



Interpretation

Section 12. Installation and maintenance of equipment

Rule 124 Guarding live parts (2017 Edition, page 48) (4 May 2017) IR582

Question: Rule 124 covers the guarding of live parts in substations. For the purposes of guarding, do cable terminations fall under parts of indeterminate potential (Rule 124A3) or insulating covering on conductors (Rule 124C6)?

Discussion: The substations for our company utilize cable systems operating at 4160 V and 6900 V (phase to phase). The cables are multi-conductor, shielded, type MC and connect to the overhead bus via riser structures where the cables have cable termination kits (as per IEEE Std 48). Guarding for the live parts (the compression lugs) are governed by Rule 124A1 and are typically achieved using the clearances from Table 124-1. The insulated, shielded parts of the cable are guarded by insulation per Rule 124C6.

The cable termination provides insulation from the conductor and the exposed live part (the lug) of the cable at the top of the termination and covers the grounded, shield wire that comes out of the bottom of the termination. The top of the termination is at line potential, and the bottom of the termination is at ground potential, therefore the termination itself may be considered a part at indeterminate potential (Rule 124A3). However, the termination is also a non-shielded insulation covering the live parts of the cable, which for the 4160 V system would appear to meet the requirements of Rule 124C6a (less than 2500 V to ground).

The 6900 V system exceeds the 2500 V to ground requirement of Rule 124C6a, as the termination itself is non-shielded. The exception for Rule 124C6a does reference Article 310.6 of the National Electrical Code® (NEC®) (NFPA 70®) for use of non-shielded insulated conductors for use up to 8000 V (phase to phase). However, neither Article 310.6 nor the 8000 V exception are in the latest version of the 2017 Edition of the NEC.

The 2002 Edition of the NEC was the last version to have the 8000 V exception. In the 2005 Edition, the exception was changed to 2400 V; this change effectively required all 4160 V cable systems to use shielded conductors. Both the exception for NESC Rule 124C6a and the exception for NEC Article 310.6 required the non-shielded insulated conductors to be listed by a qualified testing laboratory. Following the change in the 2005 Edition of the NEC from 8000 V to 2400 V maximum, UL 1072 (Standard for Medium-Voltage Power Cables) was consequently revised to require shielded conductors above 2400 V.



In the 2011 Edition, Article 310.6 was removed and the content inserted into Article 310.10(E). From 2011 to the current 2017 Edition, Article 310.10(E) does allow the use of non-shielded, type MC cables up to 5000 V “in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation,” but otherwise limits non-shielded conductors to 2400 V maximum.

It is unclear if the intent of Rule 124C6a is to allow non-shielded, insulated conductors from 2400 V to 8000 V when the NESC requirement to meet the NEC Article is no longer applicable and the cable can no longer be listed to UL 1072. If the exception to the NESC Rule 124C6a is then effectively limited (by reference to the NEC) to 2400 V (phase to phase), it may be interpreted to conflict with the Rule 124C6a allowance of non-shielded insulation up to 2500 V to ground.

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The answer to the question is the cable termination, as described, is of indeterminate voltage.

Rule 124A provides the information to determine when guarding of live parts is required. As stated in the request, the top of the termination is at line potential and the bottom of the termination is at ground potential. Therefore, the cable termination consists of sections of indeterminate voltages. If the cable termination does not have the required clearances for those voltages, then guarding is required. The Code does not specify the point on a cable termination at which various levels of voltage potential may be present; that depends on the gradient characteristics of the cable termination used.

Rule 124C6 provides information on a type of guard that can be used when guarding is required by Rule 124A. The requestor of this interpretation specifically referred to the Exception for this rule. This Exception is based on the type of conductor, and the Exception will not apply because the conductor is shielded.

Thanks to the requestor for pointing out the reference to the NEC Article 310.6. This information will be provided to Subcommittee 3.

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