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**DEP Electrical Facilities Ratings
Methodology (FRM)**

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PURPOSE

To ensure that Facility Ratings used in both planning and operations of the Duke Energy Progress (DEP) Bulk Electric System (BES) are determined based on an established methodology or methodologies.

CLARIFYING STATEMENT

Prior to the merger of Duke Energy and Progress Energy, the Transmission Facilities Rating Methodology of Progress Energy Carolinas had both the NERC FAC-008-3 compliance language and the equipment rating methodology scope describing the basis, criteria, and methodology in the determination of the ampacity ratings of the different equipment comprising a facility. In order to streamline the approach to facility ratings throughout the enterprise, the decision was made to have two (2) separate documents; the Electrical FRM which is this document describing the NERC FAC-008-3 compliance, and the DEP Equipment Ratings Methodology (ERM), mentioned below, describing the basis, criteria, and methodology in the determination of the ampacity ratings of the different equipment comprising a facility.

The effective date of this document is July 31, 2015.

BACKGROUND AND GENERAL RATING METHODOLOGY

With regard to electrical facility ratings, a facility is defined as the set of all current carrying components, including protective and control devices, between two buses.

DEP's facility ratings are predominantly continuous. A small number of DEP transmission lines have two hour emergency ratings. The emergency ratings are only available for use during system contingency events. [FAC-008-3: R2.4.2, R3.4.2] The ratings are defined as follows:

Continuous Rating [FAC-008-3: R2.4.2 R3.4.2]

The Continuous Rating is the maximum load that the power system element can carry continuously without exceeding its normal allowable operating temperature. This rating will have acceptable impact on loss of equipment life.

Eight Hour Emergency Rating [FAC-008-3: R.2.4.2, R3.4.2]

A subset of the lines that have two hour emergency ratings (see Table 4.3 of ERM) have documented engineering evaluations to allow the lines to have eight hour ratings.

Situational Rating

DEP reserves the right to develop a situational rating that is temporary in nature (with a defined time) for a specific facility under specific conditions.

Ambient Temperature

DEP has calculated Facility Ratings for its three regions of service (Coastal, Piedmont, and Mountain) at the following ambient temperatures: 32, 65, 70, 78, 87, and 95 degrees Fahrenheit (F). Planning personnel will use 95 degrees F for its summer models and 70 degrees F for its winter models in the Coastal and Piedmont regions. The Mountain region is calculated with 87 degree summer and 32 degree winter ratings. Those ambient temperatures will likely be the basis for driving capacity upgrades due to planning studies.

Facilities

DEP's facilities can be divided into three main groups: transformers, breakers, and transmission lines. Transformer facilities would include all the components that carry the same current as that transformer bank – that means components on the low voltage side and high voltage side. Transmission Line facilities would include all the components that carry the same current as the transmission line conductor including those at both ends. Breaker facilities are included with the applicable transformer facilities and transmission line facilities. Breaker facilities would include components that carry the same load as the breaker, such as switches, protective devices, etc.

The facility rating will be equal to the minimum rating of the components that make up the facility. [FAC-008-3: R2.3, R3.3] Electrical schematics are reviewed to document the current carrying components within the facility. Electrical ratings have been developed for each current carrying component. Components that make up a facility are documented with their respective ratings.

Ratings for transformers are developed on an individual basis to account for design and final test data.

To develop the ratings for the actual line conductors, the conductor, the line's construction, and the clearances to ground and other items crossing under the line conductors are reviewed. The clearances are used to determine the maximum operating temperature of the line conductors. This maximum operating temperature is then used to determine the ampacity (or rating) of the line segment.

Facility ratings are entered into DEP's electronic planning and operating models of the transmission system to allow performing planning and operating studies of the system. Facility ratings are also entered into the 'real time' Energy Management System (EMS) used by DEP's system operators to monitor and control the daily activities on the transmission system.

Planning, Engineering, and Operational Guidelines for Loading Transmission Lines and Terminal Equipment.

Conductor ratings may be set by the maximum temperature that the conductor, using its designed installation or more recently verified clearances, can operate at and still maintain required NESC clearances. Ratings may also be set to avoid thermal damage to conductor or line accessories. Equipment ratings are based on American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), and other industry standards requirements or by limits set by the equipment manufacturer.

The ratings for conductors and equipment should be adjusted for as-built conditions that are discovered in the field. These can result from items such as encroachments on the right-of-way by others or through errors created during the initial design and construction of the facility. When an as-built condition is discovered that delivers clearances less than those required by the NESC the following actions should be taken:

1. Identify all the spans that do not meet the NESC clearance requirements.
2. Analyze each span identified to determine the new temperature rating.
3. Notify System Operations of the new temperature rating.
4. System Operations, together with Field Operations, Planning, and Engineering as appropriate, will perform an operational risk assessment associated with implementing the new rating.
 - a. If the risk assessment determines that the operational risk is acceptable, then de-rate the line to the new rating and develop a work plan to return the line to the desired rating in a timely fashion.
 - b. If the risk assessment determines that the operational risk is not acceptable, then put an emergency operational plan in place that allows the facility to be operated at a rating that mitigates the operational risk. Additionally, a work plan will be developed to return the line to the desired rating in a timely fashion.
5. Line Engineering models should be updated to reflect as-built conditions.

Due to limitations of planning models ability to accurately reflect flows of breaker and a half or ring bus configurations, DEP calculates ratings based on the normal operating conditions for the system. These “Normal Ratings” assume no equipment being out of service with the load being split between the breakers of any configuration other than a single breaker configuration. These “Normal Ratings” include what is physically located in series with the transmission line such as single breakers, switches, and wave traps. CT ratio settings for the transmission line protection are also included as a possible limitation. For these “Normal Ratings”, the criteria for limits on the transmission line stops where the line meets the bus inside the substation; thus only the single breaker configuration is considered as a line limit. The Facility Rating Spreadsheet has the ability to show “*Study Ratings*” which has the same criteria as the Normal Ratings and also includes the breakers and switches on each side of the bus where the transmission line connects. This allows the operators and planners to observe substation equipment limitations that were not considered in the normal limitations.

Jointly-owned and jointly-operated facilities [FAC-008-3: R6]

Examples of these facilities include transmission lines that run between the DEP transmission system and generating facilities and facilities that run between the DEP transmission system and neighboring utilities.

The rating of jointly-owned and jointly-operated facilities will be coordinated among the joint owners and operators so that there is a single set of ratings for these facilities.

For each interconnection:

DEP’s neighboring utilities provide rating limits for their side;
 DEP lists all components on the DEP side;
 DEP and neighboring utilities combine those to determine overall limit

Generator owners supply facility ratings for components starting with the generator and up to the point of interconnection with the transmission owner (could be the generator step up transformer). Transmission owners determine facility ratings for the components on their side of the interconnection point. Generation methodology for R2 and Transmission methodology for R3 share a common methodology for some generator interconnecting facilities, typically from the GSU to the point of interconnection. Facility ratings are determined considering the generation equipment, the generator step up transformer (GSU) and the transmission arrangement. [FAC-008-3: R6]

EQUIPMENT RATING METHODOLOGY

The DEP Equipment Ratings Methodology SPS document provides the methodology for the determination of equipment ratings that comprise the facility. The methodology is based on manufacturers’ specifications, industry standards, or engineering/industry practices that have been verified by testing, performance history, or engineering analysis. [FAC-008-3: R3.1] The underlying assumptions, design criteria, and methods used to determine the equipment ratings include the following considerations [FAC-008-3: R3.2]:

- ratings provided by equipment manufacturers [FAC-008-3: R3.2.2]
- design criteria (industry practices, industry standards, etc.) [FAC-008-3: R3.2.1]
- ambient temperature (the temperature of the surrounding medium such as air, earth, liquid, etc.) [FAC-008-3: R3.2.3]
- operating limitations [FAC-008-3: R3.2.4]
- other assumptions (solar, wind, etc.)

The scope of equipment addressed in the DEP Equipment Ratings Methodology SPS document in determining ratings of the Bulk Electric System (BES) shall include, but not be limited to, transmission conductors, transformers, relay protective devices, terminal equipment, and series and shunt compensation devices (shunt capacitors, shunt reactors, static VAR compensators, series reactors). It should be noted that no primary fuses are utilized as terminal equipment in the DEP transmission BES. [FAC-008-3: R3.4, R3.4.1]

The most current version of the DEP Equipment Ratings Methodology SPS document is stored in the corporate document management system (STDP-STD-TRM-00103).

Relay Settings

For those transmission lines that meet NERC Standard PRC-023 by using requirement R.1.12, a relay setting component is considered as part of the Facility Rating.

When overcurrent relay settings exist for a facility, they are included in the facility rating.

Capacitor Banks

DEP determines the effective MVAR of capacitor banks based on kV ratings of cans, number of cans in series, KVAR rating of cans, and the nominal voltage and inserts those capacitors in planning models accordingly.

COMMUNICATION OF FACILITY RATING METHODOLOGY

Electrical Facilities Ratings Methodology documents will be made available upon request, within 21 calendar days of receiving a request. *[FAC-008-3: R4]*

DEP will provide a written response to a technical review of Electrical Facilities Ratings Methodology documents within 45 calendar days, upon the receipt of a written request from a PA, RC, TP, or TOP. The response shall indicate whether a change will be made to the Facility Ratings Methodology and, if no change will be made to that Facility Ratings Methodology, the reason why. *[FAC-008-3: R5]*

DEP will provide Facility Ratings *[FAC-008-3: R8.1.1]* and the identity of the most limiting component *[FAC-008-3: R8.1.2]* for its solely owned and jointly owned Facilities to its associated RC, PC, TP, TO and TOP, when requested.

Under the circumstances listed in FAC-008: R8.2, DEP will provide the identity of the next most limiting component *[FAC-008-3: R8.2.1]* and its thermal rating *[FAC-008-3: R8.2.2]*

REVISION HISTORY

Date	Revision	Changed By	Pages or Sections Revised and Description
07/31/2015	000	Mark Byrd	Revised as part of the Roles and Responsibilities Agreement on Transmission Facility Ratings signed/agreed upon in 2014 by Transmission Planning, Compliance, System Operations, Engineering, and Asset Management to be implemented in 2015. The Facility Ratings Methodology for DEP to address NERC FAC-008-3 compliance language is this revised FRM document. The basis, criteria, and methodology in the determination of the ampacity ratings of the different equipment comprising a facility which were in the previous revision are now included in the DEP Equipment Ratings Methodology SPS (TSS-LRS-SPS-CE-0004) document. Both documents become effective with the Effective Date of this FRM document. FRM was modified to FUSION format.
7/1/2017	001	Bill Quaintance	Page 2, "Ambient Temperature" section, corrected the winter temperature assumption (from 32 to 70) for Coastal and Piedmont regions. Page 4, last sentence, added new document number for the DEP Equipment Ratings Methodology SPS document (STDP-STD-TRM-00103). Minor punctuation and grammar edits. Turned off yellow highlighting.