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Application of NESC Insulator Requirements in PLS-CADD, PLS-POLE and TOWER

Introduction

An understanding of the NESC insulator strength requirements and their application in PLS-CADD, PLS-POLE, and TOWER is critical in order to ensure that correct results are obtained. This Technical Note will briefly discuss the NESC requirements and show how to translate this into settings for criteria and loads within our software.

NESC Requirements

First, let's cover the NESC requirements for insulator strengths. Rule 277 of the NESC governs the mechanical strength of insulators. It can be found on page 216 and 217 of the 2023 NESC (page 255 and 256 of the PDF version) and is as follows:

> *277. Mechanical Strength of Insulators*
> *Insulators shall withstand all applicable loads specified in Rules 250, 251, and 252 without exceeding the percentages of their strength rating for the respective insulator type shown in Table 277-1.*
> *EXCEPTION: Strength rating percentages other than those in Table 277-1 may be used if supported by a qualified engineering study, operating experience for local conditions, or recommendations of manufacturers.*

This Rule indicates that all applicable loads from Rules 250, 251, and 252 should be used.

Rule 250 is *General Loadings and Maps*; Rule 251 is *Conductor Loading* and Rule 252 is *Loads on Line Supports*. It should be noted that Rule 253 is NOT required to be followed. Rule 253 is *Load Factors for Structures, Crossarms, Support Hardware, Guys, Foundations, and Anchors*.

Literal interpretation of these requirements is that the loadings as specified in Rule 250B (NESC District Loading), Rule 250C (Extreme wind loading), and Rule 250D (Extreme wind with concurrent ice loading) with conductor tensions adjusted to account for the constant specified in Rule 251, and applied to the structure as specified in Rule 252 should be used. Note that literal interpretation of these requirements does NOT specify that the overload factors specified in Rule 253 should be used. This is further clarified by footnote 8 of **Table 253-1 – Load factors for structures, crossarms, support hardware, guys, foundations, and anchors to be used with the Strength Factors of Table 261-1** which states '*Support hardware does not include insulators. See Rule 277 for insulator strength and loading requirements*.'

Implementation in PLS-CADD, PLS-POLE and TOWER

With that background let's cover the application of these Rules in PLS-CADD, PLS-POLE and TOWER. In PLS-CADD (both the full version and in Lite), under ***Criteria/ Structure Loads (methods 3,4)…***, Rule 250B, 250C and 250D load cases should be specified for the insulators.

For these load cases, the vertical, wind, tension, and structure weight Load Factors should be set to 1.0 for the insulator loading conditions for literal interpretation of the NESC.

On the other side of the loading equation is the Strength Factor. For Insulators the entered value should correspond to the what has been input in the PLS-POLE / TOWER Insulator Component library. There are two ways this can be approached:

1. If you specify the ultimate strength of the insulators in the Component library of PLS-POLE / TOWER, then you need to take the strength reduction factor of Rule 277 as the Strength Factor for Insulators in PLS-CADD.

2. If you use the reduced published rated ultimate strength of the insulators in the Component library of PLS-POLE / TOWER, then you should use a value of 1.0 for the Strength Factor for Insulators in PLS-CADD.

The Engineer of Record needs to understand if their load curves or published capacities from the manufacturer include or exclude the Strength Factor value and then make the correct decision for the Strength Factor in PLS-CADD to ensure that the Strength Factor is not missed or inadvertently applied twice. **Coordination of Load Factors, Strength Factors, and Component strength properties is the responsibility of the Engineer of Record.**

Conclusion

As a software vendor, Power Line Systems cannot take responsibility for deciphering codes, their intentions, or recommending practices with respect to them. This is the responsibility of the Engineer of Record of the project. This Technical Note is meant to flag this important issue so that designers can set up PLS-CADD criteria to match their interpretation of the code.