MORRISON HERSHFIELD

Isolated-Parallel Redundancy: A New and Better Approach to Large Critical Power Systems Configuration

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This **White Paper** describes a new approach to large critical power system configuration, which offers significant advantages over current practice for a broad range of commercial applications.

Authored by:
Michael Mosman, PE
Principal
Vice President and Chief Technical Officer

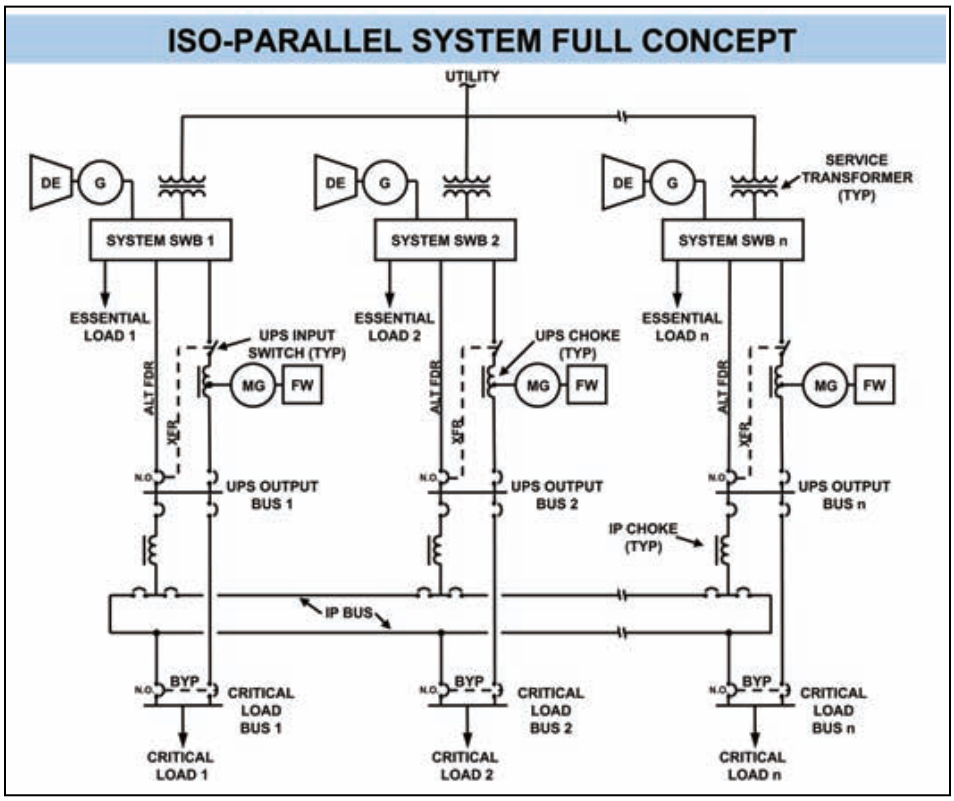
For more information contact:

Morrison Hershfield
1500 S Edgewood Street | Baltimore, MD 21227
Phone: 410-525-0010

www.morrisonhershfield.com

A New and Better Approach to Large Critical Power Systems Configuration

Large technology facilities such as enterprise, wholesale and co-location data centers, and other special uses such as processing centers and laboratories are some of the most energy intensive sites in the world. These facilities hold great responsibility to meet the demands put on them by the business mission they support. When these systems are designed, they typically are provided with emergency back-up engine generators (EGs), and/or uninterruptible power supply systems (UPSs), and are configured with multiple units for redundancy in order to minimize the risk of downtime.



Typically, these configurations have taken one of four basic forms: double-redundant (or system-plus-system) with independent “A” and “B” systems; multi-module parallel-redundant (multiple modules paralleled on a common power bus); isolated-redundant (dedicated modules or systems to act as the redundant unit to all others), and shared-redundant (or distributed redundant) wherein loads are transferred among multiple systems.

Each of these configurations has advantages and disadvantages. Double-redundant, isolated-redundant, and shared-redundant systems provide excellent fault separation between systems, but require expensive fast-acting switches to transfer a load away from a failing unit. Multi-module parallel-redundant systems divide the loads equally among all units, but expose all units to a fault occurring on any unit.

Morrison Hershfield has developed a new form of redundancy, termed Isolated-Parallel (IP) Redundancy. The term 'Isolated-Parallel' implies that the units of the design are isolated from each other, yet still paralleled. The units that make up an IP configuration are paralleled on a common bus through inductive reactors (magnetic chokes). These "IP Chokes" are designed to present little impedance to normal power flow and high impedance to fault power flow. This allows any module connected to the 'IP Bus' to exchange load power with all other modules connected, yet be restricted from providing large amounts of fault power to any point in the system on the other side of its choke.

This configuration combines the advantages of the above noted systems, and significantly reduces the disadvantages. An Isolated-Parallel (IP) arrangement:

- Allows loads to be shared among all units, with no particular unit identified as 'redundant', and can produce paralleled capacities of over 20 MW, providing excellent capacity flexibility.
- Provides fault isolation among units such that a fault on one unit does not cause any other unit to deviate from an acceptable output tolerance.
- Does not require fast acting switches to produce redundancy among the units or systems, although such switches can be used within the design if desired, improving reliability.
- Bypasses a single unit's load equally to all other units within the system during maintenance, not to utility or generators, improving reliability.
- Is adaptable to a broad range of available equipment, including dynamic or static UPS, inertial (flywheel) or chemical (battery) energy storage, diesel UPS with coupled engines, or even engine-generators alone, and to both low and medium voltage levels.
- Allows units to be sized and quantified only for their individual loads plus a percentage equal to the desired level of redundancy, reducing costs.

The IP Redundancy design represents an advancement in the configuration of critical systems.

A number of large critical facility operators have successfully taken advantage of this concept, including DuPont Fabros Technology, Yahoo!, and Chevron Energy Services.