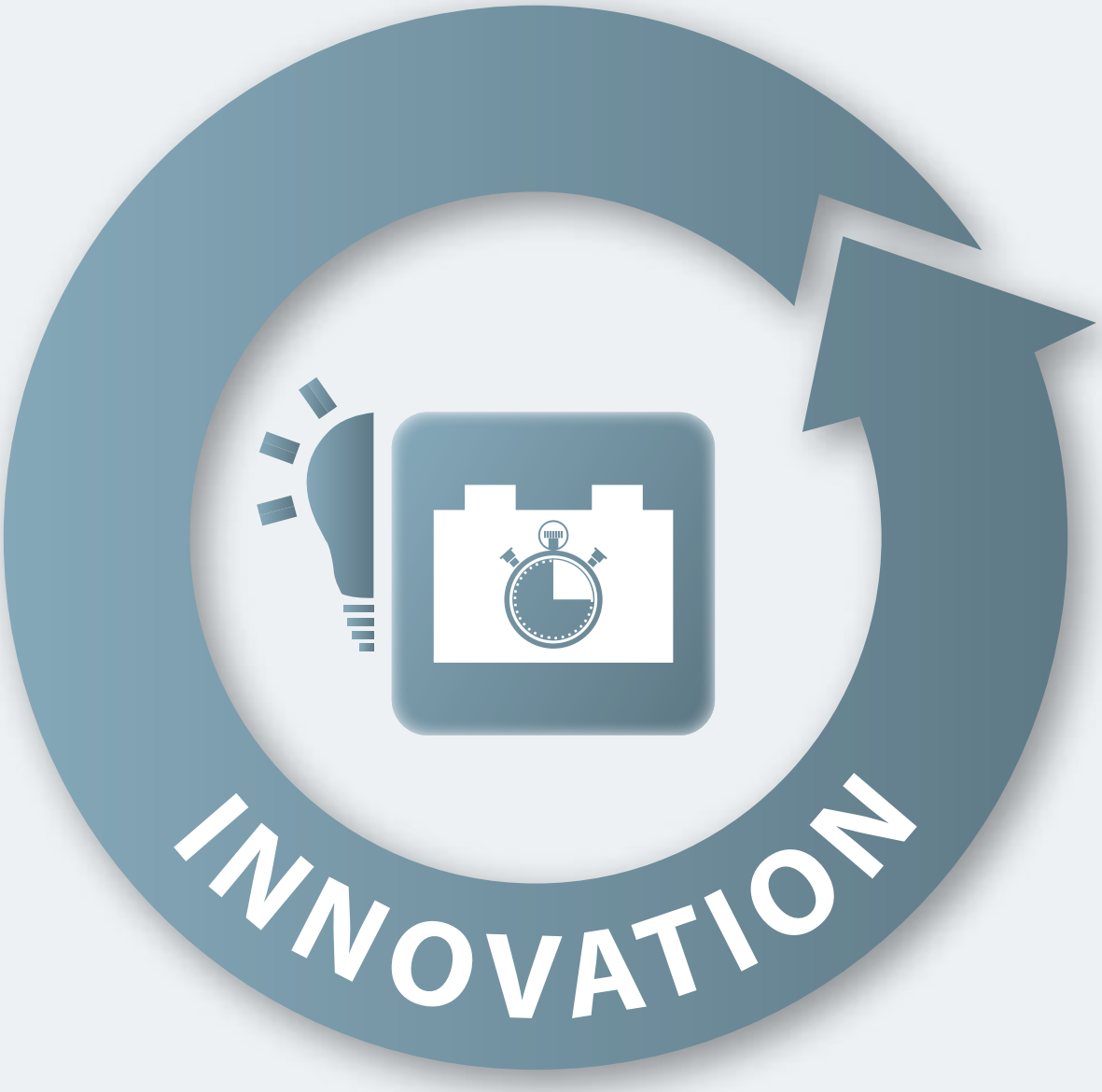
TECHNICAL NOTE

BCR - Battery Capacity Re-injection

Delphys GP & Modulys XL



When **energy** matters

socomec
Innovative Power Solutions

Introduction

APPLI 574 A

There are only 3 main reasons to voluntary discharge a battery

- Check the remaining back up time by discharging the battery until the end of the discharge.
- Discharging the battery for the specified autonomy time to confirm correct battery capacity.
- Stress the battery with a short discharged (e.g.: 5 min) & monitor the test to detect battery weaknesses.

2 moments to voluntary discharge a battery

- During the system commissioning.
- During the life time of the system.

but there are SEVERAL ways to discharge a battery

- By using the real load.
- By using a resistive load bank.
- By re-injecting the current through the bypass of the unit being tested.
- By using the SOCOMEC Battery Capacity Re-injection option.

Contents

Main Battery Capacity Re-injection advantages

Cost saving

- Avoids having to rent/or buy and install a dedicated resistive load bank.
- No dedicated electrical infrastructure required to connect the bank (double bus bar, etc.).
- Battery energy is re-used instead of being wasted.

Accurate and simplified periodical battery discharge test

- Constant power discharge (settable kW).
- Easy to plan.
- No requirement to find a place to site the load bank.
- No additional heat losses to manage.
- Reproducibility of the test conditions year over year.

Safe operation

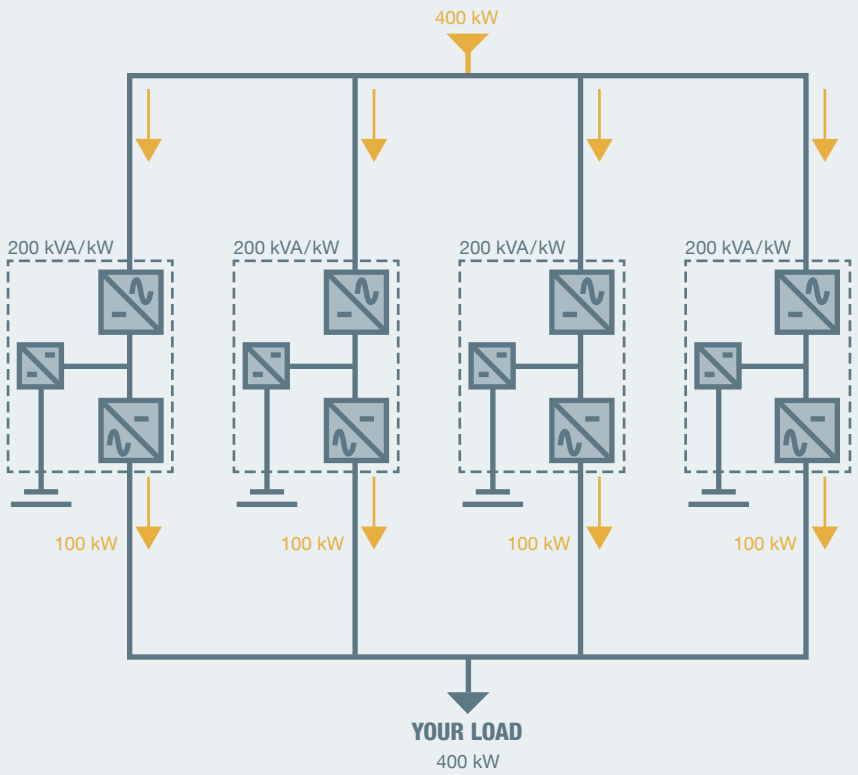
- No temporary installation.
- No electrical hazard risk.

Example

Let's compare the 4 possible solutions:
- using the real load (solution A),
- using a resistive load bank (solution B),
- re-injecting the current through the bypass (solution C),
- using the SOCOMEC Battery Capacity Re-injection option (solution D).

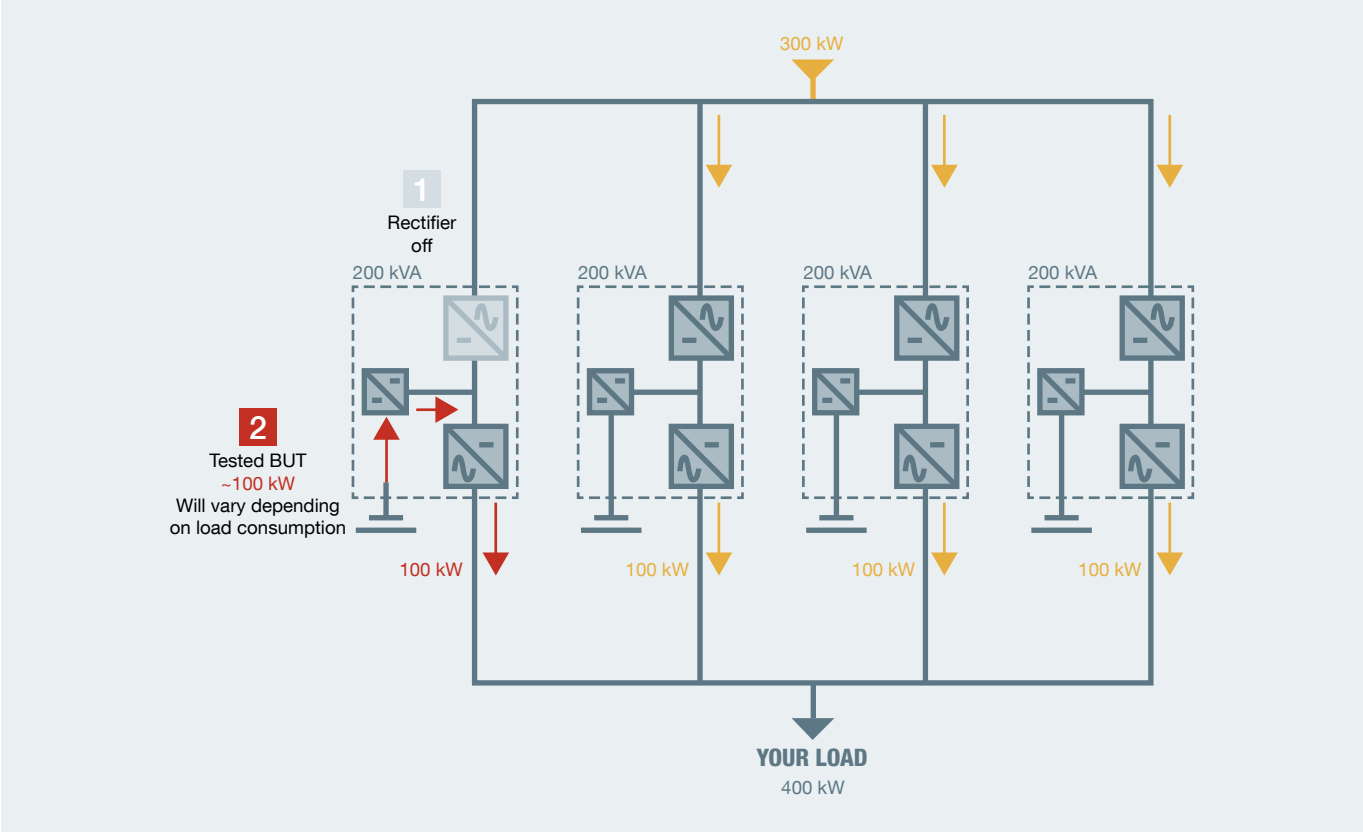
Example of installation of **4 units of 200 kVA/kW working in parallel supplying a load of 400 kW**.
To simplify the explanation and the calculation, we consider no losses within the system.

Normal operation



WP 040 A GB

SOLUTION A
The real load



Principle

The rectifier is usually manually turned off to proceed the test 1 & the battery energy is used to supply the load 2.

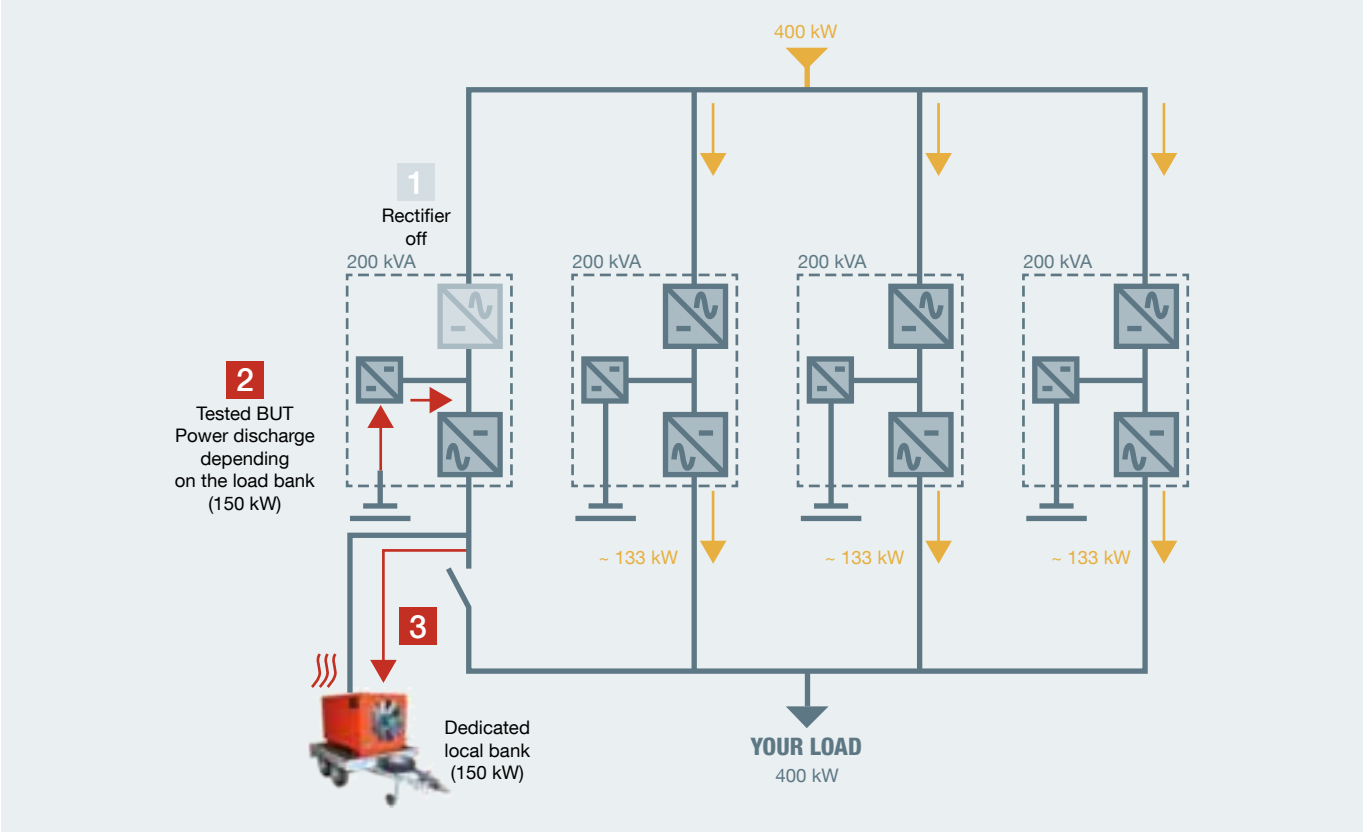
Advantages

- No need to hire a load bank.
- The energy of the battery is used by the load: no energy wasted, no need for additional electrical infrastructure, no extra heat dissipation.
- In case of main failure, the remaining energy within the battery will continue to supply the load.
- The test can be performed with several units in parallel, in “n” or “n+1”; configuration with distributed or centralized bypass architecture.

Disadvantages

- The backup time will depend on the state of your load during the test:
  - the **discharge will not be constant** and will depend on your load utilization during the test,
  - will the load have the same energy consumption the day you have a main failure? Will the battery be able to withstand the BUT if the load has a higher consumption?
  - it will not **be possible to compare the backup time from one measurement to another** (load variation).
- After a mains failure, a **manual action is required** to restart the system and to start to recharge the battery (rectifier is manually turned off during the test).

SOLUTION B
Resistive load bank



Principle

The rectifier is usually manually turned off to proceed the test 1 ; The battery energy is used 2 to supply a temporary load bank 3 .
The load bank has to be installed in a dedicated room or outside. The load bank will dissipate the energy in heat.

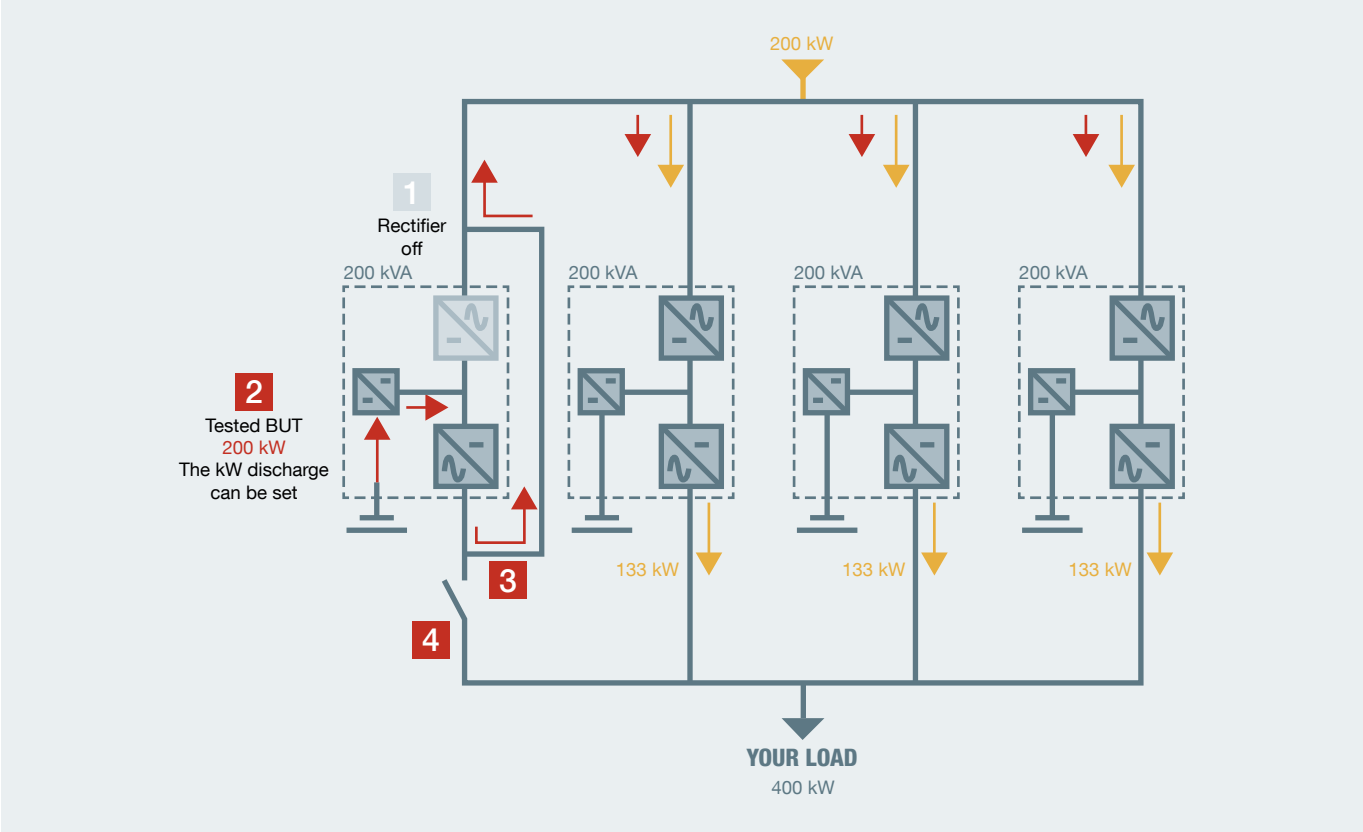
Advantages

- The most common way today to discharge a battery to carry out the test.
- Constant & chosen discharge in terms of kW ; depending on the fix test load bank size ; data will be comparable year over year.
- The test can be performed with several units in parallel (“n+1” configuration only); with distributed or centralized bypass architecture.

Disadvantages

- The **cost**
  - renting or buying a load bank,
  - a potential dedicated electrical infrastructure (test bar, switchboard, panel…),
  - the energy is just wasted in heat,
  - cooling problematic to manage the extra heating if load bank installed indoor.
- Safety due to **electrical hazard** (UPS doors might be kept opened if no dedicated electrical infrastructure have been provided). Temporary installation means cable on the floor, from UPS to load bank. Security doors (i.e. fire retardant) might have to be kept open…
- **Organization issues** (internal agreement & external synchronization required).
- After a mains failure, a **manual action is required** to restart the system and start to recharge the battery (rectifier is manually turned off during the test).
- The test **can be performed ONLY with redundant configuration**, because the tested unit has to be disconnected from the use.

SOLUTION C
Re-injection through bypass



Principle

The rectifier is usually manually turned off to proceed the test 1. The battery is discharged 2 through the bypass 3. If units are working in parallel, the unit has to be disconnected from the load 4.

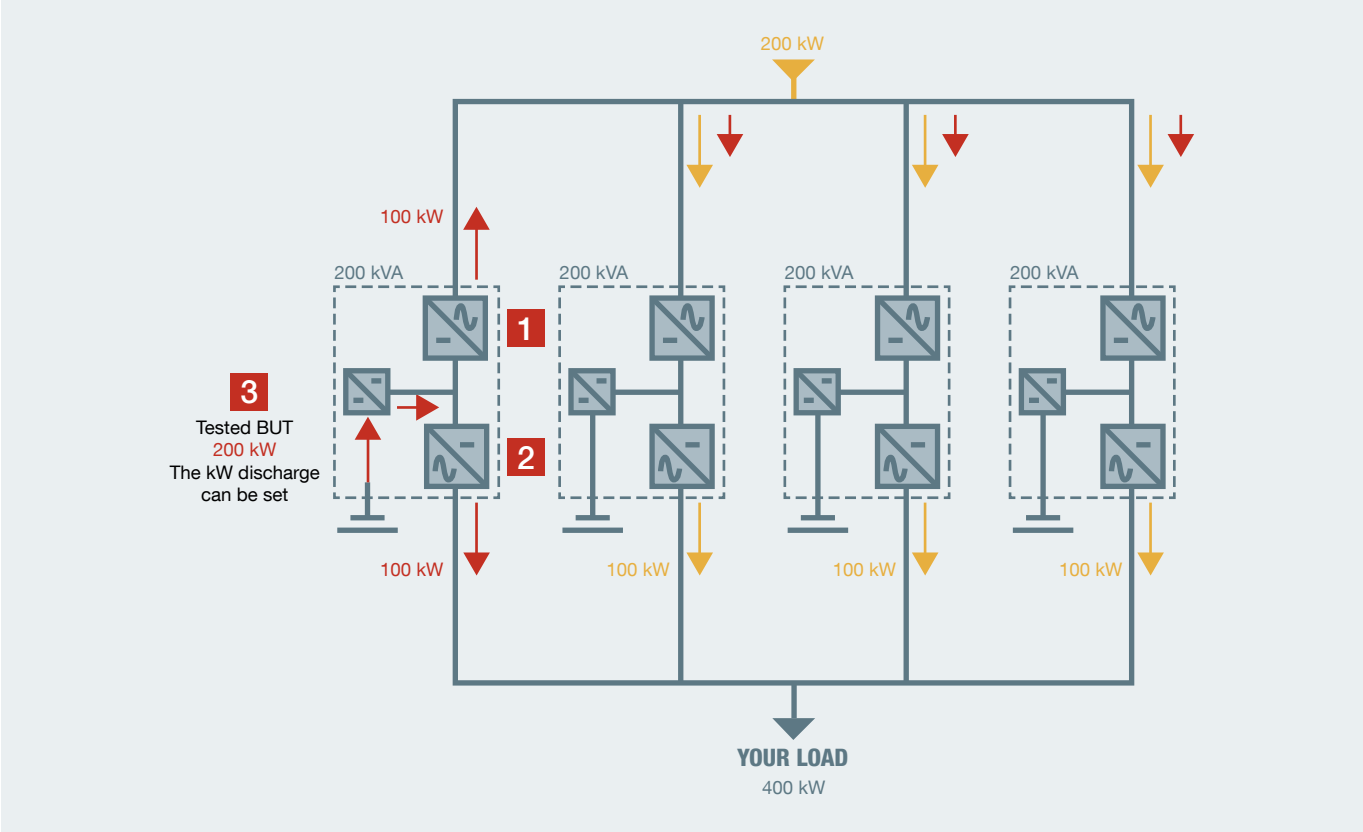
Advantages

- No need to hire a load bank.
- The energy of the battery is used by the load: no energy wasting, no need for dedicated electrical infrastructure.
- Constant & chosen discharge in terms of kW; data will be comparable year over year.
- The test can be performed with several units in parallel ("n+1" configuration only).

Disadvantages

- Test not possible with a centralized by-pass architecture.
- If the system is working in parallel, the **UPS tested CANNOT be connected to the load**:
  - if mains failure, the load is not supplied by this UPS. The remaining back up time is "lost",
  - the test can be performed ONLY with redundant configuration.
- After a mains failure, **a manual action is required** to restart the system and start to recharge the battery (rectifier is manually turned off during the test).

SOLUTION D
SOCOMEC Battery Capacity Re-injection



Principle

The battery is discharged through the inverter 1 & the rectifier 2. The discharge level (kW) is constant and set by the technician 3.
If the output load varies, the discharged kW from the battery will remain constant.
The reinjected power is always equal to the energy coming from the battery minus the energy required to supply the load

--> $kW_{(reinjected)} = kW_{(battery)} - kW_{(load)}$ or 1 = 3 - 2.

Advantages

- **Cost saving**:
  - no need to rent and install a dedicated load bank,
  - no dedicated electrical infrastructure,
  - battery energy is re-used instead of being wasted.
- **Accurate and simplified** periodical battery discharge test:
  - constant power discharge (settable kW); data will be comparable year over year,
  - easy to plan,
  - no need to find a place for the load bank,
  - no additional heat losses to manage.
- **Safe** operation (No temporary installation; No electrical hazard risk).
- In case of mains failure, the test is stopped automatically & the remaining battery energy is used to supply the load.
- Once the mains comes back, the rectifier starts automatically to charge the battery **without any manual intervention**.
- Available with **centralized by-pass** and distributed solution.
- The test can be performed for **single unit or even if no redundant configuration**, as the tested unit remains supplying the load.

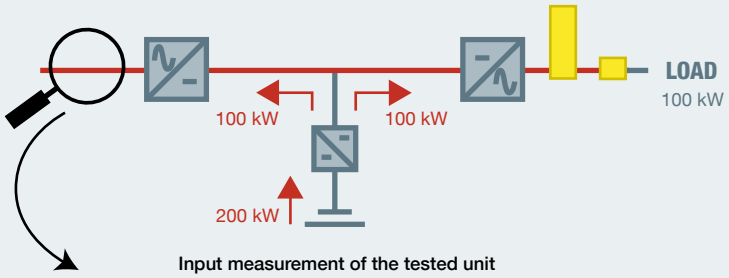
SOCOMEC Battery Capacity Re-injection, the advantages of all the "traditional" battery discharge test solutions, WITHOUT the disadvantages!

SOCOMEC Battery Capacity Re-injection

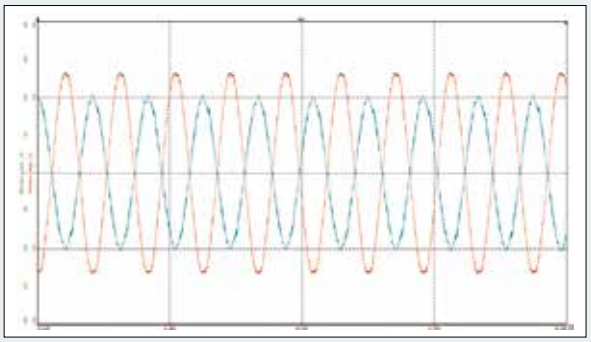
Results

No upstream disturbances

The rectifier is working as an AC generator,
The rectifier current is synchronized & follow the voltage of the upstream installation (as a “solar converter”).



Input measurement of the tested unit



Clean current reinjection

Curves of live test with our Xtend product

WP 045 A GB

No risk for your load

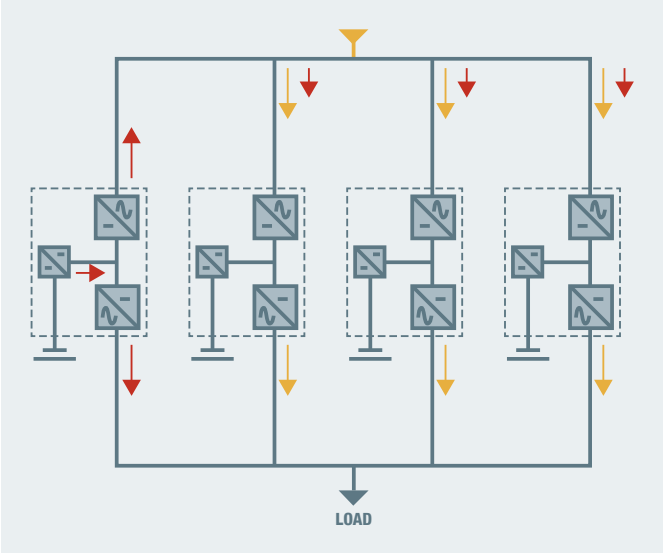
In case of mains failure, the test is automatically stopped. If the UPS is connected to the load, the remaining back-up time will feed the load. Once the mains comes back, the rectifier restarts automatically without any manual intervention to supply the load in double conversion and charge the battery.

Costs comparison

	Typical installation 200 kW loadbank	SOCOMEC Battery Capacity Re-injection
		
First test*	Load renting	BCR option
After 5 years* (1 test per year)	Load renting	The option has to be bought only once!
Additional costs	• Battery energy wasted • Cooling management • Cabling or dedicated electrical infrastructure • Indirect costs (organization…)	

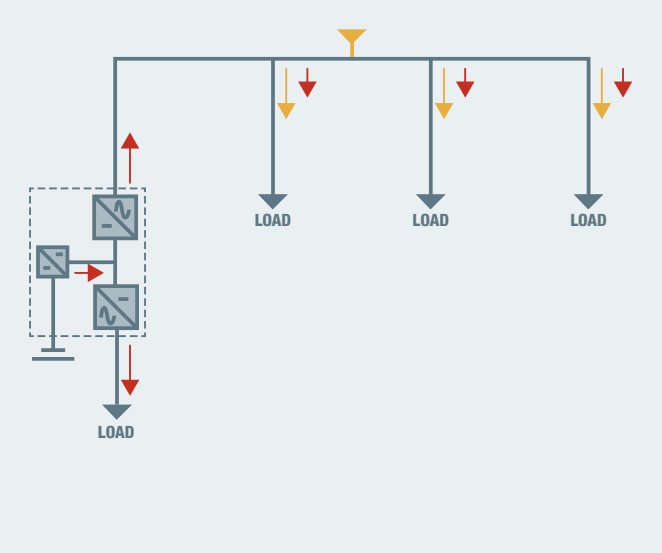
** A technician is requested to manage the test.*

Several ways to use SOCOMEC Battery Capacity Re-injection



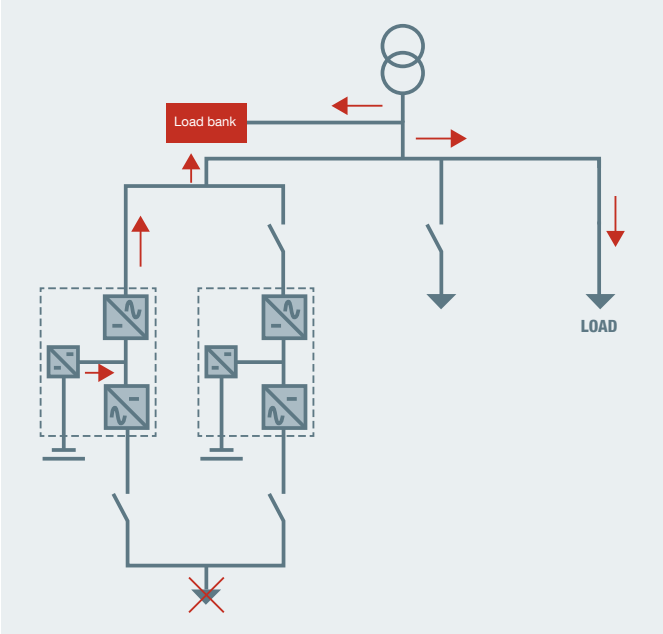
With UPS in parrallel, load connected

- BCR option is available for distributed and centralized by-pass.
- If required, the tested unit can be disconnected from the downstream installation.



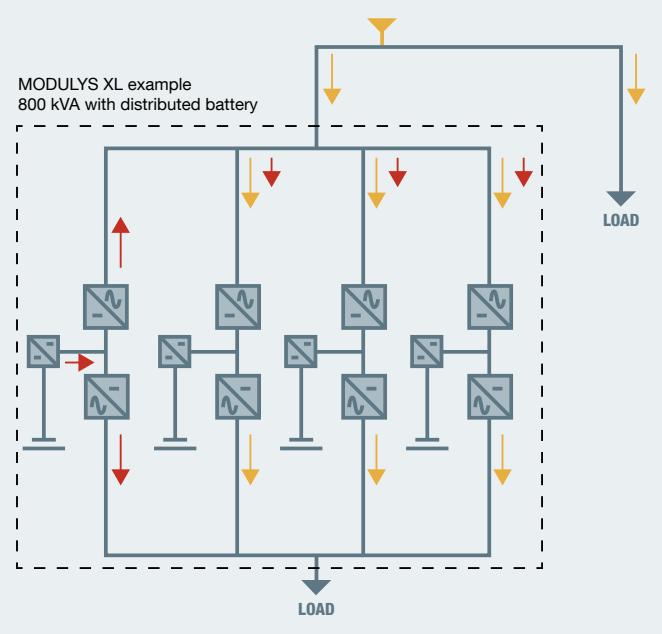
Single unit

- BCR can be used on single unit.
- The load remains connected to the unit under test and protected by the inverter during the discharge (no need to switch on maintenance by-pass).



Commissioning

- BCR can be used during commissioning. In this case, an extra load bank could be required (if not enough load to absorb the discharged power).
- Advantages of using BCR in such conditions:
  - the user can connect the load bank where it is the easiest for him in his electrical infrastructure,
  - if several UPS with battery connected to the same LV transformer, all of them can be tested without physically moving the load bank.



Modular solution with distributed or blended batteries, load connected

BCR is also available on MODULYS XL with distributed or blended battery configurations.
The feature is available for each battery set within the UPS Unit.

- Distributed batteries configuration Each single power module has its own battery set
- Blended batteries configuration 2 or 3 battery sets are connected to different power modules within a Unit.
  If the battery set is shared at the entire Unit level, the BCR can be used like on a monolithic UPS unit (single or parallel when applicable).

Summary

Advantages of each solution

Solution	SOLUTION A **The real load** page 5	SOLUTION B **Resistive load bank** page 6	SOLUTION C **Re-injection through bypass** page 7	SOLUTION D **SOCOMEC Battery Capacity Re-injection** page 8
No need to rent a load bank	✓		✓	✓
No need of electrical dedicated design (dedicated test bus bar…)	✓		✓	✓
Battery energy can be used by the real load	✓		Not with several units in parallel	✓
No extra heat dissipation to manage	✓		✓	✓
100 % safe (physical and electrical)	✓		✓	✓
In case of mains failure, the remaining energy within the battery will continue to supply the load without manual intervention	✓			✓
In case of mains failure during the test, no manual action required when the mains comes back to start to recharge the battery				✓
The power of the discharge is managed (constant discharge)		✓	✓	✓
Data comparable year on year (reproducibility of the test conditions)		✓	✓	✓
The test can be done in “n” or “n+1” system with the load connected to the tested unit	✓			✓
The test can be performed with a centralized bypass	✓	✓		✓

SOCOMEC Battery Capacity Re-injection or the most clever and flexible way to test your battery.

Socomec: our innovations supporting your energy performance

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400 experts dedicated to service provision

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