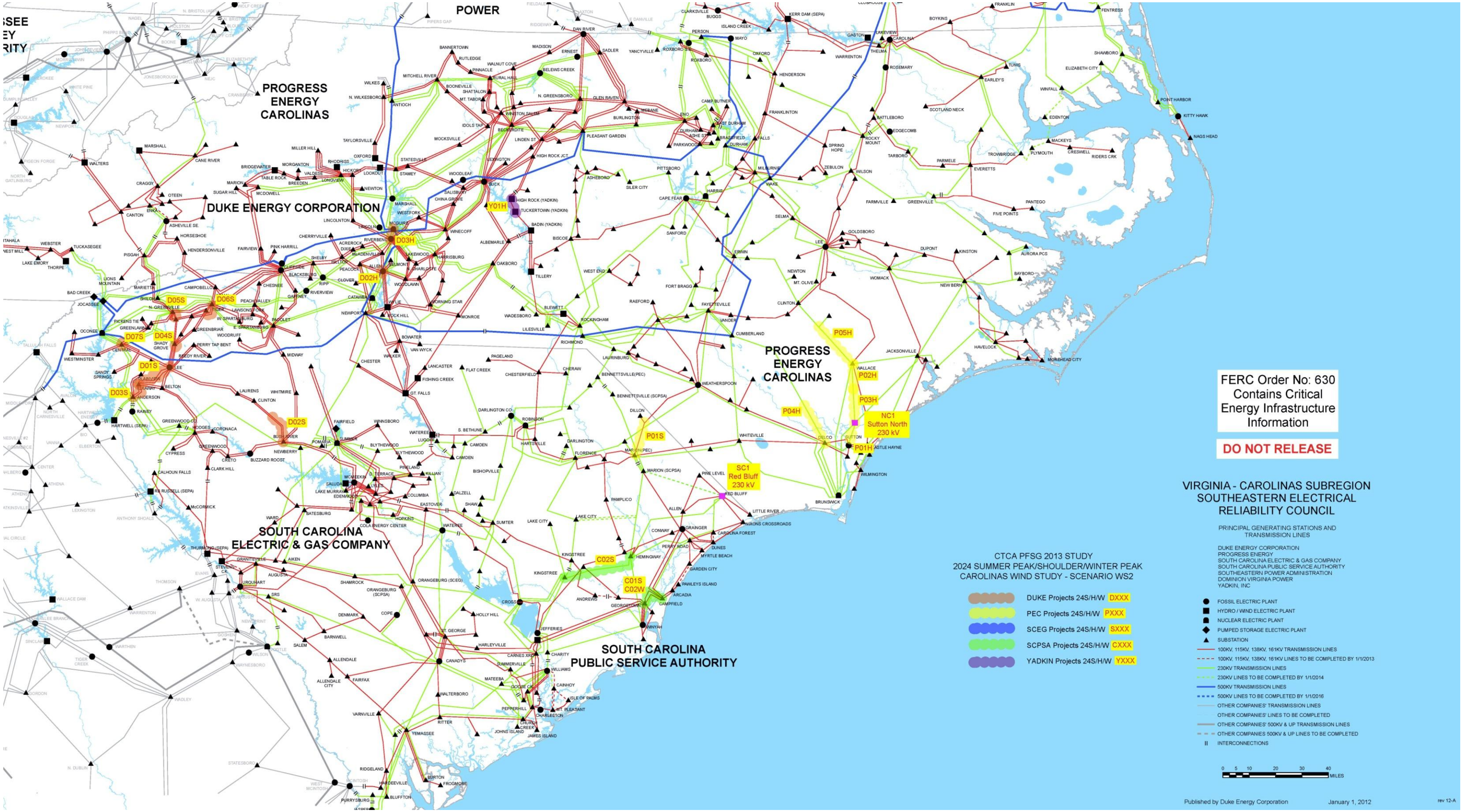


FIGURE C
POTENTIAL PROJECTS - WIND SCENARIO 3 (24S/24H/24W-WS3)