National Electrical Safety Code®

Interpretation

Section 23.
Clearances

Rule 235C2b(1)(c)
Clearance for wires, conductors, or cables carried on the same supporting structure – Vertical clearance at the support for line conductor and service drops - Additional clearances – Sag-related clearances

(2017 Edition, page 162)
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Question
What loading conditions are intended for use of an upper conductor to determine an associated ambient temperature for lower conductor sag analysis?

The upper conductor can be evaluated at fully rated conductor ampacity or use historical ampacity loading data to determine an ambient temperature. Depending on which condition is used provides much different ambient temperature results.

Discussion
Example includes an upper 69 kV circuit with 12 kV underbuild on same structures of the same utility. Rule 235C2b(1)(c)i drives the greater vertical clearance and what is being utilized. The upper conductor is of ACSR, thus has a 167 °F maximum operating temperature. Analysis of upper conductor sag can either use conductor rated ampacity loading (970 A), or use actual historical maximum conductor loading data (310 A). Depending on which amperage loading is used drastically changes the ambient temperature at which to evaluate the lower conductor.

To clarify the ambiguous part of the rule comes from what the conductor loading conditions are intended to be in order to achieve the NESC requested ‘maximum conductor temperature’ condition for sag analysis. There are many different combinations of amperage and ambient temperature conditions that can be used to create the designed maximum conductor temperature condition. The design maximum conductor temperature is known based on the conductor ratings from the manufacturer, ambient temperature would therefore be a dependent variable of amperage loading. Subsequently, the determined ambient temperature shall be used to calculate the lower conductor sag at no

load. Clarification is needed as to the intent of the loading conditions for the upper conductor, so the lower conductor can be analyzed at the same ambient condition.

Options for upper conductor amperage loading include: 1) amperage rating limit for the conductor, or, 2) a historically high amperage loading (in my case these are two very different numbers – 900 A vs 200 A, respectively), or, 3) some loading in-between.

This request is not intended or implied as solicitation of design advice, but is instead a necessary clarification in order to ensure proper analysis of existing infrastructure, whereby compliance with the intent of the sag-related clearance rule(s) can be achieved.

Interpretation

The intent of Rule 235C2b(1)(c) is the applicable NESC clearances will be met under the specified conditions where the conductors would be expected to be at their closest approach. The NESC does not specify those conditions. The utility is responsible for determining the ambient loading conditions and the conductor or messenger conditions including (but not limited to) the following:

- Conductor's maximum ampacity under the ambient conditions determined by the utility (may differ by seasons)
- Ambient air temperature
- Each conductor's or messenger's emissivity
- Each conductor's or messenger's absorptivity
- Appropriate ice loadings applicable to the upper conductor or messenger (no ice on lower conductor or messenger)
- Wind speed and direction applicable to the upper and lower conductor or messenger

The maximum operating temperature (not less than 120 °F) for the upper conductor is determined using the above conditions, as defined by the utility, to meet Rule 235C2b(1)(c)i. The same ambient conditions used to determine the maximum operating temperature for the upper conductor will be used for the lower conductor without electrical loading. Likewise, the utility defines the conditions for when the upper conductor temperature is 32 °F with ice loading to meet Rule 235C2b(1)(c)ii.