RedEarth

TECHNICAL BULLETIN

Selecting your generator

When it comes to generators, choosing the right size is essential. If the generator is too small, it won't power your loads, and your batteries will run flat. If it's too large, you'll be spending more than necessary, and the generator will run at a worse efficiency.

NOTE: RedEarth does not supply generators. This document provides general information on sizing and features of a suitable generator for a RedEarth Battery Energy Storage System (BESS).

Generator sizing considerations

- Generators typically achieve maximum efficiency between 50-75% of their rated output
- Generators have a prime and standby rating, using the prime value as the maximum improves longevity
- It is recommended to select a generator that supplies the full inverter capacity (kW) at its optimal output
- Generators are commonly sized in kVA, so the power factor must be considered
- Most generators have a power factor of 0.8, meaning their effective output in kW is 80% of the kVA rating
- Diesel generators are preferred due to their reliability

If the generator is under-sized

- A smaller generator, only slightly larger than the loads, limits excess power available to charge batteries
- This results in slower battery charging due to reduced overhead

For example, with a **100kW BESS**, a **50kW load**, and a **75kVA generator** (equivalent to **60kW** at a power factor of **0.8**), the generator could supply **10kW** for battery charging while covering the **50kW load**. This results in significantly slower battery charging due to the limited excess capacity.

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RedEarth Energy Storage Tech Bulletin: Selecting your generator
For sales enquiries contact sales@redearth.energy
For technical support: support@redearth.energy
1800 733 637 | 15 Fienta Place, Darra BRISBANE QLD 4076 | www.redearth.energy

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If the generator is over-sized

- A larger generator allows the BESS to utilize the extra capacity for charging.
- Excessive oversizing may reduce efficiency as the generator may not run at its maximum efficiency.

For example, with a **100kW BESS**, a **50kW load** and a **250kVA generator** (equivalent to **200kW** at a power factor of **0.8**). The generator could supply **150kW** allowing the batteries to charge at the full **100kW**, while the load is covered by the pass-through power.

Generator Requirements to Operate with a RedEarth BESS

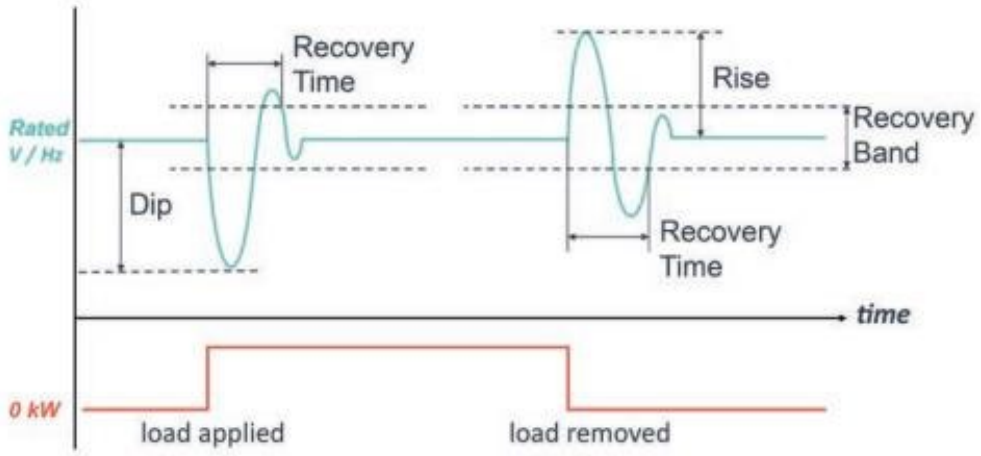
Essential base requirements:

- Ensure the generator is compatible with **2-wire AutoStart**
- Ensure the generator has a **pure sinewave output** and is of a **reputable brand**
- Diesel generators are preferred due to their reliability

Synchronisation and control requirements

- **Speed Control**
  In order for the Engine to get 'in sync' with the BESS, it must have a speed control option.
  ◦ For modern, electronically controlled engines, this must be done over CAN by the TCS1 command as specified in the J1939 norm, allowing the engine to deviate slightly (e.g., from 1500 rpm for 50 Hz) until synchronized, at which point the engine speed can be locked.
  ◦ For mechanical engines, the speed control can usually be achieved with a PWM controlled actuator, which must be present and controllable by the inverter.
  ◦ **Hardware compatibility and software (protocol) compatibility must be requested to RedEarth if a mechanical governor is used.**
- **Load Acceptance**
  The generator's G-rating, as described in ISO 8528, must be communicated to RedEarth and **must be rated G3 or above.**

Equivalent Class		Steady State	Frequency Droop	Load Rejection	Load Acceptance	Recovery Band	Recovery Time
G1	Hz	±2.5%	8%	18%	15% (25%)(1)	3.5%	10 s
	V	±5%	---	35%	25%	10.0%	10 s
G2	Hz	±1.5%	5%	12%	10% (20%)(1)	2.0%	5 s
	V	±2.5%	---	25%	20%	5.0%	6 s
G3	Hz	±0.5%	3%	10%	7% (15%)(1)	2.0%	3 s
	V	±1%	---	20%	15%	2.0%	4 s



Typical Generator Operation with RedEarth BESS

When the generator is called the BESS will synchronise and begin to charge the batteries without dropping power to the load, this typically takes 60 seconds.

A generator peak shaving value would be set, the BESS will then maintain the generator's output to this value.

For example, the generator peak shaving is set to 100kW. If the BESS is powering a 50kW load when it reaches its low state of charge setpoint, it will call the generator, synchronise, and pull 100kW from the generator.

This means 50kW will go directly to the load and the remaining 50kW will be utilised to charge the batteries. If the load decreases, more power will be utilised for charging and vice versa.

Recommended Generator Sizing for RedEarth Systems

Battery system inverting capacity	Generator Power factor	Generator Kva rating	Generator optimal loading	Generator Kw rating
5KW	0.8	9kVA	75%	6kW
6KW	0.8	10kVA	75%	8kW
8KW	0.8	11kVA	75%	10kW
10KW	0.8	17kVA	75%	13kW
12KW	0.8	20kVA	75%	15kW
30KW	0.8	50kVA	75%	37kW
50KW	0.8	83kVA	75%	63kW
100KW	0.8	167kVA	75%	125kW
200KW	0.8	334kVA	75%	250kW

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Frequently Asked Questions

- If the generator is being called too often, the BESS is most likely undersized
- Diesel fuel can typically be stored for only 6 months to 1 year

Don't forget, we're here to help

If you have any questions or need further assistance, please don't hesitate to reach out to our support team. Thank you for choosing RedEarth, and we look forward to powering your energy independence!

Warm regards,

The RedEarth Team