WHY BREAK BEFORE MAKE CONTACTS ON AUTOMATIC STANDBY GENERATOR SYSTEMS

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Switching mechanisms within a standby generator system are vital for reliable, safe operation. In its simplest form, a switch is a mechanism between two points of an electrical line carrying current. When the switch is switched to the open position to prevent electrical current from flowing from one point to the other, it is referred to as braked. Conversely, when the switch is closed to allow current flow between the two points, it is referred to as made or in the make position. When switch mechanisms work together to supply load from independent sources of power, two common terms are used, Make Before Break (MBB) and Break Before Make (BBM). There are reasons for adopting one version over the other when switching a load's electrical supply from one source to another. This information sheet discusses the differences between MBB and BBM, the advantages of adopting one system over the other, and why standby generator systems predominately adopt the BBM switching arrangement.

1.0 THE DIFFERENCE BETWEEN BBM AND MBB:

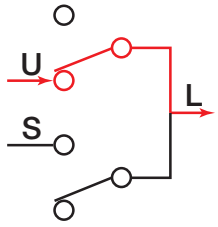
In its simplest form, a switch is either in the closed or open position or, in electrical switching terminology, braked (open - no current flow) or made (closed - allowing current flow). Switches in a system managing current flow from two different power sources frequently must operate together. There are two main differences in how these switches transfer power to the load from one source to the other:

Break Before Make and Make Before Break Switching

Figure 1

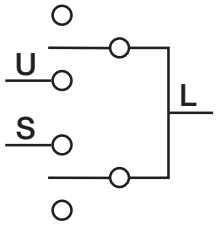
Break Before Make (BBM) switching ATS

Normal State
Utility **U** supplying load



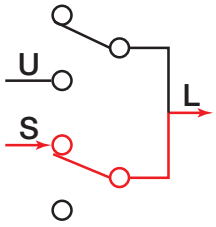
Normal state for ATS load, **L** supplied from the utility **U**. **U** contact/switch is made (closed), standby source **S** open (breaks.)

Break Stage
Utility **contact U** breaks



Controls sense utility is not within limits, **U** opens (breaks) and Standby remains open. Load **L** sees period of no power feed.

Before Make Stage
Utility **U** open S makes (closed)

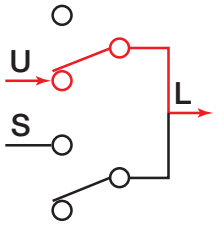


Standby supply comes on line **S** contact/switch makes (closes) and **U** utility contact opens (breaks) completing feed to load **L**.

Figure 2

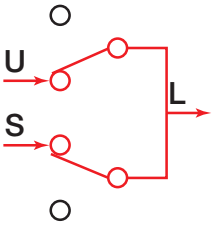
Make Before Break (MBB) switching

Normal State
Utility **U** supplying load



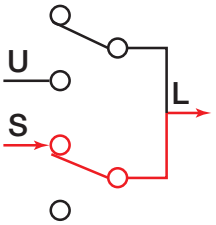
Normal state for ATS, load **L** supplied from the utility **U**. **U** contact/switch is made (closed), standby source **S** open (breaks.)

Make Stage
Utility **contact U** breaks



Controls sense utility is not within limits, **S** standby starts and **S** contact makes (closed) while **U** contact remains closed. For short period back feed.

Before Break Stage
Utility **U** open S makes (closed)

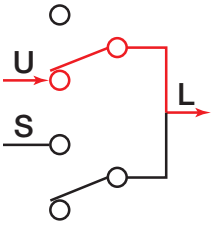


Standby supply **S** remains closed and feeds **L** the load, and Utility contact **U** opens (breaks).

Figure 3

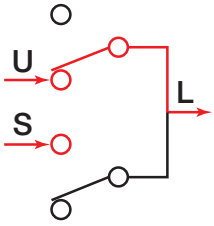
Make Before Break (MBB) switching using paralleling

Normal State
Utility **U** supplying load



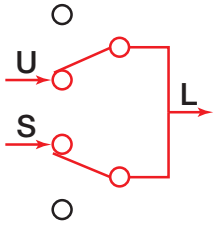
Utility **U** supplying connected loads **L**

Paralleling U & S
S contact remains open



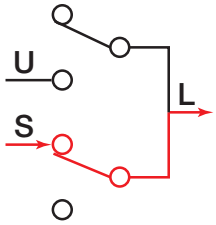
Controller signals load needs to be transferred to standby power source. Before transfer switchgear parallels **S** with **U**

U & S Closed
S contact closes



After paralleling **S** and **U** contacts/switches, **S** makes and **U** remains closed. Both now feeding load paralleled together

U Breaks (Opens)
Utility supplying load

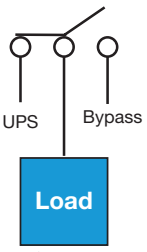


When controls sense **S** has power output to supply load **L**, contact **U** opens/breaks

Figure 4

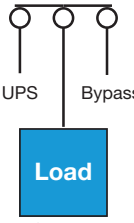
UPS Isolator MBB switching

Normal
UPS feed load



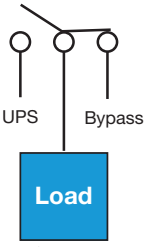
Stage 1

Make
UPS & Bypass feed load



Stage 2
First switching stage Bypass and UPS feed load

Break
Only Bypass feeds load



Stage 3
Next switching stage Bypass only Bypass feeds the load

1.0 THE DIFFERENCE BETWEEN BBM AND MBB: *(Continued from page 1.)*

1.1 Brake Before Make BBM:

When a pair of switches, such as an Automatic Transfer Switch (ATS), operates with one of the pair switching power on and off to the load from the utility and the second of the pair switching power on and off to the load from a standby generator system. The sequence of how they switch is precisely as the acronym BBM. When the load receives power from the utility switch, and the utility goes offline, the utility switch breaks (or opens) before the generator supply switch can close (make) for the load to receive power from the standby generator. In this sequence, the load can only receive power from one source: the utility or the generator. ***See figure 1.***

1.2 MAKE BEFORE BREAK MBB:

In the MBB scenario, when the utility fails, the switch supplying load from the utility to the load remains closed until the switch switching power from the secondary source (standby generator) closes (makes) to supply the load from the generator. In this case, the other switch does not open until one switch closes. ***See figure 2.***

2.0 WHY BBM IS USED ON MOST STANDBY SYSTEMS WITH ATS:

In the MBB scenario there is the possibility of load being supplied simultaneously from the utility and the generator. In MBB arrangement, the contactor will not open (Break) until the second contactor supplying generator power has closed.

Many standby systems will switch the load from one power source to another when one supply source drops in voltage or frequency, not just a complete failure of power. This means in the MBB scenario, during transition, the load could be fed simultaneously from both sources. If the two AC power sources, even for a fraction of time, are not phased to be in parallel, a short circuit could occur and damage the standby power generator.

Therefore, most generator systems using an ATS (pair of change-over-switches) use a Break Before Make (BBM) arrangement. To avoid the possibility of both switches being closed simultaneously, their contacts are electrically and mechanically interlocked to ensure the load can be fed from only one source. *See information sheet on Automatic Transfer Switches.*

3.0 WHEN AN MBB ARRANGEMENT WOULD BE USED:

Many standby generator installations supply power to critical loads that cannot tolerate an interruption in power for even a fraction of a second, let alone the few seconds it takes a secondary power source to come online. In a situation where one power source is starting to fail or cannot deliver full power, it may be preferential to have some power over no power while the alternative power runs up to speed. In this scenario, the outgoing source will not break (be disconnected from the load) until the incoming source is up to speed. This is now a MBB switching system.

To make am MBB system work and avoid AC current from two sources feeding into each other, one of the following arrangements should be adopted.

3.1 PARALLELING POWER SOURCES BEFORE SWITCHING:

While introducing paralleling switchgear is a higher-cost solution, it may be preferable to the risk of losing power to both life and economical critical loads. *See information sheet on Paralleling generator systems*.

When the control gear senses that the existing power supply is outside of required limits, such as voltage and frequency or load demand, the secondary power source will be started. As the secondary runs up to operational voltage and frequency, the paralleling switchgear will sync the AC waveform for the voltage and frequency of both power sources. When the power from the secondary is in sync with the primary (paralleled), it will also be switched to power the load. The existing power source will then break contact after the secondary has made contact. Here, we have a make before break switching system. ***See figure 3.***

Generator applications that incorporate multiple generator sets arranged to run in parallel as demand load fluctuates employ MBB switching systems to ensure downstream loads see no interruption in power supply throughout the transfer process.

3.2 SWITCHING POWER SUPPLY TO UPS COMPONENT:

Many critical loads rely on an Uninterrupted Power Source (UPS) to provide power to the load during the transition from one power source to another. *See information sheet on UPS system*.

In a UPS system, DC electrical energy stored in a battery is converted by an inverter to AC power. AC power fed from the power supply through a rectifier ensures the battery remains fully charged. If one power source fails, a bypass switch will transfer the load to draw power from the UPS system while the secondary power source comes online. This scenario is MBB with the switches momentarily connecting the UPS output and secondary source to the load. Because the UPS battery received rectified DC input from each source, paralleling separate AC supply sources is unnecessary. ***See figure 4.***

4.0 SUMMARY:

A generator system designer, when considering whether the application should use BBM or MBB, will consider:

- **How Critical is the Load** - If the load can tolerate a short power interruption, the most economical solution is BBM. An ATS with mechanical and electrically interlocked contactors will ensure no backfeed on switching.
- **Power Interruptions are Unacceptable** - Many critical loads cannot tolerate a power loss for even a fraction of a second. In this case, MBB with paralleling of the incoming power source is required.
- **Applications with UPS Component** - The application of an isolator switch to ensure connection to the UPS component with MBB switching between the power sources.

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CANAL WINCHESTER, OH
8155 Howe Industrial Parkway
Canal Winchester, OH 43110
(614) 751-4515
(866) 889-2628

CINCINNATI, OH
4992 Rialto Road
West Chester, OH 45069
(513) 755-2323
(800) 368-7422

CLEVELAND, OH
8465 Tower Drive
Twinsburg, OH 44087-0394
(330) 425-9165
(800) 966-2825

TOLEDO, OH
27100 Oakmead Dr.
Perrysburg, OH 43551
(855) 638-2728

CHICAGO, IL
1308 Marquette Drive
Romeoville, IL 60446
(630) 914-3000

INDIANAPOLIS, IN
1707 S. Franklin Road
Indianapolis, IN 46239
(317) 271-9661
(800) 632-0339

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7525 Maplecrest Road #221
Fort Wayne, IN 46835
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