Server Technology, Inc.

Branch Circuit Protection:

Power Distribution for IT Equipment in the Data Center

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White Paper: Branch Circuits

Corporate data centers account for some of the most expensive and sought after real estate in the world today. Enterprises invest huge amounts of capital to design, construct, and secure their investment in IT Equipment (ITE) in the data center. New requirements in the data center require all Information Technology Equipment placed in the data center to meet new UL 60950-1 standards. A key component of this certification for both UL and the National Electric Code (NEC) is ***Branch Circuit Protection***. Without branch circuit protection, enterprises expose themselves to risks and severe consequences.

Consider these important points and weigh the implications of not utilizing safety-agency approved branch circuit protection in your data center:

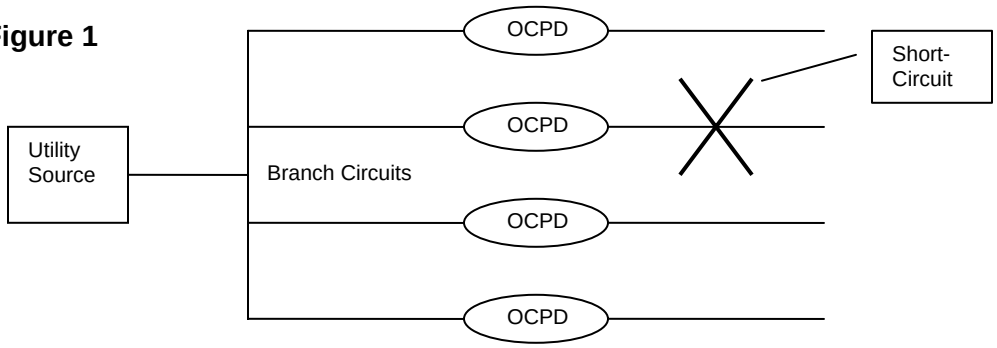
1. Building inspectors following local civic codes or the NEC may fault the data center for being in violation of branch circuit protection requirements.
2. Fire or damage to the data center caused by or contributed to a PDU that is not safety-agency certified may not be covered by property & casualty insurance.
3. Additionally, any organization that uses PDUs *without* safety-agency certification for branch circuit protection in a finished product, or distributes these products, may face a reduction, limitation or exclusion of their product liability coverage, or find that they are not covered in the general liability insurance coverage.

What is a Branch Circuit?

In a rack Power Distribution Unit (PDU), the power input is often broken into multiple segments. A division of the circuit with current limited by a fuse or circuit breaker is referred to as a *branch circuit.*

In a data center IT environment, a PDU with more than one branch circuit is more desirable than a PDU with a single branch circuit because of the protection it provides by limiting the number of outlets associated with each branch circuit. In the event of an overload to a single outlet on the PDU, the overload will be carried back to the fuse or circuit breaker for the branch circuit. If the PDU has only one branch circuit, *all* the outlets on the PDU will be affected – *lost* – as the PDU has only one (1) fuse or circuit breaker (or the branch circuit protection is provided at the main utility PDU). If the PDU has multiple branch circuits, then only the outlets associated within that branch circuit would be lost; the remaining outlets on the PDU's other branch circuit(s) would not be affected. *(See Figure 1).*

Figure 1



About New Branch Circuit Protection Requirements

- PDUs designed for data center equipment cabinets fall into UL's listing for Information Technology Equipment (ITE); UL requires that all new IT equipment submitted for certification be evaluated using the requirements of UL 60950-1.
- As a key component of this certification, all PDUs safety-agency certified in North America to the new UL 60950-1 standard (CSA/UL/TUV) & the National Electrical Code (NEC) are required to have branch circuit protection for receptacles.
- This certification states that all standard outlets and receptacles shall be protected by an overcurrent protection device (OCPD) in the branch circuit, rated or set at not more than the rating of the outlet or receptacle.
- Furthermore, the requirement states that the OCPD shall be of a type that is suitable for branch circuit protection in accordance with the National Electrical Code, ANSI/NFPA 70, and the Canadian Electrical Code, Part 1, CSA 22.1.
- Additionally, the only option for new Information Technology Equipment (ITE) submitted for certification will be UL60950-1, which *does not* permit the use of supplementary overcurrent protection for branch circuits.

What Does this Mean – How does it Differ than Previous Versions?

On any given rack-level PDU, each branch circuit must be protected by a fuse or circuit breaker equal to the individual rating of each outlet. For instance, a PDU with 20 Amp-rated (20A) outlets must have branch circuit protection of 20A, and a PDU with multiple branch circuits must have 20A overcurrent protection (fuse or circuit breaker) for each branch circuit.

For a 20A rated PDU, branch circuit protection can be provided by one of two options:

- On a PDU with a single branch circuit, either an approved OCPD must reside within the PDU, or branch circuit protection for the entire PDU can be provided upstream at the main utility PDU or fuse panel.
- On a PDU with multiple branch circuits, an approved OCPD must reside within the PDU for each branch circuit.

For a PDU with 30A power input feed(s) and 20A outlets, branch circuit protection on the PDU is an absolute requirement:

- Each branch circuit of a 30A power feed must have an OCPD equal to the rating of each outlet.
- The OCPD prevents cordage attached to the PDU's outlets from exceeding its current rating and causing a potential safety hazard.

Additionally, the type of overcurrent device must be of a specific type; circuit breakers must meet UL standard # 489. Most circuit breaker types do not meet the stringent requirements of UL # 489, which includes fault-free overcurrent operation with line faults reaching 5,000 amps. Fuses providing overcurrent protection must meet UL # 248 standards and meet JDDZ designation.

How Does this Impact Your Choice of a Rack PDU?

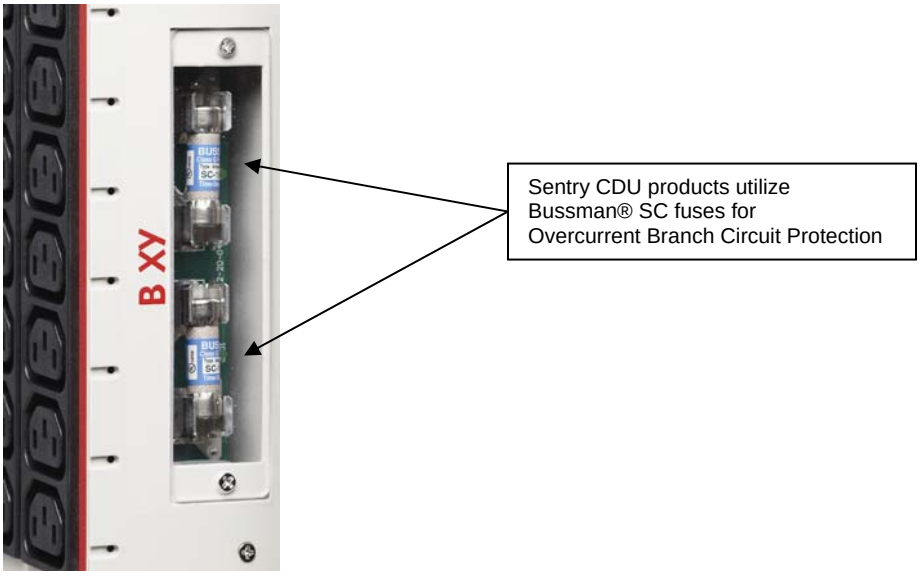
1. To meet the newest safety ratings of the National Electric Code, consider using only PDUs that meet UL 60950-1 standards.
2. For high amperage loads, i.e. 30A per input feed, only a PDU with branch circuit protection will meet the new requirements.
3. PDUs with supplementary circuit breakers will not meet UL 60950-1 criteria. NEC Section 240.10, Supplementary Overcurrent Protection, states:

   "Where supplementary overcurrent protection [i.e., a circuit breaker] is used for [PDUs], it shall not be a substitute for branch-circuit overcurrent devices or in place of the branch-circuit protection."

   This is the key NEC requirement that mandates the use of listed fuses or circuit breakers when branch circuit protection is needed and is the basis for present OCPD requirements in UL 60950-1.

For the security and protection of the data center – and the enterprise – all PDUs, like the Sentry Cabinet Power Distribution Unit (CDU) product family, should be UL 60950-1 certified.

Server Technology's Sentry Cabinet Power Distribution Unit (CDU) is the first product family to address the requirements and importance of branch circuit protection in a cabinet or rack PDU. The Sentry CDU products provide branch circuit protection and meet the new UL 60950-1 criteria by providing branch circuit protection with UL-listed Bussman® SC fuses for each branch circuit. The Sentry CDU products are available with branch circuit protection for (single-phase) 110V, 208V, 240V and three-Phase 208V circuits, and are available in a variety of enclosures – all with the UL 60950-1 certification.



Summary:

Characteristic	Analysis	Description/ Reasoning
A 20A PDU with no overcurrent protection device; branch circuit protection is provided at the main PDU or circuit/ fuse panel	Con	While this product does not require branch circuit protection, consider the implications of not having it; if one outlet on the PDU is overloaded, the circuit breaker/fuse for the entire circuit trips/blows – and all the connected equipment on that circuit is downed.
A 20A CDU with an OCPD fuse approved for UL60950-1	Pro	In the event one outlet is overloaded, the fuse for the corresponding branch circuit will blow, affecting only the outlets on that branch circuit – not all outlets on the CDU.
A 30A PDU with no overcurrent protection device	Con	Branch circuit protection is an absolute requirement for PDUs with a 30A input feed and individual 20A outlet receptacles.
A 30A CDU with an OCPD fuse approved for UL 60950-1	Pro	1.) Branch circuit protection is an absolute requirement for PDUs with a 30A input feed and individual 20A outlet receptacles; and 2.) Fuses provide Fast-acting protection: in the event of a short circuit, the fuse will blow quicker (than a circuit breaker) as a 20A fuse will trip before a 30A breaker; and 3.) Fuses also have an overload time-delay which permits them to pass temporary overloads.
A PDU with an OCPD circuit breaker approved for UL 60950-1	Con	1.) Circuit breakers are mechanical devices, and unlike a fuse, each time they trip or are switched to an off position, it reduces the exact specification is was built to withstand; and 2.) While a circuit breaker can be used as a local power disconnect control, it also has the ability to be accidentally used as a power disconnect. Due to this potential nuisance outage and the importance of maintaining uptime in the data center, we recommend against using circuit breakers; and 3.) The physical size of a UL # 489 rated circuit breaker would not fit within a 1U-wide PDU.
A PDU with a supplementary circuit breaker	Con	A non-UL #489 rated circuit breaker on a PDU is a direct violation of the National Electric Code and UL 60950-1.

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