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Latest Calculation Rules for Secondary Distribution Boxes



Overview

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Key Takeaways

Secondary distribution boxes must be sized and configured based on load calculations, fault current ratings, and compliance with standards such as NEC 220 and IEC 61439 to ensure safe and reliable operation.Load Calculation

The first step in designing a secondary distribution box is to determine the total connected load. According to NEC Article 220, continuous loads (expected to run for 3 hours or more) must be multiplied by 125% to account for sustained operation. General lighting loads are calculated using 3 VA per square foot, excluding garages, unfinished areas, and unused spaces. Fixed appliances, such as dishwashers or microwaves, may require a 75% demand factor if more than four are installed. Small appliance circuits and accessory dwelling units should also be included in the load calculation to ensure accurate sizing of feeders and breakers .

Short-Circuit and Fault Current Considerations

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Secondary distribution boxes must be rated to withstand short-circuit currents that may occur in the system. IEC 61439 specifies that switchgear assemblies must be designed to handle the rated short-time withstand current and the peak short-circuit current without damage. This includes verifying the current-carrying capacity of busbars, cables, and protective devices under operating conditions . IEEE Std 525 provides guidance on cable selection, installation, and protection to minimize failures and ensure that secondary distribution cables can safely carry fault currents .

Configuration and Redundancy

Secondary distribution boxes are often part of radial, selective, or looped systems. In a simple radial system, each bus serves a single load path, while selective or looped configurations allow for automatic or manual switching to maintain service continuity during faults. For example, in a secondary selective system, two independent unit substations can share the load, and a bus tie breaker can restore service quickly if one primary circuit fails . Spot networks, commonly used in high-density areas, provide multiple current paths from transformers to loads, ensuring high reliability and operational flexibility .

Cable and Bus Sizing

Cables and busbars must be sized according to the calculated load, voltage drop, and thermal limits. Shorter secondary distribution runs reduce voltage drop and improve efficiency. IEC 61439 emphasizes verifying maximum temperature rise to prevent overheating, while IEEE 525 recommends proper routing, separation, and handling of cables to maintain system integrity .

Summary

To properly calculate and design secondary distribution boxes:

• Determine total connected and continuous loads using NEC 220 demand factors .

• Verify short-circuit ratings and current-carrying capacity per IEC 61439 .

• Choose an appropriate system configuration (radial, selective, loop, or spot network) for reliability .

• Size cables and busbars to handle load and fault currents while minimizing voltage drop .

• Ensure compliance with relevant standards and maintain documentation for safety and legal protection. Following these rules ensures that secondary distribution boxes operate safely, efficiently, and reliably under both normal and fault conditions.

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