2024 Base Reliability Study

Purpose of Study

The purpose of the Base Reliability Study is to assess the Duke Energy Carolinas ("DEC") and Duke Energy Progress ("DEP") transmission systems' reliability and develop a single collaborative transmission plan for the DEC and DEP transmission systems that ensures reliability of service in accordance with NERC, SERC, DEC, and DEP requirements. In addition, the study will also assess Local Economic Study and/or Public Policy Study requests provided by the Transmission Advisory Group ("TAG") and approved for study by the Oversight Steering Committee ("OSC"). Multi-Value Strategic Transmission ("MVST") requests will be addressed in a separate scope document. The Planning Working Group ("PWG") will perform the technical analysis outlined in this study scope under the guidance and direction of the OSC with compliance with the currently effective version of Attachment N-1 to the Duke Joint OATT.

One Local Economic Study request was received from TAG stakeholders by the February 16th deadline for the 2024 study year ("2024 Study").

Four Public Policy study requests were received from TAG stakeholders by the February 16th deadline for the 2024 study year ("2024 Study"); however, these requests are to be included in the MVST Study.

Overview of the Study Process Scope

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.
   - Determine the different resource supply scenarios to evaluate.
4. **Methodology**

- Determine the methodologies that will be used to carry out the study.

5. **Technical Analysis and Study Results**
   - Perform the study analysis and produce the results. Initially, power flow analyses will be performed based on the assumption that thermal limits will be the controlling limit for the reliability plan. Voltage, stability, short circuit and phase angle studies may be performed if circumstances warrant.
6. **Assessment and Problem Identification**
   - Evaluate the results to identify problems/issues.
7. **Solution Development**
   - Identify potential solutions to the problems/issues.
   - Test the effectiveness of the potential solutions through additional studies and modify the solutions as necessary such that all reliability criteria are met.
   - Perform a financial analysis and rough scheduling estimate for each of the proposed solutions (e.g., cost, cash flow, present value).
8. **Selection of a Recommended Collaborative Transmission Plan**
   - Compare alternatives and select the preferred solution alternatives – balancing cost, benefits and risks.
   - Select a preferred set of transmission improvements that provide a reliable transmission system to customers most cost effectively while prudently managing the associated risks.
9. **Report on the Study Results**
   - Prepare a report on the recommended Collaborative Transmission Plan.

Each of these study steps is described in more specific detail below.

Study Assumptions

The specific assumptions selected for the 2024 Study are:

- The years to be studied (study years) will be 2029 Summer and 2029/2030 Winter for a near term reliability analysis and 2034 Summer and 2034/2035 Winter for a longer-term reliability analysis. Each Load Serving Entity ("LSE") will provide a list of resource supply assumptions and include the resource dispatch order for each of its Designated Network Resources in the DEC and DEP Balancing Authority Areas. Generation will be dispatched for each LSE in the cases to meet that LSE's peak load in accordance with the designated dispatch order. LSEs will also include generation down scenarios for their resources, if applicable (e.g., generation outage with description of how generation will be replaced, such as by that LSE's dispatch orders).
- PSS/E and/or TARA will be used for the study.

- Generation, load, interchange and other assumptions will be coordinated between Participants as needed.
- The tables below list the major generation facility additions and retirements assumed to occur by 2029 Summer, 2029/2030 Winter, 2034 Summer and 2034/2035 Winter.
- The retirements and resource additions modeled in the study are generally based on portfolios in the Carbon Plan approved by the North Carolina Utilities Commission in its December 31, 2022 order.
- "Surplus" indicates surplus interconnection service, which is defined in the Duke Joint OATT as shall mean any unneeded portion of Interconnection Service established in a Large Generator Interconnection Agreement, such that if Surplus Interconnection Service is utilized the total amount of Interconnection Service at the Point of Interconnection would remain the same.

Major Generation[1] Facility Additions in 2024 Reliability Study

Includes facilities with a signed Interconnection Agreement (IA) as of 7/19/2024. Additional queued generation (e.g. Bad Creek II, Person County CC 2, etc.) that does not have a signed IA as of 7/19/2024 is not included in the 2024 Reliability Study.

Company	Generation Facility	2029S	2029/30W	2034S	2034/35W
DEC	Lincoln County CT (525 MW)	Included	Included	Included	Included
DEC	Allen Battery (50 MW)	Included	Included	Included	Included
DEC	Apex Solar (30 MW)	Included	Included	Included	Included
DEC	Bear Branch Solar (34.5 MW)	Included	Included	Included	Included
DEC	Beaverdam Solar (42 MW)	Included	Included	Included	Included
DEC	Brookcliff Solar (50 MW)	Included	Included	Included	Included
DEC	Five Circles Solar (74.9 MW)	Not Included	Not Included	Included	Included
DEC	Healing Springs Solar (55 MW)	Included	Included	Included	Included
DEC	Hornet Solar (73 MW)	Included	Included	Included	Included
DEC	Hudson Place Solar (70.7 MW)	Not Included	Not Included	Included	Included
DEC	Joanna White Solar (37.5 MW)	Included	Included	Included	Included

[1] Major Generation is 10 MW or greater and connected to the transmission system.

DEC	Marshall CT 1, 2 (780 MW)	Included	Included	Included	Included
DEC	Misenheimer Solar (74.4 MW)	Included	Included	Included	Included
DEC	Monroe Solar (Surplus 25 MW) *	Included	Included	Included	Included
DEC	Newberry Solar (74.5 MW)	Included	Included	Included	Included
DEC	Olin Creek Solar (35 MW)	Included	Included	Included	Included
DEC	Partin Solar (50 MW)	Included	Included	Included	Included
DEC	Pelham Solar (32 MW)	Included	Included	Included	Included
DEC	Quail/Baxter Creek Solar (30 MW)[2]	Included	Included	Included	Included
DEC	Quaker Creek Farm Solar (35 MW)	Included	Included	Included	Included
DEC	Riverbend Battery (115 MW)	Included	Included	Included	Included
DEC	Rutabaga Solar (69.75 MW)	Included	Included	Included	Included
DEC	South Davidson Solar (80 MW)	Included	Included	Included	Included
DEC	Sweetwater Solar (34 MW)	Included	Included	Included	Included
DEC	Two Hearted Solar (22 MW)	Included	Included	Included	Included
DEC	West River Solar (40 MW)	Included	Included	Included	Included
DEC	Westminster Solar (70 MW)	Included	Included	Included	Included
DEP	Asheville Battery (17.25 MW)	Included	Included	Included	Included
DEP	Asheville Solar (9.5 MW)	Included	Included	Included	Included
DEP	B&K Solar (74.9 MW)	Included	Included	Included	Included
DEP	Craggy Battery (30.5 MW)	Included	Included	Included	Included
DEP	Clarendon Solar (67 MW)	Included	Included	Included	Included
DEP	Creed Solar (48 MW)	Included	Included	Included	Included

[2] This project was originally queued as Quail Solar but may undergo a name change in the future to Baxter Creek Solar.

DEP	Culpepper Solar (74.9 MW)	Included	Included	Included	Included
DEP	Gum Swamp Solar (80 MW)	Included	Included	Included	Included
DEP	Hyco Solar (80 MW)	Included	Included	Included	Included
DEP	IP Solar (75 MW)	Included	Included	Included	Included
DEP	Juniper Solar (74.9 MW)	Included	Included	Included	Included
DEP	Knightdale Battery (100 MW)	Included	Included	Included	Included
DEP	Loftins Crossroads (75 MW)	Included	Included	Included	Included
DEP	Lotus Solar (75 MW)	Included	Included	Included	Included
DEP	Maple Leaf Solar (73 MW)	Included	Included	Included	Included
DEP	Martins Crossroads Solar (74.9 MW)	Included	Included	Included	Included
DEP	New Hill Battery (56 MW)	Included	Included	Included	Included
DEP	Panola Solar (67 MW)	Included	Included	Included	Included
DEP	Person County CC1 (1,091 MW)	Included	Included	Included	Included
DEP	Pig Basket Creek (80 MW)	Included	Included	Included	Included
DEP	Robinson Solar (76 MW)	Included	Included	Included	Included
DEP	Rollins Solar (74.9 MW)	Included	Included	Included	Included
DEP	Ross Solar (74.9 MW)	Included	Included	Included	Included
DEP	Stevens Mill Solar (80 MW)	Included	Included	Included	Included
DEP	Shorthorn Solar (60 MW)	Included	Included	Included	Included
DEP	Sleepy Creek Solar (80 MW)	Included	Included	Included	Included
DEP	Warsaw Battery (Surplus 30 MW) *	Included	Included	Included	Included

*Utilizing the FERC Surplus Interconnection Process

Major Generation[3] Facility Retirements in 2024 Reliability Study

Company	Generation Facility	2029S	2029/30W	2034S	2034/35 W
DEC	Allen 5 (259 MW)	Retired	Retired	Retired	Retired
DEC	Marshall 1&2 (780 MW) – Generator Replacement Request (GRR) approved	Retired	Retired	Retired	Retired
DEP	Blewett CTs 1-4 and Weatherspoon CTs 1- 4 (232 MW)	Retired	Retired	Retired	Retired
DEP	Roxboro 1&4 (1091 MW) – GRR approved	Retired	Retired	Retired	Retired

Local Economic Studies for 2024 Study

2034/35 Winter Hypothetical Transfer Scenarios

- For a variety of reasons (such as load growth, generation retirements, or power purchase agreements expiring), some LSEs may wish to evaluate other resource supply options to meet future load demand. These resource supply options can be either in the form of transactions or some "hypothetical" generators which are added to meet the resource adequacy requirements for this study.
- In 2024, the PWG will analyze cases that examine the impacts of eight different hypothetical transfers into, out of, or through the DEC and DEP systems. These 2034/35W hypothetical transfers are identified in the table below:

ID	Resource From	Sink	Test Level (MW)
1	SOCO	DUK[4]	1,000
2	DUK	SOCO	1,000
3	TVA	DUK	1,000
4	DUK	TVA	1,000
5	PJM	DUK / CPLE[5]	1,000 / 1,000
6	DUK / CPLE	PJM	1,000 / 1,000
7[6]	MISO	DUK	1,500
8	DUK	CPLE	1,000

[3] Major Generation Threshold is considered to be 10 MW or greater and connected to the transmission system.
[4] DUK is the Balancing Authority Area for DEC.
[5] CPLE is the eastern Balancing Authority Area for DEP.
[6] This hypothetical transfer is intended to satisfy a Local Economic Study request submitted by the TAG.

- The PWG will analyze these hypothetical resource options to determine if any reliability criteria violations are created. Based on this analysis, the PWG will provide feedback to the Participants on the viability of these options for meeting future load requirements. The results of this analysis will be included in the 2024 Collaborative Transmission Plan Report.

Study Criteria

The study criteria used will promote consistency in the planning criteria used across the systems of the Participants, while recognizing differences between individual systems. The study criteria will consider the following reliability elements:

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

Case Development

- The most current MMWG system models will be used for the systems external to DEC and DEP as a starting point for the Base Case.
- The Base Case will include the detailed internal models for DEC and DEP and will include current transmission additions planned to be in-service for the given year (e.g., in-service by summer 2034 for 2034S cases and in-service by the winter for 2034/2034W cases).
- An "All Firm Transmission" Case(s) will be developed which will include all confirmed long term firm transmission reservations with roll-over rights applicable to the study year(s).
- DEC and DEP will each create their respective generation down cases from the common Base Case and share the relevant cases with each other.
- Additional 2034/35W cases will be developed to evaluate the resource supply scenarios of the fifteen hypothetical transfers identified under the Study Assumptions section.

Study Methodology

DEC and DEP will exchange contingency and monitored element files so that each can test the impact of the other company's contingencies on its transmission system. Initially, power flow analyses will be performed based on the assumption that thermal limits will be the controlling limit for the reliability plan. Voltage, stability, short circuit and phase angle studies may be performed if circumstances warrant.

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.

DEC and DEP will report results throughout the study area based on:

- Thermal loadings greater than 95%.
- Voltages less than 100% for 500 kV and less than 95% for 230 kV, 161 kV, 115 kV, and 100 kV buses; pre- to post-contingency voltage drops of 5% or more.

Assessment and Problem Identification

- Each utility will utilize its own reliability criteria for its own transmission facilities. Each utility will document the reliability problems resulting from its assessments. These results will be reviewed and discussed with the TAG for feedback.

Solution Development

- The PWG will develop potential solution alternatives to the identified reliability problems.
- The TAG will have the opportunity to propose solution alternatives to the identified reliability problems.
- DEC and DEP will evaluate the effectiveness of the potential solution alternatives using the same cases, methodologies, assumptions and criteria described above.
- DEC and DEP will develop rough, planning-level cost estimates and construction schedules for the solution alternatives.

Selection of a Recommended Collaborative Transmission Plan

- The PWG will compare alternatives and select the preferred solution alternatives, balancing costs, benefits, and risks.
- The PWG will select a preferred set of transmission improvements that provides a reliable and cost-effective transmission solution to meet customers' needs while prudently managing the associated risks.
- The preferred set of transmission improvements developed by the PWG will be reviewed and discussed with the TAG for feedback.

Report on the Study Results

The PWG will compile all the study results and prepare a recommended collaborative plan for OSC review and approval. Prior to the OSC's final review and approval, the final draft of the study report will be reviewed and discussed with the TAG members to solicit their input on the recommended collaborative plan. The final report will include a comprehensive summary of all the study activities as well as the recommended transmission improvements including estimates of costs and construction schedules.