CAROLINAS TRANSMISSION PLANNING COORDINATION ARRANGEMENT (CTPCA)

2015/18 SUMMER PEAK RELIABILITY STUDY

FINAL

October 11, 2011

STUDY PARTICIPANTS

Prepared by: CTPCA Power Flow Studies Group (PFSG)

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Brian D. Moss, Chair	Duke Energy Carolinas
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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 ("SCEG"), and South Carolina Public Service Authority ("SCPSA") to ensure that the plans are simultaneously feasible. In addition, this study evaluated any potential joint alternatives identified by the Steering Committee ("SC") representatives which might improve the simultaneous feasibility of the Participants' transmission expansion plans. The Power Flow Studies Group ("PFSG") performed the technical analysis outlined in this study scope under the guidance and direction of the SC.

OVERVIEW OF THE STUDY PROCESS

The scope of the study process included 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 SC
7. Potential Alternative Assessment
   - Evaluate potential joint alternatives as directed by the SC
8. Report on the Study Results
   - Combine the study scope and assessment results into a report

STUDY ASSUMPTIONS

- The years studied (study year) are 2015 Summer for a near term reliability analysis and 2018 Summer for a longer term reliability analysis.
- Generation is dispatched for each Participant in the study cases to meet that Participant's peak load in accordance with the designated dispatch order. Participants also provided 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 are used for the study.
- Load growth assumptions are in accordance with each Participant company's practice.
- Generation, interchange, and other assumptions are coordinated between the Participant companies as needed. The 2011 series LTSG cases for 2015 and 2018 Summer are used as the starting points for study case and interchange development.
- The PFSG use the 2015 and 2018 Summer 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 SC on the simultaneous feasibility of these plans for ensuring the reliability of service. The results of this analysis are included in this report.

STUDY CRITERIA

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

CASE DEVELOPMENT

- The most current MMWG models are used for the systems external to Duke, Progress, SCEG, and SCPSA as a starting point for the study cases used by the PFSG in their analyses.
- The study cases include the detailed internal models for Duke, Progress, SCEG, and SCPSA and include existing transmission additions planned to be in-service for the given year (i.e. in-service by summer 2015 for 2015S cases as well as in-service by summer 2018 for 2018S cases).
- The Participants coordinated interchange which will include all confirmed long term firm transmission reservations with roll-over rights applicable to the study year(s).

CASE DEVELOPMENT (continued)

- Duke, Progress, SCEG, and SCPSA each created 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, Catawba 1, Cliffside 6, Dan River CC, McGuire 1, McGuire 2, Oconee 1, Oconee 3 replaced with internal generation redispatch
  - Progress: Brunswick 1, Brunswick 2, Robinson 2, Harris, Roxboro 4 replaced with TRM import
  - SCEG\SCPSA: VC Summer 1 (2015), VC Summer 2 (2018) 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 were performed based on the assumption that thermal and voltage limits are the controlling limits for the reliability plan. Stability, short circuit and phase angle studies were performed if circumstances warrant.
- Duke, Progress, SCEG, and SCPSA exchanged 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 was performed in accordance with the study methodology. Results from the technical analysis are 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 shared 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, SCEG, and SCPSA each ran an assessment on the base cases and the requested generation down cases using their own internal planning processes. Each Participant's reliability criteria are used for their transmission facilities. Duke, Progress, SCEG, and SCPSA each documented the reliability issues resulting from their assessments. A summary of the potential reliability issues identified in this assessment are found in Tables A-H. These results were

reviewed and discussed among the PFSG and SC to identify potential joint alternatives which might improve the simultaneous feasibility of the Participants' transmission expansion 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.

- Study results indicate the Participants' current transmission expansion plans are simultaneously feasible.
- The SC 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.
- As a result of this study, Progress and SCEG will jointly assess increasing the rating of the Sumter-Wateree 230 kV tie line.
- 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.

REPORT ON STUDY RESULTS

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

TABLE A
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Folkstone-Jacksonville 115 kV Line	Base Case Folkstone-Jacksonville 230 kV Line	Loading (97.0 %)	Loop-in Brunswick Unit 1-Jacksonville 230 kV Line at Folkstone 230 kV Substation [2016]
Falls 230/115 kV Transformer	Harris Gd (TRM) Henderson-Franklinton and Henderson-Falls 115 kV Lines	Loading (96.0 %)	New Falls 230/115 kV Transformer [2016]
Raeford 230/115 kV Transformer 1/2	Brunswick 1 Gd (TRM) Raeford 230/115 kV Transformer 2/1	Loading (94.8 %)	New Arabia 230/115 kV Substation [2018]
Rockingham-West End 230 kV West Line	Harris Gd (TRM) Rockingham-West End 230 kV East Line	Loading (92.1 %)	Existing Operating Procedure [2019]

TABLE A (continued)
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Folkstone-Jacksonville City 115 kV Line	Base Case Folkstone-Jacksonville 230 kV Line	Loading (97.0 %)	Loop-in Brunswick Unit 1-Jacksonville 230 kV Line at Folkstone 230 kV Substation [2016]
Weatherspoon-Marion 115 kV Line	Brunswick 1 Gd (TRM) Weatherspoon-Latta 230 kV Line	Loading (91.4 %)	Existing Operating Procedure [2019]

TABLE B
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Rockingham-West End 230 kV West Line	Harris Gd (TRM) Rockingham-West End 230 kV East Line	Loading (101.8 %)	Existing Operating Procedure [2018]
Weatherspoon-Marion 115 kV Line	Brunswick 1 Gd (TRM) Weatherspoon-Latta 230 kV Line	Loading (99.8 %)	Existing Operating Procedure [2018]
Sutton-Delco 115 kV South Line	Brunswick 2 Gd (TRM) Sutton Terminal End of Sutton-Delco 115 kV South Line	Loading (94.0 %)	New Operating Procedure [2021]
Florence-Marion 115 kV Line	Brunswick 2 Gd (TRM) Marion PEC-Marion SCPSA 230 kV Tie Lines 1 and 2	Loading (92.4 %)	Existing Operating Procedure [2022]

TABLE B (continued)
PROGRESS ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Durham-RTP 230 kV Line	Harris Gd (TRM) Method-East Durham Duke and Method-Durham 230 kV Lines	Loading (92.3 %)	10.00 miles 2-1590 ACSR Reconductor [2021]
Sumter-Wateree (SCEG) 230 kV Tie Line	Darlington-South Bethune 230 kV Line	Loading (91.6 %)	Progress and SCEG are jointly investigating
Lumbee River EMC Rockfish 115 kV POD	Harris Gd (TRM) Richmond-Raeford 230 kV Line	Voltage (0.9153 pu)	New Arabia 230/115 kV Substation [2018]

TABLE C
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
McGuire-Riverbend 230 kV Line 1/2 (Norman)	Allen 4 Gm McGuire-Riverbend 230 kV Line 2/1 (Norman)	Loading (94.4 %)	Generation Redispatch [2019]
Mini Ranch-Lancaster-Red Rose 100 kV Line (Monroe)	McGuire 1 Gm Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line	Loading (92.6 %)	8.94 miles 2/0 Cu Reconductor [2020]
Central-Shady Grove Tap 230 kV Line 2/1 (Fisher)	Cliffside 5 Gm Central-Shady Grove Tap 230 kV Line 1/2 (Fisher)	Loading (88.8 %)	17.80 miles 954 ACSR Reconductor [2023]
Parkwood 500/230 kV Transformer 5	Roxboro 4 Gd (TRM) Parkwood 500/230 kV Transformer 6	Loading (89.0 %)	New Operating Procedure [2023] Trips Parallel Bank

TABLE C (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
McGuire 500/230 kV Transformer A1	McGuire 1 Gm Woodleaf-Pleasant Garden 500 kV Line	Loading (89.6 %)	New 500/230 kV Substation or 230 kV Switched Reactor [2026]

TABLE D
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Lakewood 230/100 kV Transformer	Robinson 2 Gd (TRM) Lakewood 230/100 kV Transformer	Loading (104.6 %)	New Lakewood Transformer Capacity [2018]
Mini Ranch-Lancaster-Red Rose 100 kV Line (Monroe)	McGuire 1 Gm Morning Star 230/100 kV Transformer and Morning Star-Newport 230 kV Line	Loading (104.6 %)	8.94 miles 2/0 Cu Reconductor [2018]
Lakewood-Beatties Ford 100 kV Line (Long Creek)	Buck CC Gm Lakewood-Belhaven 100 kV Line (Riverbend)	Loading (98.4 %)	10.64 miles 336 ACSR Reconductor [2020]
Shelby-Transco Tap Black 100 kV Line (Earl)	Catawba 1 Gm Shelby-Transco Tap White 100 kV Line (Earl)	Loading (95.3 %)	5.01 miles 2-336 ACSR Reconductor [2022]

TABLE D (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Parkwood 500/230 kV Transformer 5	Roxboro 4 Gd (TRM) Parkwood 500/230 kV Transformer 6	Loading (94.2 %)	New Operating Procedure [2022] Trips Parallel Bank
Sadler-Ernest2 230 kV Line 1/2 (Sadler)	Dan River CC Gm Sadler-Ernest2 230 kV Line 2/1 (Sadler)	Loading (92.7 %)	12.61 miles 1272 ACSR Reconductor [2023]
Beckerdite-Willow Creek 100 kV Line (Linden Street)	Harris Gd (TRM) Beckerdite-Linden St 100 kV Line (Linden Street)	Loading (95.1 %)	9.74 miles 477 ACSR Reconductor [2023]
Morning Star-Union EMC 9 100 kV Line (Indian Trail)	Robinson 2 Gd (TRM) Morning Star-Monroe Main 100 kV Line (Indian Trail)	Loading (88.7 %)	5.40 miles 2-366 ACSR Reconductor [2026]

TABLE D (continued)
DUKE ENERGY CAROLINAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Riverbend-Beatties Ford 100 kV Line (Long Creek)	Buck CC Gm Lakewood-Belhaven 100 kV Line (Riverbend)	Loading (89.2 %)	3.91 miles 336 ACSR Reconductor [2026]
Peach Valley-Riverview 230 kV Line 1 (London Creek)	Oconee 1 Gm Peach Valley-Riverview 230 kV Line 2 (London Creek)	Loading (87.4 %)	19.33 miles 795 ACSR Reconductor [2027]
Horseshoe-Asheville Hwy 100 kV Line (Echo)	Cliffside 5 Gm Horseshoe-Hendersonville 100 kV Line (Echo)	Loading (87.9 %)	5.38 miles 477 ACSR Reconductor [2027]

TABLE E
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
None	-	-	-

TABLE F
SOUTH CAROLINA ELECTRIC AND GAS
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Savannah River Services-Canadys 230 kV Line	Cross 3 Gd Vogtle-West McIntosh 500 kV Line	Loading (93.9%)	57.81 miles 1272 ACSR Reconductor [2020]
Vogtle-Savannah River Services 230 kV Line	VC Summer 2 Gd Vogtle-West McIntosh 500 kV Line	Loading (90.2%)	17.14 miles 2-1272 ACSR Reconductor [2022]

TABLE G
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2015 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Arcadia-Campfield 115 kV Line 1/2	Dan River CC Gm Arcadia-Campfield 115 kV Line 2/1	Loading (98.0 %)	Bucksville 230/115 kV Sub [2014] Winyah-Bucksville 230 kV [2015] Bucksville-Garden City 115 kV [2016]
Arcadia-Garden City 115 kV Line 1/2	Dan River CC Gm Arcadia-Garden City 115 kV Line 2/1	Loading (102.0 %)	Bucksville 230/115 kV Sub [2014] Winyah-Bucksville 230 kV [2015] Bucksville-Garden City 115 kV [2016]
Georgetown Switching Station-Campfield 115 kV Line	Dan River CC Gm Winyah-Campfield 230 kV Line	Loading (95.0 %)	Existing Operating Procedure [2018] Opens Winyah 230/115 kV Transformer
Bucksville-Conway 115 kV Line 1	Brunswick 2 Gd (TRM) Bucksville-Conway 115 kV Line 2	Loading (98.0 %)	Conway 230 kV SS Bucksville-Conway 230 kV Line [2018]

TABLE H
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Myrtle Beach-Perry Road 115 kV Line 1(w/loads)	Roxboro 4 Gd (TRM) Myrtle Beach-Perry Road 115 kV 2	Loading (103.0 %)	5.40 miles 556 ACSR Reconductor [2018]
Campfield-Arcadia 115 kV Line 1/2	Belews Creek 1 Gm Campfield-Arcadia 115 kV Line 2/1	Loading (92.0 %)	Evaluating
Arcadia-Garden City 115 kV Line 1/2	Catawba 1 Gm Arcadia-Garden City 115 kV Line 2/1	Loading (93.0 %)	Evaluating
Campfield 230/115 kV Transformer	Belews Creek 1 Gm Georgetown Switching Station-Campfield 115 kV Line	Loading (92.0 %)	Evaluating

TABLE H
SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
SUMMARY OF POTENTIAL RELIABILITY ISSUES
2018 SUMMER PEAK

Element	Contingency	Potential Issue	Potential Solution
Georgetown Switching Station-Campfield 115 kV Line	Brunswick 1 Gd (TRM) Winyah-Campfield 230 kV Line	Loading (105.0 %)	Existing Operating Procedure [2018] Opens Winyah 230/115 kV Transformer
Perry Road 230/115 kV Transformer 2	Brunswick 2 Gd (TRM) Perry Road 230/115 kV Transformer 1	Loading (98.0 %)	Energize Existing 3rd Perry Road 230/115 kV Transformer
Columbia-Lyles 115 kV Line	Brunswick 2 Gd (TRM) Sandy Run-Lyles 115 kV Line	Loading (92.0 %)	Evaluating