Standardized and optimized system architectures for data center power distribution

Balancing reliability and cost

Data Center reliability increases as redundant components or systems are added, which decreases utilization of infrastructure assets and increases the cost

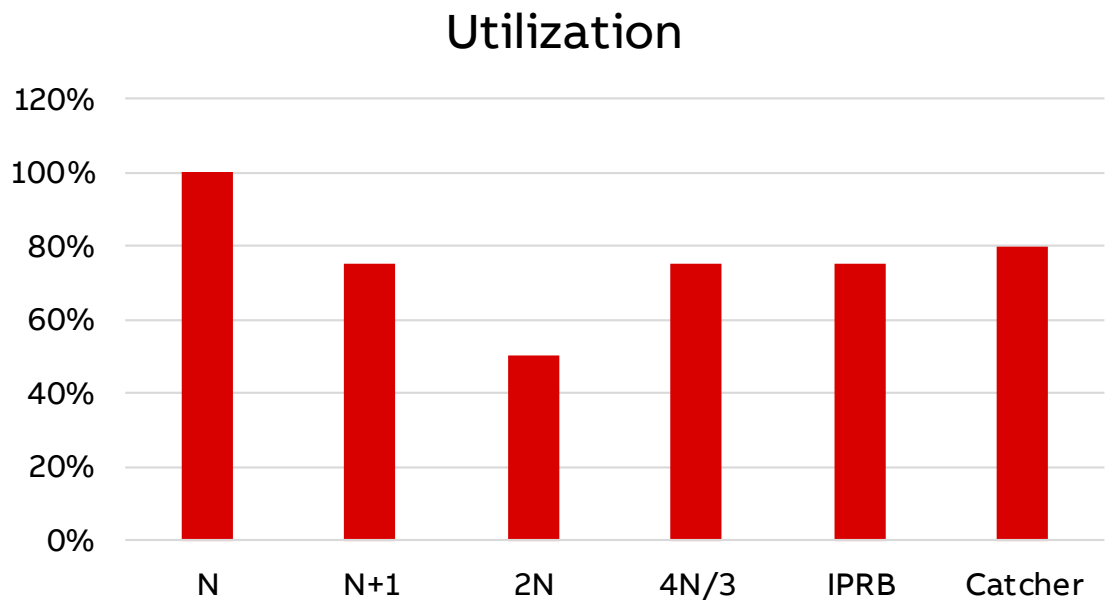
Utilization

Definition:

- to put to use
- turn to profitable account, usually measured as a percentage

Examples:

- Processor utilization: indication of the use versus capacity
- Data center infrastructure: actual load/maximum capacity or design load/equipment capacity



System Plus System Topology

Descriptions

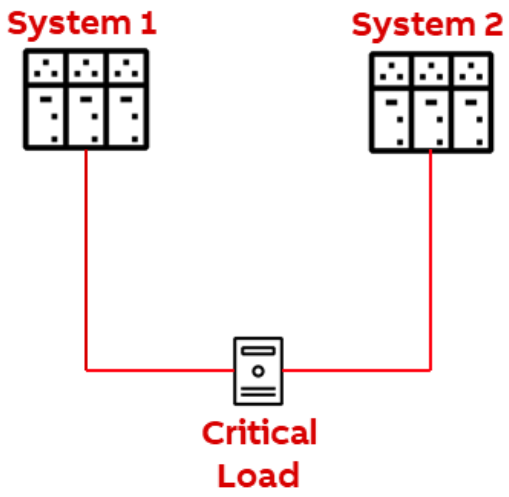
System Plus System

System plus System (aka 2N) topology utilizes two completely independent systems to feed the critical load. The design is based on the customer deploying IT equipment with redundant power supplies sometimes referred to as dual corded loads..

The system plus system design has proven reliability, but is expensive since 50% is the maximum utilization of assets possible with this design

A variant of this topology is System + Utility. The “System” has N+1 UPS while the Utility does not have UPS.

Single Line



Example Customer Types

- Enterprise Data Centers
- Financial Data Centers
- Government Data Centers
- Colocation Data Centers

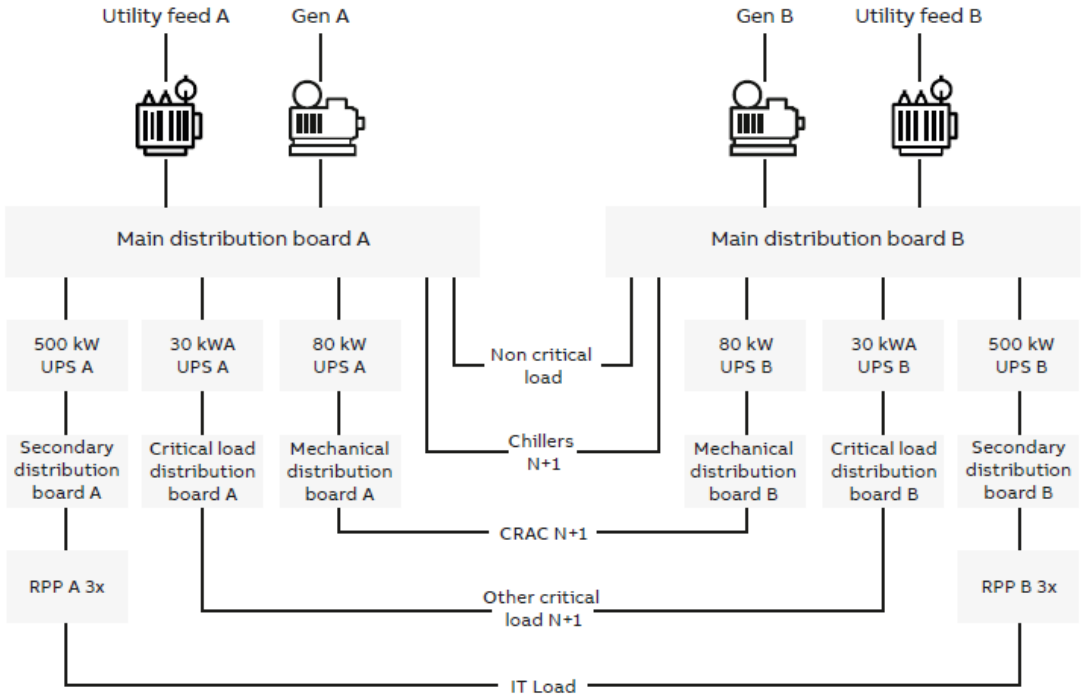
Data Center System Architecture by ABB

System plus system (2N) electrical distribution Data Centers design. 0.5 MW IT load design

Design details

- System plus System for high reliability
- 63 racks with 7 kW/rackPDU for total IT load of 441kW
- Dual corded loads
- Other load (mechanical, safety, service…) designed according to most typical design of this data center size
- Cooling system with chillers and CRACs

Design is realized according to the most typical data center of this size



Our solution for your business

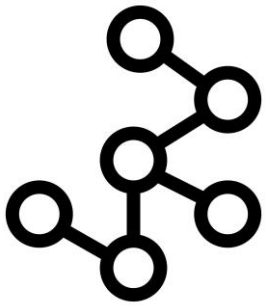
Value Proposition

Consultants/EPCs

- Maximized time saving
- Flexible solution to fit any data center requirements
- Modular and highly reliable design
- Compliant to data center Standards

System integrators

- Seamless integration with other parts of data center infrastructure
- A standalone or integrated monitoring system
- Components integrated in non-electrical systems



Panel builders

- Simplicity and time saving for realization of digitally enabled panel
- Predesigned solution to support building and testing process

End users

- Continuity of service
- Energy efficiency
- Space saving
- Scalability

System plus system (2N) Topology

0.5 MW IT load design

Added value and support for your project

- The main objective is to support data center electrical distribution designers by providing an example of a fully designed low voltage power distribution for a data center along with its main components
- Design is realized to best fit most typical “small-mid” size data center project, however **it always needs to be modified according to specific project** (IT load size and type, cooling system, infrastructure…)
- ABB can provide support throughout the project, but ABB cannot be considered accountable or responsible for the final design and/or project outcome
- The full potential of the documentation is when it is used with:
  1. Single line diagram of the power distribution design and
  2. ABB Ability EDCS wiring diagram

System plus system (2N) Topology

0.5 MW IT load design

Load breakdown

- Nominal IT load of 441kW
- Total data center load is 760 kW
- Table represents the nominal electric input power of the loads which are considered in this data center design
- This can be changed according to type of cooling system, fire suspension system, infrastructure…
- In case of any change, selection of components needs to be done accordingly

Looking at the total load and IT load of a data center, and distribution losses of no more than 5% → **1 < PUE < 1.8**

Load type	Number of loads	Nominal input electrical power [kW]	Double input feed internal to unit	Connected to UPS	Configuration	Type of load	Load connection	Total load N [kW]
Computer room (servers)	63	7	yes	yes		IT load	Single phase	**441**
Building automation system	2	0.5	yes	yes	N+1	IT load	Three phase	**0.5**
CRAC	6	15	no	yes	N+1	Mechanical load	Three phase	**75**
Chillers	3	100	no	no	N+1	Mechanical load	Three phase	**200**
Fire extinguishing pumps	3	5	yes	yes	N+1	Critical	Three phase	**10**
Intrusion alarm control	2	0.5	yes	yes	N+1	Critical	Three phase	**0.5**
Excess control	2	0.5	yes	yes	N+1	Critical	Three phase	**0.5**
Fire detection	7	0.5	yes	yes	N+1	Critical	Three phase	**6.5**
Other critical loads	2	1	Yes	Yes	N+1	Critical	Three phase	**1**
Service	11	2.5	no	no	N+1	Non-critical	Three phase	**25**
Total load								**760**

System plus system (2N) Topology

0.5 MW IT load design

Tier IV equivalent

- Electrical system is designed to correspond to Tier IV data center, but being Tier IV certified depends on the rest of the system (cooling, security, infrastructure…)
- Document is **checked by Uptime Institute** and we got approval to publish the document with references to this body and Tier level classification

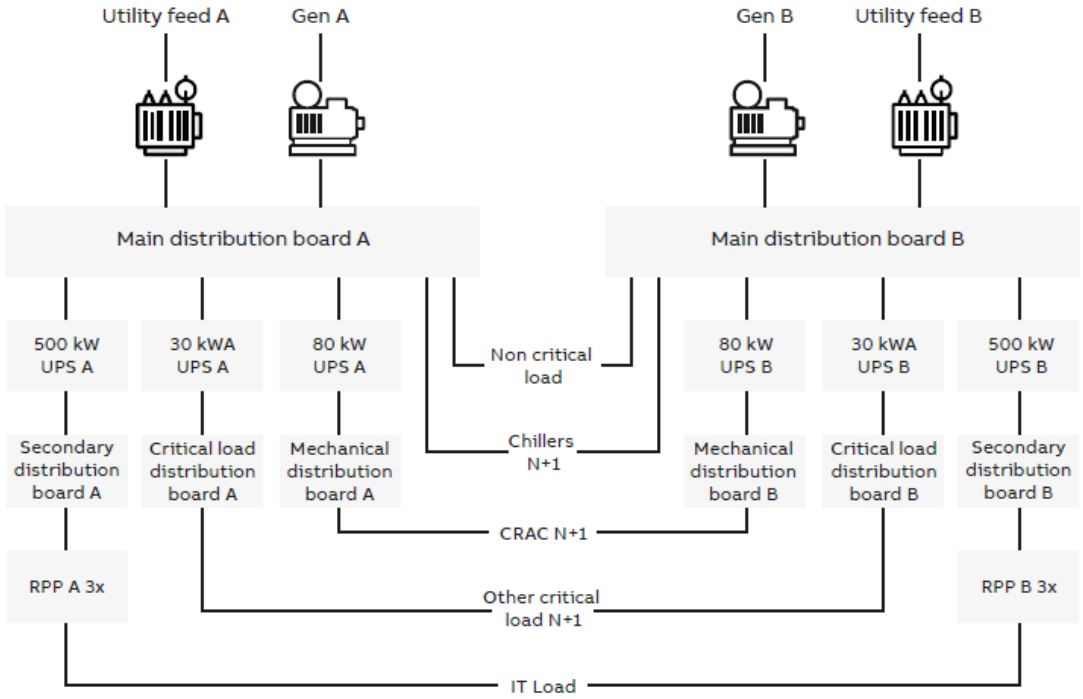
	Tier I	Tier II	Tier III	Tier IV
Minimum capacity components to support the IT Load	N	N+1	N+1	N After any Failure
Distribution paths-electrical power backbone	1	1	1 Active and 1 Alternate	2 Simultaneously Active
Critical power distribution	1	1	2 Simultaneously Active	2 Simultaneously Active
Concurrently maintainable	No	No	Yes	Yes
Fault tollerance	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous cooling	No	No	No	Yes

System plus system (2N) Topology

0.5 MW IT load design

ABB solution for electrical distribution

- The complete choice of equipment for power distribution has been done
- Advantages of using certain products and solutions
- Easy modifications to fit different data center design
- Unique ABB solutions to maximize energy efficiency, reliability, space saving and scalability
- Continuity of service as highest priority:
  - Embedded ATS on ABB circuit breakers
  - ABB circuit breaker predictive maintenance
  - “Hot” swapability of UPS modules and miniature circuit breakers
  - Total selectivity by ABB
  - Dry type transformers
  - Detailed equipment monitoring including inside switchgear temperature, and other

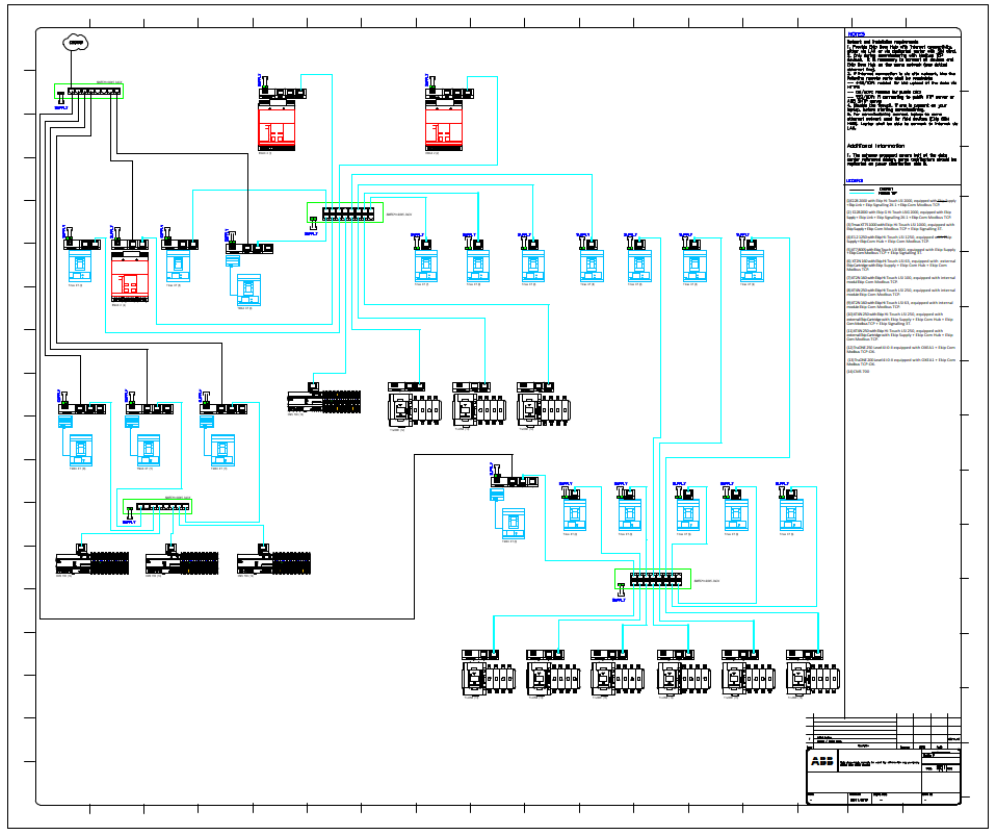


System plus system (2N) Topology

0.5 MW IT load design

Monitoring system

- Full connectivity and communication diagram allowing connection to the local monitoring system (also 3rd party) and/or cloud connection to ABB Ability EDCS
- Editable version also available
- ABB Ability EDCS is selected as a monitoring system since it fits the size and requirements of this type of data center

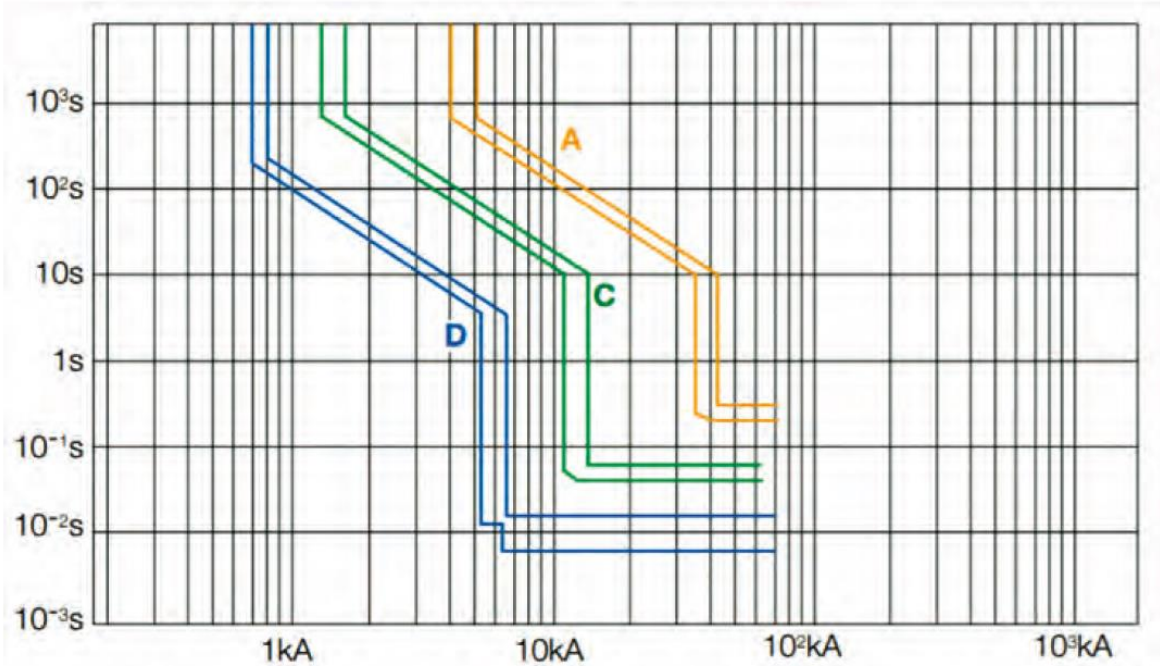


System plus system (2N) Topology

0.5 MW IT load design

Selectivity

- For this data center design, total selectivity is guaranteed between protection zones. This allows disconnection of the minimum possible area affected by the fault
- Particular attention is paid on coordination between circuit breakers and UPSs
- For any change in the data center design, selectivity analysis should be re-done
- To analyze and set the selectivity between protection devices “DOC web” can be used (link)



System plus system (2N) Topology

0.5 MW IT load design

Modularity principle

- Modularity principle as a key data center requirement
- This is especially thanks to the DPA UPS design by ABB, which allows a true modularity of the UPS system
- Additionally, modularity of the UPS is followed by **all devices within the system** (e.g. using the Smissline TP technology of MCBs)
- This enables the data center customer to really respect the **"pay as you grow"** principle with very high granularity, which is especially valuable for colocation data center providers

Steps	Maximum number of racks	Maximum IT Load [kW]	Minimum number of DPA 500 100kW UPS modules	RPPs number (N+N)	Minimum number of chillers + TruONE 250A (N+1)	Minimum number of CRAC units + TruONE 200A (N+1)	Minimum number of DPA UPScale S2 ST 120 20kW modules (N+N)
1	12	84	1+1 (100 kW + 100 kW)	1+1	1+1	1+1	2+2 (40 kW + 40 kW)
2	21	147	2+2 (200 kW + 200 kW)	1+1	1+1	2+1	3+3 (60 kW + 60 kW)
3	42	294	3+3 (300 kW + 300 kW)	2+2	2+1	4+1	4+4 (80 kW + 80 kW)
4	57	399	4+4 (400 kW + 400 kW)	3+3	2+1	5+1	4+4 (80 kW + 80 kW)
5	63	441	5+5 (500 kW + 500 kW)	3+3	2+1	5+1	4+4 (80 kW + 80 kW)

System plus system (2N) Topology

How to get the documentation

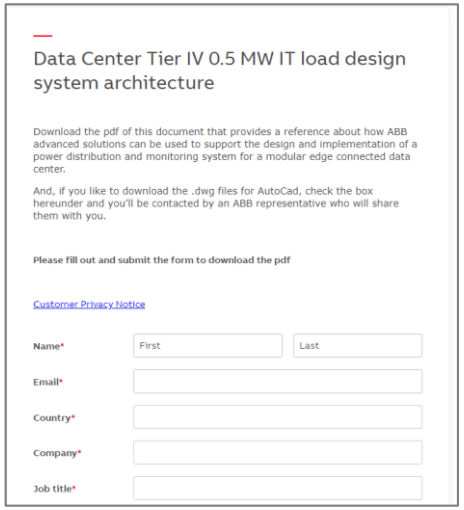
Download white paper from internet

- You will be able to find the full and detailed description of the data center design
- (LINK)

Download PDF designs from white paper

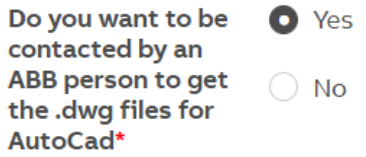
- By clicking on QR code within document it is possible to get more detailed documentation by filling the form (LINK)
- This gives you access to non editable PDF version of single line diagram (SLD) and connectivity diagram

Single line diagram of a power distribution design and ABB Ability EDCS wiring diagram



Download DWG designs from white paper

- Within the form (LINK) there is a section to select if you want to be contacted by ABB to get editable version of the files
- The automatic email is sent to ABB, and our data center responsible within your country will contact you and send you the editable DWG version of single line diagram (SLD) and connectivity diagram
- At the same time, you will be able to get support from ABB when designing and building your data center



Shared Redundant Topology

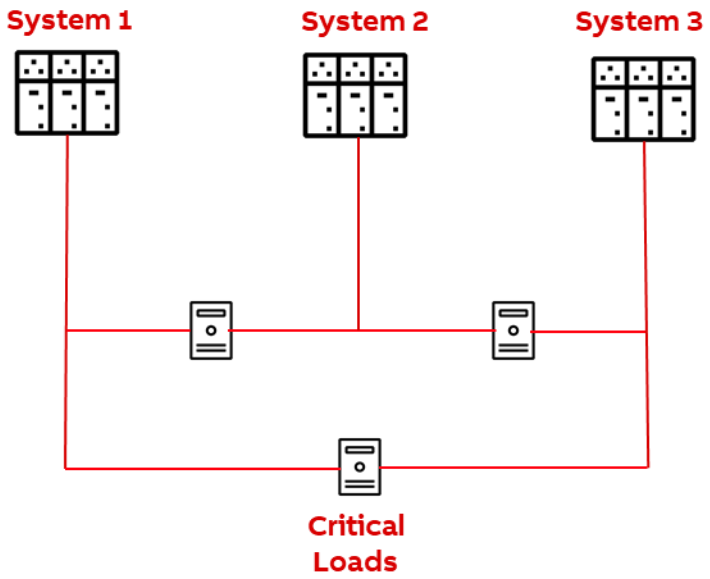
Descriptions

Shared Redundant

Shared redundant is similar to system plus system, but uses multiple systems to reduce cost by increasing utilization. The shared redundant design is normally referred to by the number of systems over the number of loads – 3N/2, 4N/3, etc. For example using 1 MW blocks of IT load, a 3N/2 system would have 3 MW of capacity feeding 2 MW of IT load. This improves utilization to 66%. 4N/3 improves utilization to 75%.

While shared redundant improves utilization, it requires monitoring of loads to insure redundancy is maintained

Single Line



Example Customer Types

- Cloud Data Centers
- Colocation Data Centers

Block Redundant Topology

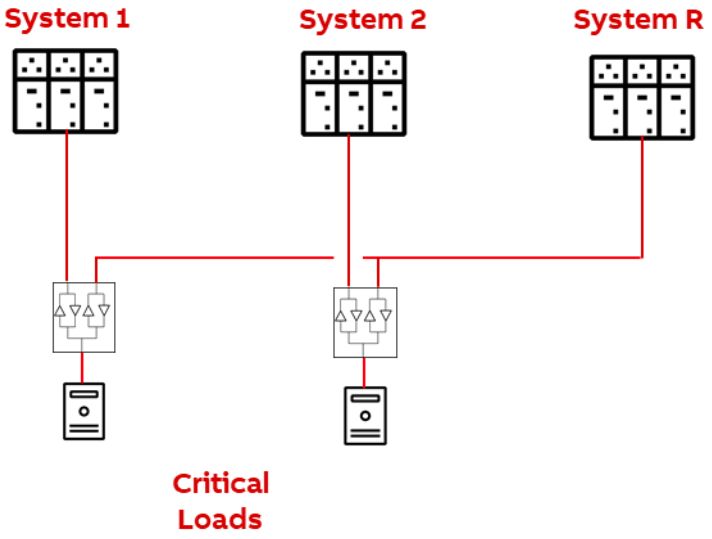
Descriptions

Block Redundant

Block redundant, also known as a catcher topology, utilizes a static transfer switch (STS) to transfer the critical load from the primary or active system to the reserve or catcher system. The active UPS can be loaded to full capacity. The reserve UPS has no load in normal operation. The reserve system can be larger than the active systems. Block redundant utilization as high as 80% is possible.

Block Redundant can be applied with single cord or dual corded IT loads. When using single corded IT loads, the STS is a single point of failure.

Single Line



Example Customer Types

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Data Center Solutions

ABB Pre-Engineered Offerings

Packaged Solution

Supplied as individual components with installation and interconnections by others. Packaged solutions are used with traditional construction methods. A packaged solution can include skid and eHouse solutions.

The value of a packaged solution is one point of contact to coordinate and manage logistics to ensure adherence to project goals and schedules.

Customer values:

- Packaged solution
- Project management
- Worldwide reach
- Coordinated solution
- Reduced overall cost

Skid Solution

The skid is a open frame mounted, compact solution with factory installed equipment and interconnections.

The value of Indoor Skid solutions is to accelerate the construction schedule by supplying a pre-engineered, pre-installed and pre-tested system.

Customer values:

- Simple and quick installation
- Pre-engineered products
- Type tested
- Indoor construction
- Compact

eHouse Solution

The eHouse is a pre-fabricated environmentally controlled building with factory installed equipment and interconnections.

The value of the eHouse solution accelerates the construction schedule, saves building space, and may provide tax advantages.

Customer values:

- Fully integrated system
- Better insulation and thermal management
- Reduced site resources


ABB