CAROLINAS TRANSMISSION COORDINATION ARRANGEMENT (CTCA)

2016 SUMMER PEAK/SHOULDER RELIABILITY STUDY

FINAL

October 8, 2012

STUDY PARTICIPANTS

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

Representative	Company
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Brian D. Moss, Chair	Duke Energy Carolinas
Bob Pierce	Duke Energy Carolinas (Alternate)
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Reviewed by: **CTCA Planning Committee (PC)**

Representative	Company
Samuel Waters, Chair	Progress Energy Carolinas
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Tom Abrams	South Carolina Public Service Authority
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PURPOSE OF STUDY

The purpose of this study is to assess the existing transmission expansion plans of Duke Energy Carolinas ("Duke"), Progress Energy Carolinas ("Progress"), South Carolina Electric and Gas ("SCE&G"), and South Carolina Public Service Authority ("SCPSA") to ensure that the plans are simultaneously feasible. In addition, this study will evaluate any potential joint alternatives identified by the Planning Committee ("PC") representatives which might improve the simultaneous feasibility of the Participants' transmission expansion plans through potentially more efficient or cost-effective joint plans. The Power Flow Studies Group ("PFSG") will perform the technical analysis outlined in this study scope under the guidance and direction of the PC.

OVERVIEW OF THE STUDY PROCESS

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

1. **Study Assumptions**
   - Study assumptions selected
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
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 (thermal, voltage, and stability as needed) and produce the study results
6. **Assessment and Potential Issues Identification**
   - Evaluate the results to identify potential issues
   - Report potential issues to the PC
7. **Potential Alternative Development**
   - Evaluate potential joint alternatives as directed by the PC
8. **Report on the Study Results**
   - Combine the study scope and assessment results into a report

STUDY ASSUMPTIONS

Study Year	Reliability Study	Description
2010	2014/21 Summer Peak	14S: Near-term 21S: Long-term (VC Summer 2-3)
2011	2015/18 Summer Peak	15S: Near-term 18S: Long-term (VC Summer 2)
2012	2016 Summer Peak/Shoulder	16S: VC Summer Transmission Only 16H: Low Gas Price Dispatch

- The year to be studied (study year) will be 2016 for a near term reliability analysis. VC Summer unit 2 has been delayed from 2016 until 2017, while the related transmission expansion plans continue to be scheduled for completion prior to 2016. A summer peak case will be used to evaluate the impact of the VC Summer expansion related transmission plans prior to any new units coming on-line. A shoulder case will be used to evaluate a potential low gas price dispatch scenario where CCs and/or CTs are being dispatched before the coal units.
- 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 2012 series LTSG case for 2016 summer 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 a low gas price dispatch scenario on their system.
- The PFSG will use the 2016 summer and shoulder peak cases to analyze the existing transmission expansion plans to determine if any reliability criteria violations are created. Based on this analysis, the PFSG will provide feedback to the PC on the simultaneous feasibility of these plans for ensuring the reliability of service. The results of this analysis will be included in the 2012 study report.

STUDY CRITERIA

- 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 PFSG in their analyses. Systems external to Duke, Progress, SCE&G, and SCPSA will come directly from the LTSG model.
- The study cases will include the detailed internal models for Duke, Progress, SCE&G, and SCPSA and will include existing transmission additions planned to be in-service for the given year (i.e. in-service by 2016 summer).
- 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, SCE&G, and SCPSA will each create any requested generation down cases from the common study cases and share the relevant cases with each other.

  Generation Down Cases Shared

  - Duke: Belews Creek 1, Buck CC, Catawba 1, Cliffside 5, Cliffside 6, Dan River CC, McGuire 1, McGuire 2, Oconee 1, Oconee 3 replaced with internal generation redispatch
  - Progress: Brunswick 1, Robinson 2, Harris replaced with TRM import
  - SCE&G: VC Summer 1, Cope (2016S only) replaced with internal generation redispatch and import
  - SCPSA: Rainey CC, Cross 3 replaced with internal generation redispatch and import

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. Voltage stability, angular stability, short circuit and phase angle studies may be performed if circumstances warrant.
- Duke, Progress, SCE&G, 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, SCE&G, and SCPSA will report results throughout the study area based on:

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

ASSESSMENT AND POTENTIAL ISSUES IDENTIFICATION

Duke, Progress, SCE&G, 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, SCE&G, and SCPSA will each document the reliability issues resulting from their assessments. These results will be reviewed and discussed among the PFSG and PC to identify potential joint alternatives which might improve the simultaneous feasibility of the Participants' transmission expansion plans through potentially more efficient or cost-effective joint plans.

POTENTIAL ALTERNATIVE ASSESSMENT

This study allowed for the sharing of information regarding the respective needs of each of the Participants' transmission planners and potential solutions to those needs, as well as the identification and joint evaluation of alternatives to those needs.

- The PC will identify potential joint alternatives that will be assessed by the PFSG.
- These alternatives will be based on the potential for improved simultaneous feasibility through more efficient or cost-effective joint plans.
- The PFSG will assess the impact of any potential joint alternatives identified by the PC on the simultaneous feasibility of the Participants' transmission expansion plans.
- Duke, Progress, SCE&G, and SCPSA will test the effectiveness of any potential joint alternatives using the same cases, methodologies, assumptions and criteria described above.
- Study results indicate the Participants' current transmission expansion plans are simultaneously feasible.
- The PC did not identify the need to assess any potential joint alternatives based on the study results and a review of the Participants' current transmission expansion plans.

POTENTIAL ALTERNATIVE ASSESSMENT (continued)

- If an alternative is assessed to be beneficial to the simultaneous feasibility of the Participants' transmission expansion plans, the impacted Participants would perform a more detailed study to evaluate implementing the alternative under their individual interconnection agreements.
- Progress and SCPSA are planning to jointly assess upgrades in the Camden area. These potential upgrades were previously assessed by Progress and SCPSA during the PFSG's 2010 reliability study. These upgrades could potentially impact the operating status of the Wateree Tie between Duke and Progress.

REPORT ON STUDY RESULTS

The PFSG has compiled the study scope and assessment results into a report for the PC's review and approval. This final report includes a comprehensive summary of all the study activities.

TABLE A
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
P01	Rockingham-Wadesboro Tap2 230 kV Line 1 (Rockingham-West End East)	Harris Gd (TRM) Rockingham-West End 230 kV Line 1	Loading (98.9 %)	Existing Operating Procedure to Open West End Terminal
P02	Marion-Dillon Tap 115 kV Line 1 (Marion-Weatherspoon)	Brunswick 1 Gd (TRM) Latta SS-Dillon MP Tap 230 kV Line 1	Loading (93.1 %)	Existing Operating Procedure to Open Weatherspoon Terminal
P03	Chestnut Hills-Milburnie 115 kV Line 1	Harris Gd (TRM) Durham-Falls 230 kV and Falls-Method 115 kV Lines	Loading (92.3 %)	Relocate Neuse 115 kV Substation to Falls-Method 115 kV Line [2022]

TABLE B
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SHOULDER (with Low Gas Price Dispatch)

Element	Contingency	Potential Issue	Potential Solution
None	-	-	-

TABLE C
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D01	North Winston Retail-Wake Forest 100 kV Line 1 (Whitaker)	Buck CC Gm Beckerdite 230/100/44 kV Transformer 1	Loading (110.5 %)	2.29 miles 477 ACSR Reconductor [2016]
D02	Parkwood 500/230 kV Transformer 5	Harris Gd (TRM) Parkwood 500/230 kV Transformer 6	Loading (112.3 %)	New Operating Procedure [2019] Trips Parallel Bank
D03	Lakewood 230/100 kV Transformer	Catawba 1 Gm Lakewood 230/100 kV Transformer and Lakewood-Riverbend 230 kV Line 2 (Pinoca)	Loading (103.0 %)	New Lakewood Transformer Capacity [2016]
D04	Glen Raven-Burlington Tap Black 100 kV Line 1 (Alamance)	Harris Gd (TRM) Glen Raven-Mebane White 100 kV Line 1 (Alamance)	Loading (97.5 %)	3.15 miles 2-477 ACSR Reconductor [2018]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D05	Riverbend-Lakewood White 100 kV Line 2 (Long Creek)	Buck CC Gm Riverbend-Lakewood Black 100 kV Line 2 (Riverbend)	Loading (100.9 %)	10.64 miles 336 ACSR Reconductor [2016]
D06	Sadler-Ernest Sw Sta B/W 230 kV Line 1/2 (Sadler)	Dan River CC Gm Sadler-Ernest Sw Sta W/B 230 kV Line 2/1 (Sadler)	Loading (104.0 %)	12.61 miles 1272 ACSR Reconductor [2016]
D07	Pleasant Garden-Vandalia White 100 kV Line 1 (Glen Raven)	Dan River CC Gm Pleasant Garden-Glen Raven Black 100 kV Line 1 (Glen Raven)	Loading (92.2 %)	6.74 miles 795 ACSR Reconductor [2021]
D08	Mitchell River-Surry Yadkin Delivery 7 White 100 kV Line 1 (Bannertown)	Belews 1 Gm Mitchell River-Bannertown Black 100 kV Line 1 (Bannertown)	Loading (95.2 %)	6.46 miles 336 ACSR Reconductor [2019]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D09	Winecoff 230/100/44 kV Transformer 2	Mountain Island Gm Winecoff 230/100/44 kV Transformer 4	Loading (105.1 %)	New Winecoff Transformer Capacity [2022]
D10	Cliffside 230/100/44 kV Transformer A2	Cherokee Gm Cliffside 230/100/44 kV Transformer A1	Loading (99.7 %)	New Cliffside Transformer Capacity [2017]
D11	Mini Ranch-Lancaster-Red Rose White 100 kV Line 1 (Monroe)	McGuire 1 Gm Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line 1 (Sandy Ridge)	Loading (95.3 %)	8.94 miles 2/0 Cu Reconductor [2019]
D12	Hodges-Mulberry Creek Retail Black 100 kV Line 1 (Cokesbury)	VC Summer 1 Gd Hodges-Coronaca White 100 kV Line 1 (Cokesbury)	Loading (98.1 %)	2.30 miles 477 ACSR Reconductor [2018]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D13	North Charlotte-Elizabeth Black North 100 kV Line 1 (Elizabeth)	Buck CC Gm Woodlawn-Elizabeth Black South 100 kV Line 1 (Elizabeth)	Loading (96.6 %)	2.20 miles 477 ACSR Reconductor [2019]
D14	Beckerdite-Willow Creek Retail Black 100 kV Line 1 (Linden Street)	Harris Gd (TRM) Beckerdite-High Point City 4 White 100 kV Line 1 (Linden Street)	Loading (103.6 %)	9.74 miles 477 ACSR Reconductor [2016]
D15	Morning Star-Union EMC 9 B/W 100 kV Line 1 (Indian Trail)	Robinson 2 Gd (TRM) Monroe-Monroe City 4 W/B 100 kV Line 1 (Indian Trail)	Loading (103.6 %)	5.40 miles 2-366 ACSR Reconductor [2020]
D16	Newport-Wylie Hydro White 100 kV Line 1 (Hook)	Allen 5 Gm Wylie Hydro-Rock Hill City 7 Black 100 kV Line 2 (Hook)	Loading (103.7 %)	7.47 miles 795 ACSR Reconductor [2018]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D17	Wylie Hydro-Rock Hill City 7 Black 100 kV Line 2 (Hook)	Allen 5 Gm Newport-Wylie Hydro White 100 kV Line 1 (Hook)	Loading (91.8 %)	2.48 miles 795 ACSR Reconductor [2022]
D18	Harrisburg-Hickory Grove Retail W/B 100 kV Line 1 (Crab Orchard)	Catawba 1 Gm Harrisburg-Amity Sw Sta B/W 100 kV Line 1 (Crab Orchard)	Loading (92.3 %)	6.43 miles 477 ACSR Reconductor [2022]
D19	Daniels Retail-Blue Ridge EC 25 Black 100 kV Line 1 (Davidson River)	Belews 1 Gm Pisgah-Shiloh 230 kV Lines Commontower Loss (Caesar)	Loading (109.4 %)	4.66 miles 250 Cu Reconductor [2016]
D20	Peach Valley-Enola Retail Black 100 kV Line 1 (Cherokee)	Cliffside 5 Gm Cliffside 230/100/44 kV Transformer A2	Loading (97.3 %)	Relocate Load or 1.26 miles 2/0 Cu Reconductor [2018]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D21	Newport-Rock Hill City 7 Black 100 kV Line 2 (Hook)	Allen 5 Gm Newport-Wylie Hydro White 100 kV Line 1 (Hook)	Loading (107.4 %)	4.99 miles 795 ACSR Reconductor [2016]
D22	Allen 230/100 kV Transformer 2B	Allen 5 Gm Allen 230/100 kV Transformer 6	Loading (119.0 %)	New Allen Transformer Capacity [2017]
D23	Parkwood 230/100 kV Transformer 1/2	Dan River CC Gm Parkwood 230/100 kV Transformer 2/1	Loading (129.5 %)	New Parkwood Transformer Capacity [2016]
D24	Stamey 230/100 kV Transformer 2	Oxford Gm Stamey 230/100 kV Transformer 1	Loading (130.2 %)	New Stamey Transformer Capacity [2016]

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
D25	Allen-Woodlawn B/W 230 kV Line 1/2 (Steelberry)	Allen 5 Gm Allen-Woodlawn W/B 230 kV Line 2/1 (Steelberry)	Loading (144.7 %)	8.44 miles 2156 ACSR Reconductor [2023]

TABLE D
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SHOULDER (with Low Gas Price Dispatch)

	Element	Contingency	Potential Issue	Potential Solution
D02	Parkwood 500/230 kV Transformer 5	Harris Gd (TRM) Parkwood 500/230 kV Transformer 6	Loading (111.0 %)	New Operating Procedure [2020] Trips Parallel Bank
D04	Glen Raven-Burlington Tap Black 100 kV Line 1 (Alamance)	Harris Gd (TRM) Glen Raven-Mebane White 100 kV Line 1 (Alamance)	Loading (97.4 %)	3.15 miles 2-477 ACSR Reconductor [2018]
D20	Peach Valley-Enola Retail Black 100 kV Line 1 (Cherokee)	Cherokee Gm Cliffside 230/100/44 kV Transformer A2	Loading (92.5 %)	Relocate Load or 1.26 miles 2/0 Cu Reconductor [2021]

TABLE E
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
S01	Aiken 2 Tap-Urquhart 115 kV Line	Graniteville-Aiken 3 Tap 115 kV and Graniteville-Stiefeltown 115 kV Lines	Loading (92.5%)	19.33 miles 477 ACSR Reconductor [2023]

TABLE F
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SHOULDER (with Low Gas Price Dispatch)

Element	Contingency	Potential Issue	Potential Solution
None	-	-	-

TABLE G
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SUMMER PEAK

	Element	Contingency	Potential Issue	Potential Solution
C01	Perry Road-Myrtle Beach 115 kV Line 1	Belews 1 Gm Perry Road-Myrtle Beach 115 kV Line 2	Loading (97.1%)	5.40 miles 556 ACSR Reconductor [2018]
C02	Georgetown-Campfield 115 kV Line	Belews 1 Gm Winyah-Campfield 230 kV Line	Loading (90.3%)	Existing Operating Procedure Open Winyah 230/115 kV Transformer

TABLE H
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2016 SHOULDER (with Low Gas Price Dispatch)

Element	Contingency	Potential Issue	Potential Solution
None	-	-	-

FIGURE A
POTENTIAL PROJECTS

PROJECT MAP REMOVED
Contains Critical Energy Infrastructure Information (CEII)