



Grid AI Battery Energy Storage System (BESS) User Manual

Version 1.12

June 2026

Grid AI Battery Energy Storage System (BESS)

User Manual

Support through local grid power cuts

Grid AI, February 2026

Quick Reference

[Safe BESS restart / reboot via webserver – see section 5.7](#)

[Safe BESS shutdown / restart manually – see section 5.6](#)

[Emergency BESS shutdown – see section 6.4](#)

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1. Introduction

The **Grid AI Battery Energy Storage System (BESS)** is designed to:

1. **Expand the site’s electricity capacity** to cope with power cuts when the local grid goes down.
2. **Reduce costs** by significantly reducing the need to use diesel generators.
3. **Showcase the huge potential** of re-using electric vehicle batteries.

This BESS has been **designed, built, and installed by Grid AI**, with support and **funding from the UK Government**.

The site contains **three independent BESS systems**, each serving one area, which each work with the **StarTimes DEYE solar systems** which have been installed for that area:

- **BESS 1 – WTA**
- **BESS 2 – The Rock**
- **BESS 3 – Mirembe House**

Together with the StarTimes DEYE solar systems, these BESS systems will provide reliable backup power during grid outages.

2. Why do we need the Grid AI Battery Energy Storage System (BESS), and what does it do?

2.1 Why we need the BESS – existing systems can't cope

Local grid power cuts are common and can disrupt site activities, security, and safety. In the past, your site has relied on backup diesel generators, which are expensive to run, and cause polluting fumes.

Solar can provide power in the daytime, but your site also needs to run security lights and school/health centre activities in the hours of darkness. Battery storage can provide enough power to cover power cuts at any time and reduce the grid power usage.

The **StarTimes DEYE** solar-battery systems provide limited backup storage, but may struggle to provide enough battery energy storage, especially in the future as more activities requiring electrical power are done. This is why the BESS has been installed to give additional storage, demonstrating that this can be done by re-using batteries which were previously used in electric vehicles.

2.2 What does BESS do?

The Grid AI Battery Energy Storage System (BESS) uses batteries, inverters and AI software to manage your power supply much more effectively.

The **Grid AI BESS system has tripled your site's total power and battery storage capacity.**

This means your site can:

- Operate reliably during long power cuts
- Reduce expensive and polluting generator use
- Maintain lighting, charging, and the operation of essential electrical equipment for much longer periods
- Showcase AI capability to optimise performance

As a user, you will not normally notice the BESS running. **You simply continue using the power sockets and lights as usual.**

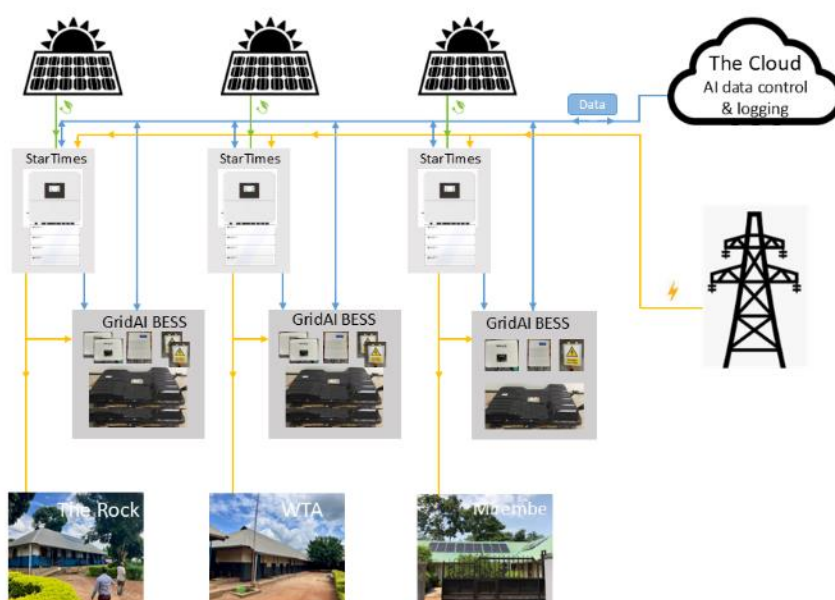
However, please remember:

The system has a **maximum power limit**, so avoid plugging in too many devices, especially high-power ones. See the table in section 3.3 for typical power consumption of different devices. The power limits are **10kW (WTA)** and **7 kW (The Rock and Mirembe)**.

Please also remember:

The BESS for each building relies on the wifi system and password. If you make any changes to the wifi, the BESS will stop working, and it would be extremely difficult to restart it. **Please contact Grid AI BEFORE making any changes to the wifi system or password.** Grid AI will help you to make your changes safely.

2.3 Overview of the systems



A site map is shown below:

Red circles - WTA and The Rock buildings housing the StarTimes DEYE solar systems

A = Hut in WTA courtyard housing BESS 1 (WTA) and BESS 2 (The Rock)

B = Location of BESS inside Mirembe building



Locations circled in red

1. Wobulenzi Town Academy – The solar is located on the administration building and computer lab building shown in the red oval No 1. This solar supports the rest of the WTA site.
2. The Rock Health Centre - The solar is located on the Rock Building, the upper of the buildings shown in the red oval No 2. This solar also supports the Connect Centre, which is the lower building in the red oval No 2.
3. Mirembe House - The solar is located on the main house shown in the red oval No 3. This solar and BESS only supports Mirembe House.

BESS locations marked by blue arrows

1. WTA – The BESS is located in the BESS house show by blue arrow A (note the small building is new and not currently on the plan)
2. The Rock – The BESS is located in the BESS house show by blue arrow A (note the small building is new and not currently on the plan)

3. Mirembe house - The BESS for this area is located in the generator room shown by blue arrow B.

The WTA BESS and Rock BESS are connected to their buildings using underground cables.

The Mirembe BESS is connected inside the garage building.

Please note that **each BESS is dedicated to one building only and cannot be moved.**

3. How each BESS works

Each BESS contains large batteries which are reused from Nissan Leaf electric cars. These batteries store the energy created by the solar panels in the StarTimes DEYE systems. This energy is then supplied back to the site when it is needed.

3.1 BESS and StarTimes DEYE

Overall, each BESS **triples the battery storage** already provided by each existing StarTimes DEYE solar system. Both the StarTimes DEYE system and the Grid AI system will recharge either from your site's solar panels or from the mains grid (if necessary).

- **The Grid AI BESS systems do not control the StarTimes DEYE solar systems; they take readings from it in real-time**, plus reading weather forecast and drawing on historical system data.
- The Grid AI BESS **AI-based control system** then determines when to charge and discharge the BESS battery.
- Each StarTimes DEYE system communicates with its BESS using the Modbus/RS423 standard, via a black Ethernet cable. This cable is not connected to the internet: it is just connected to StarTimes DEYE and BESS.

The StarTimes DEYE solar system has a number of key roles as follows:

- **The StarTimes DEYE system provides the AC voltage** available via the sockets around the site.
- The StarTimes DEYE system converts DC power from the solar panels to AC power for the site, or DC power at the correct voltage to charge the DEYE batteries.

- It is **essential that the StarTimes DEYE system is working** for the Grid AI BESS to work.
- If the **StarTimes DEYE battery** in a building **falls below 20% state of charge, and the grid is not working, then that building's electricity will stop working** until the grid is working again, or until the StarTimes DEYE battery is recharged.
- **The Grid AI BESS greatly extends the time that power is available** before the StarTimes DEYE system discharges, by discharging the Grid AI BESS batteries first.

Our engineers are working to provide or test the following features, currently under development:

- A way for The Grid AI **BESS to recharge the StarTimes DEYE batteries directly**, to optimise the power supply even further. Currently, StarTimes DEYE batteries can only recharge from solar and via the electricity grid.
- A way for the Grid AI **BESS to optimise tasks** which are not time-sensitive, **such as water heating**, to maximise use of solar power and reduce the impact of grid outages. This will need to be actively managed to ensure continuity of power to the site.

3.2 System Capacity, Charging, and Power Limits

Capacity

To protect the Grid AI BESS batteries and extend their lifespan, our engineers have set their maximum and minimum levels of charge.

In use, the Grid AI **BESS batteries will not discharge below 20% state of charge**. In practice, **each BESS system provides the following amounts of electricity storage:**

- **60-70kWh (WTA, The Rock)**
- **30-35kWh (Mirembe).**

Power Limits

Our engineers have set the maximum charge and discharge rates of each Grid AI BESS according to the needs of each building and the capacity of the existing electrical wiring.

If total power needed by all the electrical devices exceeds the available power, you may find that some devices won't work, or that no devices will work until some are switched off.

Typical Power and Runtime

Maximum output per BESS: 10kW (WTA) and 7 kW (The Rock and Mirembe)

The BESS runtime at full load will be **approximately 6 hours (WTA), 8 hours (The Rock) and 4 hours (Mirembe)**. In practice, battery runtime will be longer because the BESS will not be required to run continuously at full load: keep an eye on the battery levels to help you understand the patterns of use.

Battery runtime at low load (e.g. energy-saving bulbs) will be very much longer.

3.3 Which devices use the most power?

Use this table to help understand which devices consume the most electricity.

High-power devices (kettles, water heaters, ovens, air conditioning units) can quickly drain the batteries and may cause system overload.

Using mainly lower-power devices will allow the system to run for much longer periods.

Device	Typical Power Consumption (Watts)
Energy-saving lightbulb	8–12 W
Phone charger	5–15 W
Laptop charger	40–90 W
Wall-mounted fan	40–60 W
Television	60–150 W
Portable air conditioning unit	900–2000 W (0.9-2kW)
Iron	1000 – 3000 W (1-3 kW)
Kettle or water heater	1500–3000 W (1.5-3 kW)
Electric oven	2000–3000 W (2-3 kW)

3.4 AI-Optimised Power Management

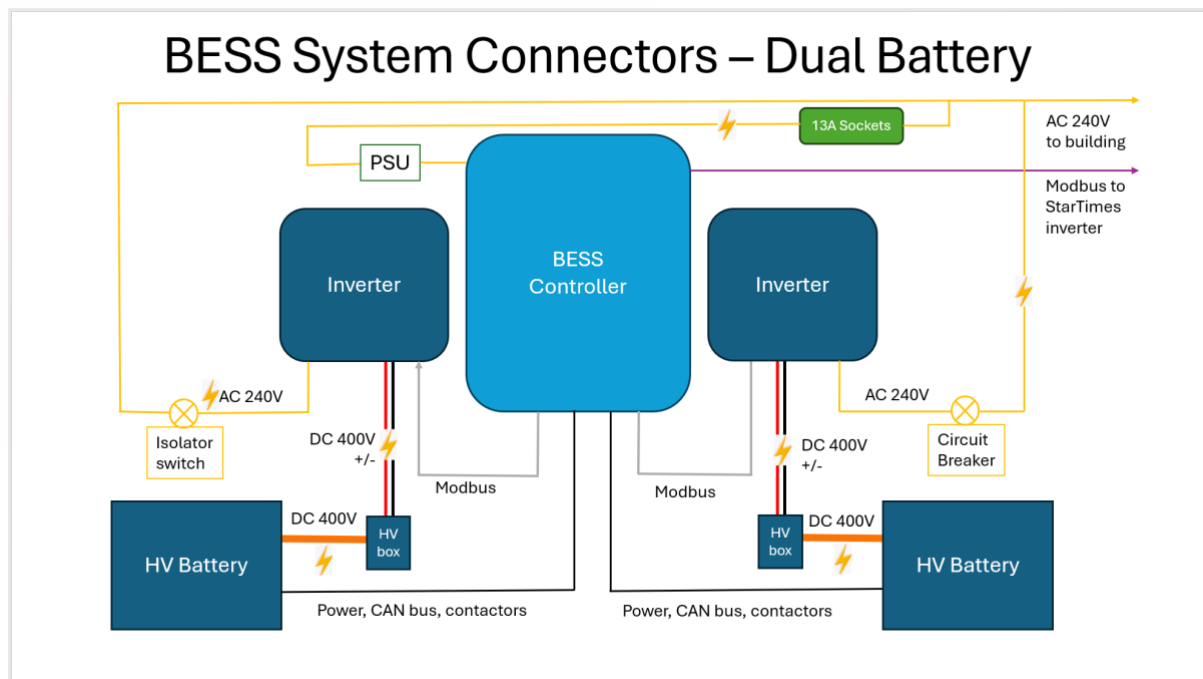
The Grid AI BESS uses a control system with **artificial intelligence** to automatically:

- Try to **balance the demand so that its own battery is discharged** rather than the StarTimes DEYE battery.
- **Predict grid outages**
- **Adjust power flow depending on weather and solar** generation
- Coordinate with the **StarTimes DEYE solar system** for maximum efficiency

No user input is required.

4. BESS System Diagrams, System Components and Functions

4.1 Schematic Diagram for BESS 1 (WTA) and BESS 2 (The Rock)

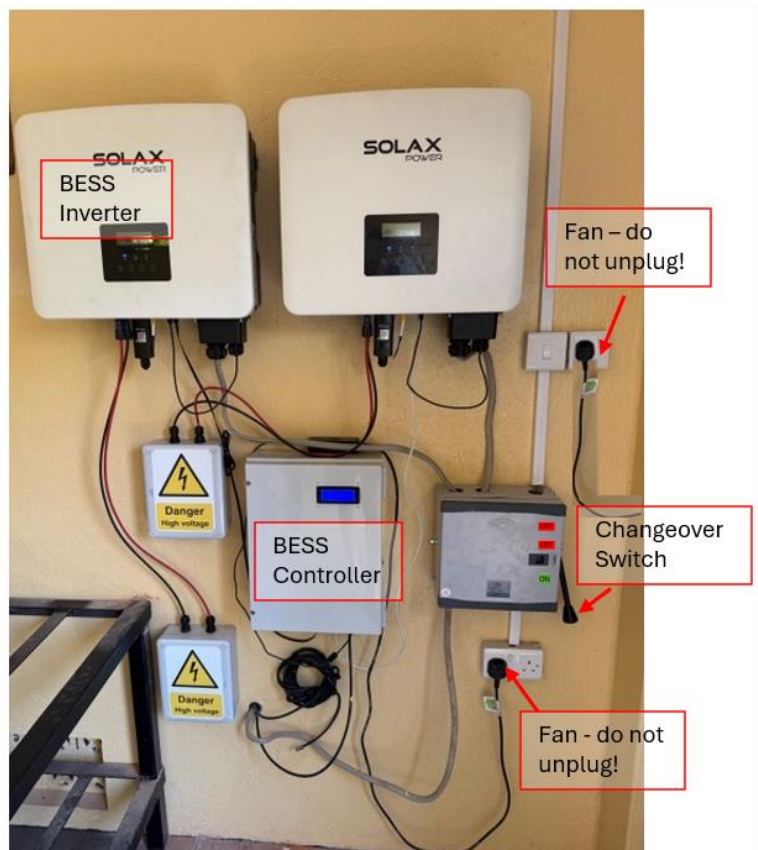
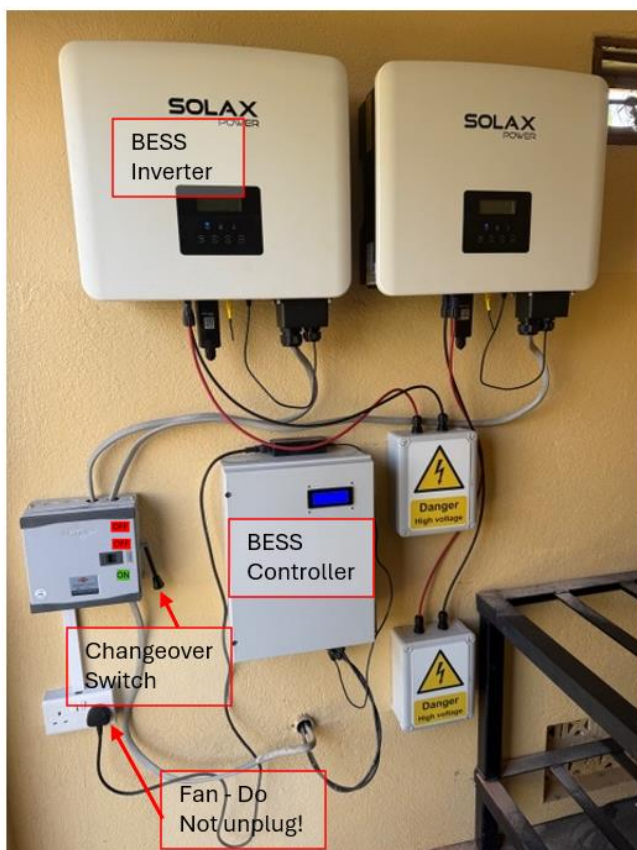


**System Components: BESS 2 – The Rock on the left, and BESS 1 – WTA on the right:
both inside WTA Hut**

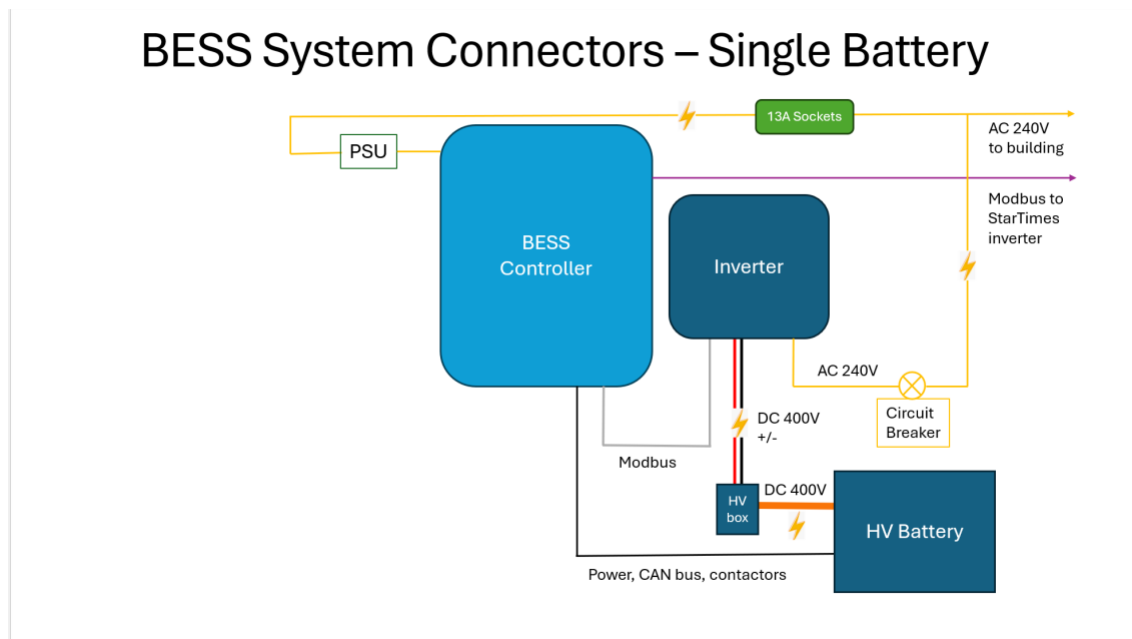
Do not store flammable items in the BESS Hut!



NB: each StarTimes DEYE system connects to its BESS using the Modbus/RS423 standard, via a black Ethernet cable. This cable is not connected to the internet: it is just connected to StarTimes DEYE and BESS.

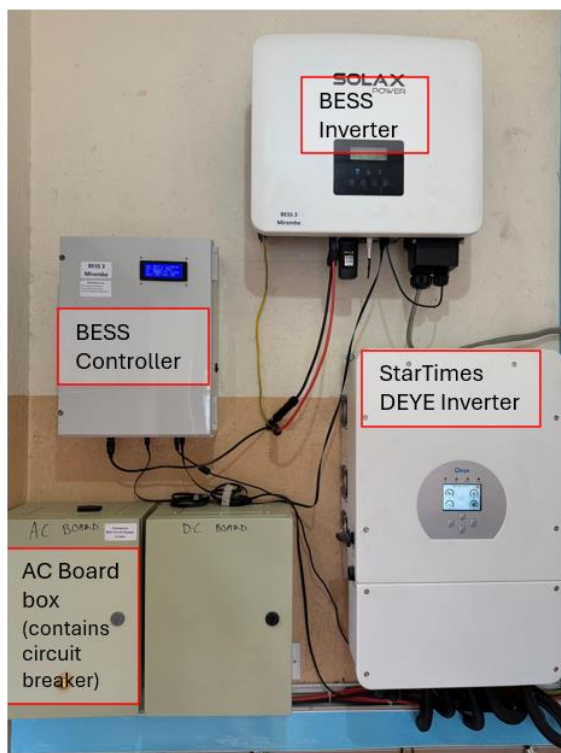


4.2 Schematic Diagram for BESS 3 (Mirembe)



System Components: BESS 3 – Mirembe

(Note: the BESS battery is on the other side of the wall to the other components) .



NB: each StarTimes DEYE system connects to its BESS using the Modbus/RS423 standard, via a black ethernet cable. This cable is not connected to the internet: it is just connected to StarTimes DEYE and BESS.

4.3 What does each component do?

- The **BESS Controller** is an embedded computer running Linux, with CAN buses, RS485 interfaces, relays to switch 12V to control battery functions, wifi, Ethernet, and software. The display on the front shows the system status.
 - **Note that BESS relies on the site wifi. If any changes are made to the site wifi systems or the wifi passwords, then the BESS system for that building must be updated.**
 - **Updating wifi details would be extremely difficult to do after the wifi has been changed and the BESS has lost wifi connection.**
 - **Please contact Grid AI BEFORE you make changes to any wifi system. Grid AI will help you update the BESS systems if any wifi changes are planned.**
- The **Inverter** converts DC power from the batteries to AC power for the site. There is one Solax inverter per battery, to convert 400V DC from the battery to 240V AC mains. The inverter also sets the charge or discharge power, as instructed by the Controller.
 - Each inverter has connections as follows: AC mains, DC battery, and the RS485 control from the Controller.
- The **HV box** is a junction box between the orange battery cable and the red and black DC cables to the inverter **DO NOT OPEN THIS**. Do not tamper with the cables or unit.
- The **Batteries** (one or two per BESS system) are second-life electric vehicle batteries. Their usable capacity is 30-35kWh per battery.

Each battery has connections as follows:

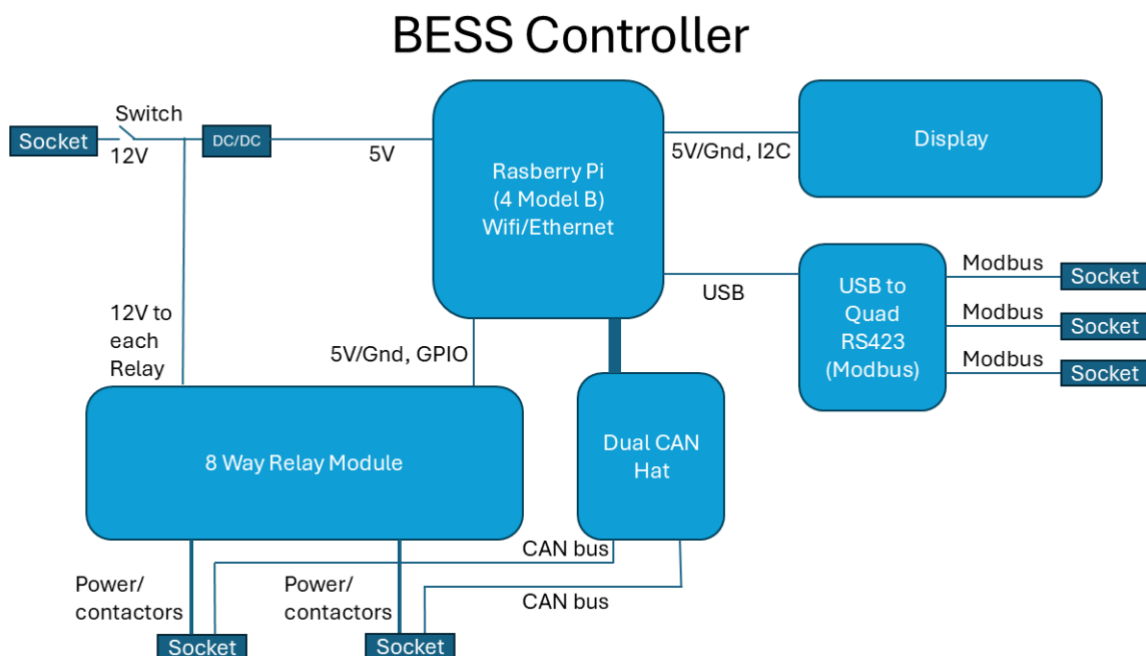
- The HV DC connector - this is an orange connector which connects the large orange battery cable (labelled A in the picture below)
- A round black control connector which powers the battery management system, connects to the battery CAN bus, and connects to contactors (large relays inside the battery) to enable

the HV DC power to the junction box. (labelled B in the picture below)

Each **battery** will cut out at a temperature of 50 degrees Celsius. This temperature has been set by GridAI to be well within the safe operating temperature of this type of battery. If a BESS battery reaches 50 degrees Celsius, the battery will stop charging or discharging until its temperature drops below this limit.

Each **CPU (inside the Controller)** will start to slow down as its temperature reaches 80 degrees Celsius.

4.4 Inside a BESS Controller and Battery Connections



BESS Battery Connections

A = High Voltage (400V) Cable connector

B = Control Cable Connector

Inside a BESS Controller



5. BESS Operation, Software and Communication

5.1 BESS Startup

BESS will generally start up automatically. The most common time for this to happen is after a long period without grid power: when the grid power resumes, or sufficient solar power has been supplied, BESS recharges itself and starts up automatically.

If the BESS fails to restart, see the Troubleshooting section.

The BESS will try to restart as follows:

- **the controller will first perform system checks.**
- If checks are passed, **the controller will then:**
 - Enable the 400v DC from each battery connection to the inverter and **wait for the inverter to go into Normal status**, i.e. ready to transfer power.
 - If the controller does not go into Normal status within 2 minutes, the connection times out, the HV is disabled again, and that battery and inverter will not be used until you restart the BESS again.
- **Once the controller has attempted to connect all the batteries in the BESS system**, it will go into its main control loop which is described below.

This is what you will see on the Controller screen when the BESS restarts:



5.2 After BESS startup checks are complete

Once the BESS inverters and batteries are initialised as above the controller will check the connection to the DEYE inverter, which is part of the StarTimes DEYE system for the same building.

When all startup tests are complete, and everything is ready, the BESS Controller will go into the main control loop. The main control loop continues to run during normal operation. Each loop runs as follows:

- Reading the DEYE inverter status and other inputs as required (e.g. weather forecast)
- Deciding how much power to request that the BESS should charge or discharge.
- Allocating that power request between the available batteries and setting the inverters accordingly.
- Updating displays and saving data to log files. These are held locally by the controller. These log files are not needed by local users – they are in case Grid AI needs to perform further system analysis.

5.3 Normal Operation

Generally, all three StarTimes systems and all three BESS systems building will be on and operating normally.

During normal operation, you will:

- Receive a daily email for each BESS
- See a readout in the display panel on each BESS inverter
 - Usually this will say 'Waiting' (temporarily, during restart) or 'Normal' plus power
- See a readout in the display panel on each BESS controller
 - Usually this will say 'Waiting' (temporarily, during restart) or 'Normal' plus battery stage of charge plus Inverter status etc

5.4 BESS Inverter Display During Normal Operation

On the Inverter, the display screen shows the system status, including:

- Power delivered so far today
- Battery Voltage
- Initialising or Normal (R)



5.5 BESS Controller Display During Normal Operation

On the Controller, the display screen shows the system status, including:

- Whether the system is Initialising or in Normal operation (I),
- Power requested and actual power delivered (P)
- Battery temperatures and charge levels (B)
- Battery state of charge)



This is the readout you will see during normal operation:



This BESS Controller is controlling two inverters and two batteries (as for WTA or The Rock. Mirembe's BESS has one inverter and one battery).

'GAI BESS @ 09:13:53' identifies this as a Grid AI BESS Controller and gives the current time.

'I Waiting Normal' means that the controller is Waiting for one Inverter to start, while the second Inverter is operating as Normal.

'P 0Wr 0W 0W' means that the 0 Watts are being requested by the Controller, and that Power from both Inverters is currently 0 Watts

'B 34% 5C 62% 6C' means that the top battery is currently charged to 34% capacity, and is at 5 degrees C temperature, while the bottom battery is currently charged to 62% capacity, and is at 6 degrees C temperature.

5.6 How to Switch off & Restart BESS units safely

There are two methods:

1) Using the webserver – see section 5.7.1 ‘BESS webserver main screen’

Note that using the webserver is the best way to switch a BESS off.

2) If you can't reach the website, use the Inverter Screens – see the rest of this section.

5.6.1 The Inverter Display

In normal operation, the screen shows:

Power: If the figure is negative, the battery is charging, and if the figure is positive, it is discharging.

Today: the energy so far today

Battery: battery voltage.

Normal (R): Mode is usually Normal. Other modes you may see temporarily are ‘Waiting’ or ‘Checking’, usually during startup.



5.6.2 Starting the Safe Switch-Off Procedure

On the inverter control panel, press Enter twice to reach the Menu screen. If needed, use the arrow buttons to select ‘System ON/OFF’

Note that there are various other options on the menu screen, but users will not need to use them.

Press Enter again to get the system ON/OFF screen



On the next screen, use the two arrow buttons to switch the inverter on or off. In the pic, the switch is ON.

if you select OFF, using the arrow buttons, then press Enter again, the first blue light will light up, indicating that the inverter is not ready.

If you now press the back arrow one or twice, you will return to the main screen showing that the system is off, and also that the Power is off.

The status will have changed to 'Idle'.



5.6.3 Safely switch the BESS controller off

When both inverters show that Power is 0W, it's safe to switch the BESS controller off, using the switch on the side of the controller.

5.6.4 Safely restart the BESS controller

First, manually turn each inverter on again, using the same command sequence as in step

'1. Starting the Safe Switch-Off Procedure'.

This time, select 'ON'.



Now use the back button to return to the top level screen on the inverter. It should display IDLE (or occasionally something else other than Off).

Note that where there are two inverters, this procedure must be carried out on both.

When you have turned on both inverters, turn on the controller, using the switch on the side of the controller.

When the controller has finished initialising, the inverters should start automatically. The screen may display Waiting, then Checking, before returning to Normal.



Note that the dual battery systems BESS 1 – WTA and BESS 2 – The Rock will still initialise and run even if one battery does not work, i.e. fails checks, or its inverter does not reach Normal status. However, the available power and capacity will then be halved.

5.6.5 Labelled Diagram of Inverter Screen

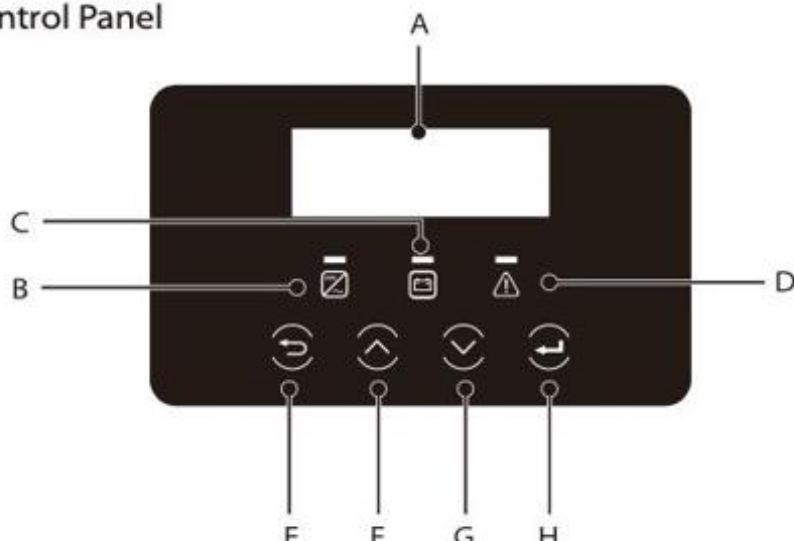
For reference, here is an extract from the inverter installation manual.

Note that the battery indicator LED marked 'C' is not used in the BESS systems, as the battery control is done by the controller, not the inverter.

Setting

8 Setting

8.1 Control Panel



Object	Name	Description
A	LCD Screen	Display inverter information on the LCD display.
B		Blue light: The inverter is in normal state or EPS(Off-grid) mode. Blue flashing: The inverter is in the waiting, checking state or the system switch is off. Off: The inverter is in a fault state.
C	LED Indicator light	Green: The battery communication is normal and working normally. Not used Green flashing: The battery communication is normal and in an idle state. Off: The battery does not communicate with the inverter.
D		Red light on: The inverter is in a fault state. Off: The inverter has no error.
E	Key Function	ESC button: Return from the current interface or function.
F		Up button: Move the cursor to the upper part or increase the value.
G		Down button: Move the cursor down or decrease the value.
H		Enter button: Confirm selection.

5.7 BESS Webserver and their information screens

More detailed information on the system operation can be found on the BESS Webserver. Each system contains its own webserver. These may be accessed by any device using the following web addresses, according to which system you wish to access:

WTA: <https://bit.ly/wtabess>

Rock: <https://bit.ly/rockbess>

Mirembé: <https://bit.ly/mirembess>

5.7.1 BESS webserver main screen

This is an example of the information on a BESS webserver:

wtabess at 18:46:43

Runtime: 0d 0h 40m, Uptime: 0d 0h 42m
WiFi: WTA LAB MESH with ping 863ms and reconnects 1
CPU Temp 55.5C, CAN messages 561577, errors 0
Chargemode Auto 10000W, SOC 10% - 90%

Deye Inv Norm, Relay OPEN, Volts 4V, Freq 0.0
Grid Downtime Today: 17.0h, Stop Events: 1
PV 0W, Batt 2482, Grid 0W, Building Load 2463W
Totals: PV: 46.70kWh, Building: 31.20kWh, Grid: 0.00kWh
Battery: SOC 96%, Batt In: 14.30kWh, Batt Out: 3.60kWh

BESS Power: Requested 0W, Actual 43W

Solax Inv0: Normal (R), Pset 0W, Pact 0W
Grid 228.4V, Today out 3.3kWh, in 5.9kWh
Battery 0: Volts 398.5, Amps 0.0, Max Temp 30.3C
SOC 89%, Cell Min 4146mV, Max 4156mV, diff 10mV

Solax Inv1: Normal (R), Pset 0W, Pact 43W
Grid 228.8V, Today out 3.0kWh, in 5.1kWh
Battery 1: Volts 398.0, Amps 0.0, Max Temp 29.9C
SOC 88%, Cell Min 4141mV, Max 4153mV, diff 12mV

Status: Main loop running



BESS Manual



BESS Emergency Card

STOP

RUN

QUIT

RESTART

REBOOT

GRAPH

Notes on the above screenshot of wtabess webserver:

The screenshot shows five main sections of information:

- Runtime section
- Deye Inv section
- BESS Power & Solax Inv0 section
- Solax Inv1 section
- Runtime section
- The buttons

Runtime section

```
Runtime: 0d 0h 40m, Uptime: 0d 0h 42m
WiFi: WTA LAB MESH with ping 863ms and reconnects 1
CPU Temp 55.5C, CAN messages 561577, errors 0
Chargemode Auto 10000W, SOC 10% - 90%
```

Runtime: Runtime since last reset (often the same as the **Uptime**)

WiFi: Details of the local WiFi – in this case, WTA LAB MESH

CPU Temp: the temperature of the CPU in the BESS Controller. Max operating temperature is around 80.0C. The CPU has a thermal cutout, and will also start to slow down well before the cutout limit is reached.

CAN messages: used by GridAI for diagnostics

Chargemode: Usually set to 'Auto 10000W, SOC 10% - 90%' – Auto operation, 10000W max power, (Battery) State of Charge, which is set to min 10% and max 90%. GridAi can use other modes temporarily, for testing.

If the BESS control program stops

- If the BESS control program stops, the webserver will be unavailable, and there will be nothing happening in the BESS
- What might make it stop? This may happen after someone has clicked  , perhaps if there is a fault.
- GridAI will also perform a  or  remotely after a software update.

The Deye Inverter section

```
Deye Inv Norm, Relay OPEN, Volts 4V, Freq 0.0  
Grid Downtime Today: 17.0h, Stop Events: 1  
PV 0W, Batt 2482, Grid 0W, Building Load 2463W  
Totals: PV: 46.70kWh, Building: 31.20kWh, Grid: 0.00kWh  
Battery: SOC 96%, Batt In: 14.30kWh, Batt Out: 3.60kWh
```

Deye Inv Norm: Deye inverter is running normally

Relay OPEN = Grid is off, ie no power. **Relay CLOSED** would mean Grid is on (usually shows ~50Hz).

Grid Downtime Today = Time that the Grid has been off today.

Batt 2482W = Power coming from the Deye battery.

Stop Events: 1 = How many times the Grid has stopped today.

PV 0W = Power coming from the solar panels

Batt 2482W= Voltage of battery

Grid 0W = Power coming from the Grid

Building Load 2463W = power being drawn by the building from any source

Totals: totals today for:

PV 46.70kWh = power supplied by the solar panels

Building 31.20kWh = power sent to the building

Grid 0.00kWh = power from the grid

Battery: SOC 96% = state of charge of the Deye battery

Batt In: 14.30kWh, Batt Out: 3.60kWh = power in and out of the Deye battery today.

BESS Power:

```
| BESS Power: Requested 0W, Actual 43W
```

Requested and actual power at the time for the BESS

Solax Inv0:

```
Solax Inv0: Normal (R), Pset 0W, Pact 0W  
Grid 228.4V, Today out 3.3kWh, in 5.9kWh  
Battery 0: Volts 398.5, Amps 0.0, Max Temp 30.3C  
SOC 89%, Cell Min 4146mV, Max 4156mV, diff 10mV
```

Solax Inv1:

Status = Normal - ignore the (R) – it is just a variant of Normal Mode

Pset = power set for Solax

Pact = actual measured power out from Solax to building.

Grid = building voltage AC

Today Out, In = total of today's power so far out and in to the building

Battery 0: = stats for BESS Battery 0:

- Volts = Voltage,
- Amps = Current
- Max = max battery temp so far today
- SOC = state of charge,
- Cell Min = voltage of weakest battery cell
- Max = voltage of strongest battery cell
- Diff = difference between the two (the smaller, the better)

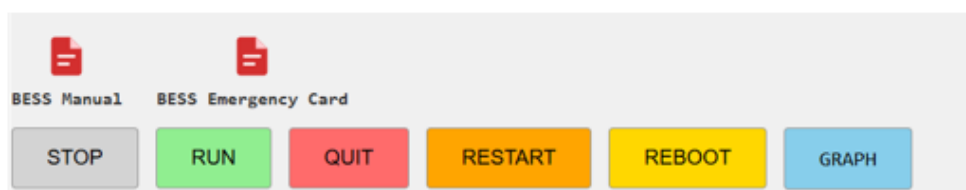
Solax Inv1: = the same stats as for Solax Inv0

Status:

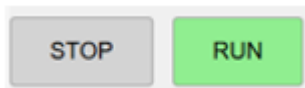
```
Status: Main loop running
```

This is the normal status: the Controller is running its main program loop, and the BESS is working as normal.

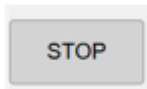
5.7.2 Website Buttons



The PDF icons  [BESS Manual](#)  [BESS Emergency Card](#) are hyperlinks to the respective documents. Hard copies should also be available near each BESS for users to familiarize themselves with the systems, and especially for emergency use.

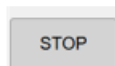


The STOP / RUN buttons switch the main control loop (running in the Controller) on or off. Normally, the Main Loop is running.



This button stops the main loop, but doesn't stop the whole program.

Clicking this STOP button halts power flow in/out of the BESS.

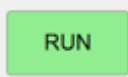


After clicking it will be safe to turn BESS off with a physical switch, if needed, using one of the switches on the side of the controller, or the changeover switch, or the building circuit breaker.

Once you have clicked , you will see:

Status: Menu, waiting for command

Meanwhile, the figures on the screen stay at last available figures – they will not updated until restart / reboot.

Click  to restart main control loop.



QUIT

exits the BESS program (rarely needed) – which turns off BESS batteries. After shutdown, the Controller screen will be blank, but there will still be a display visible on the inverter(s).



RESTART

restarts main program, but not the hardware. Used by GridAI after software updates. Users may not need to use this.

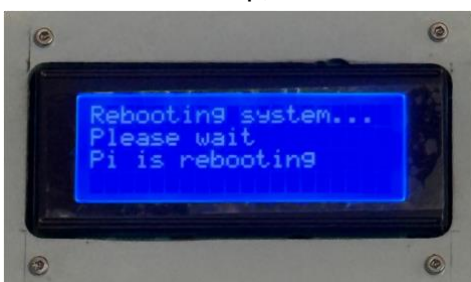


5.7.3 Reboot (restart) BESS Controller safely

REBOOT

reboots the BESS Controller. This may be useful if you are seeing errors in initialization or on the website. Restarting in this case takes a little longer than just restarting program.

- A user might reboot the system if something isn't working.
- If the power to BESS goes off, for example when the DEYE battery drains below 20%, or a manual switch has been used in an emergency, then the BESS Controller will stop, and will reboot itself when its power comes on again.

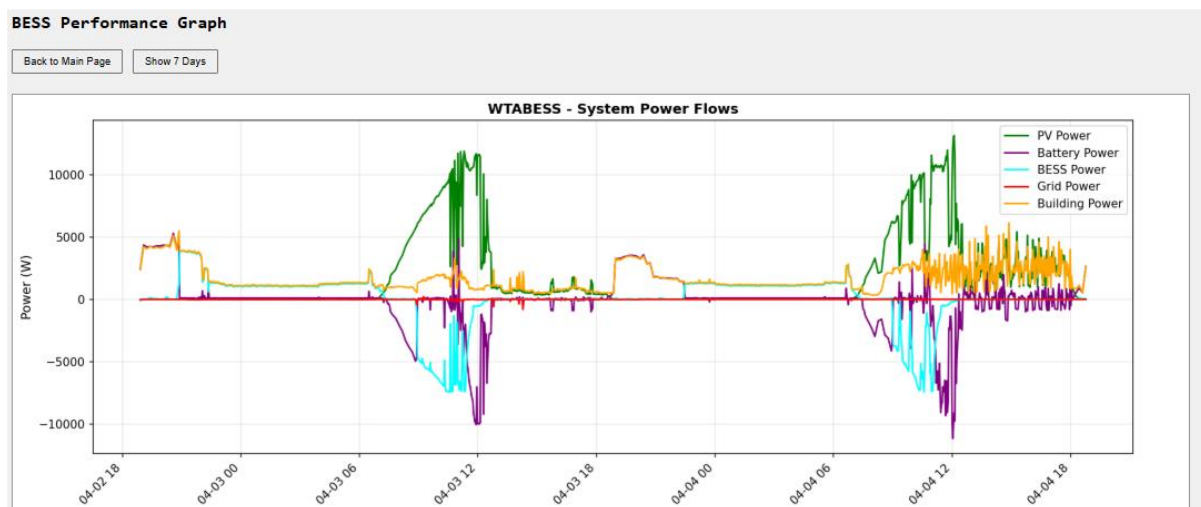


5.7.4 BESS webserver Graphs



After clicking on , you will have two options – 2 day and 7 day – both screenshots are shown below.

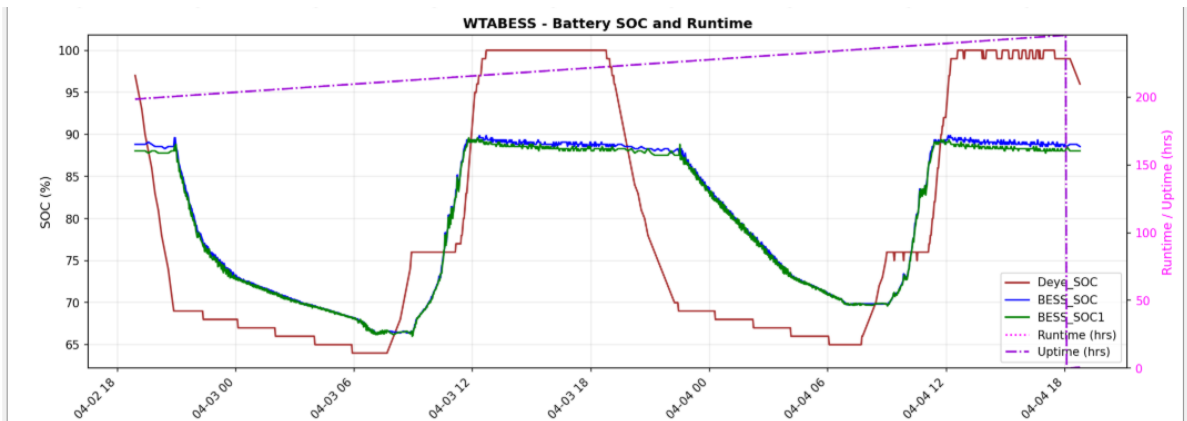
Three graphs will be displayed on your screen, as in the screenshot below.



1) Graph 1 (above): Power flows

-  PV Power: power coming into BESS from the solar panels.
-  Battery: battery discharging (above 0 on Y axis) charging (below 0).
-  BESS: power coming into BESS (below 0), or flowing out of it (above 0).
-  Grid: power coming in from grid (above 0), or grid off (at 0)
-  Building Power: power going into building (above 0)

The X axis shows time: for example, in the screenshot below on the first graph, 04-02 18 is the time 18:00 on date 4th April.



NB: In this graph, for the BESS WTA system, BESS_SOC1 = state of charge of BESS battery no 1, and BESS_SOC2 is the state of charge for BESS battery no 2

2) Graph 2 (above): WTABESS – Battery SOC and Runtime

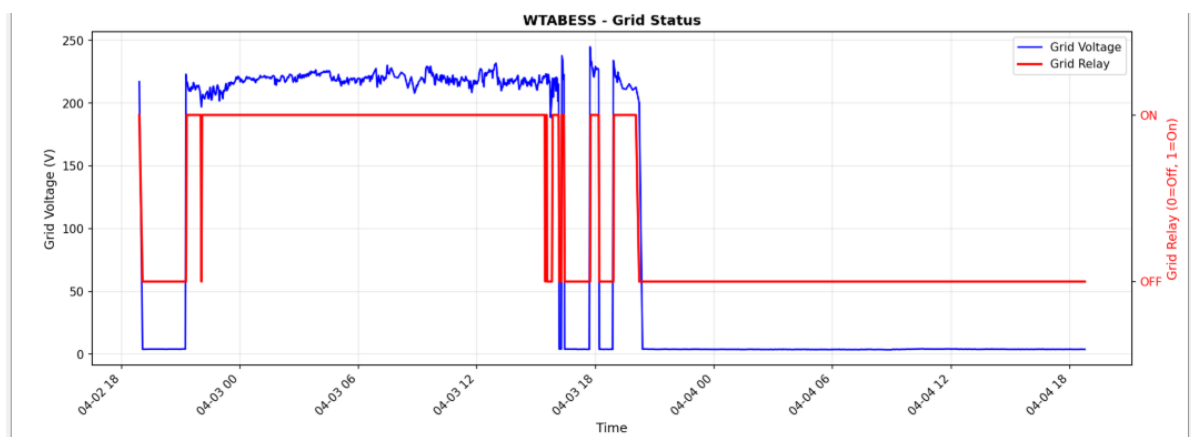
— Deye SOC: The Deye battery charge level

— BESS_SOC0: first battery charge level

— BESS_SOC1: second battery charge level

— Runtime (hrs): power coming in from grid (above 0), or grid off (at 0). Note that Runtime and Uptime both use the Y axis at the far end of the graph, in pink, to show how many hours since the last BESS reset.

— Uptime (hrs): power going into building (above 0). Note that this line often appears on top of the Runtime line, as they tend to run together.



3) Graph 3: WTABESS – Grid Status

— Grid Voltage: the Grid voltage at any given time.

— Grid Relay: using the red axis at the far end of the graph, this line shows 0 (Relay Off – meaning no grid power coming in) or 1 (Relay On – meaning the grid is providing power to the site).

Summary of events in the screenshots above:

In the screenshots, the three graphs record between them that:

Between 18:00 and 23:59 on 2nd April, the **building** was drawing power, supplied by the **Deye battery**, as the **Grid** was down. At this point, the BESS system's **Runtime** and **Uptime** were both on just under 200 hours, and rising steadily (Runtime can't be seen, as it's under Uptime).

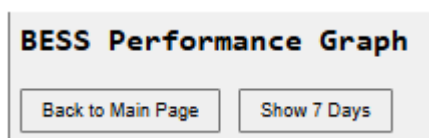
About halfway through the evening, when the **Deye battery** dropped to just under 70% charge, **BESS** started to discharge power to help keep the building going. This continued until the sun came up early the next morning, causing the **solar panels** to start sending power to **Deye** and then to the **BESS** and the **batteries** – you can see the **Deye**, **BESS_SOC** and **BESS_SOC** lines start to rise in the second graph.

At the same time, a **Grid voltage** of over 200V was detected, causing the **Grid Relay** to switch **ON** for about 18 hours, with two shorter bursts later. Note that during this period, no **Grid Power** (first graph) was drawn, because the onsite batteries met the demand.

Soon after noon on the 3rd, the weather became cloudy, and all batteries stopped charging from the solar panels. After 6pm, as the grid was still down, all the batteries started to discharge to power the building, in the same pattern as the previous evening.

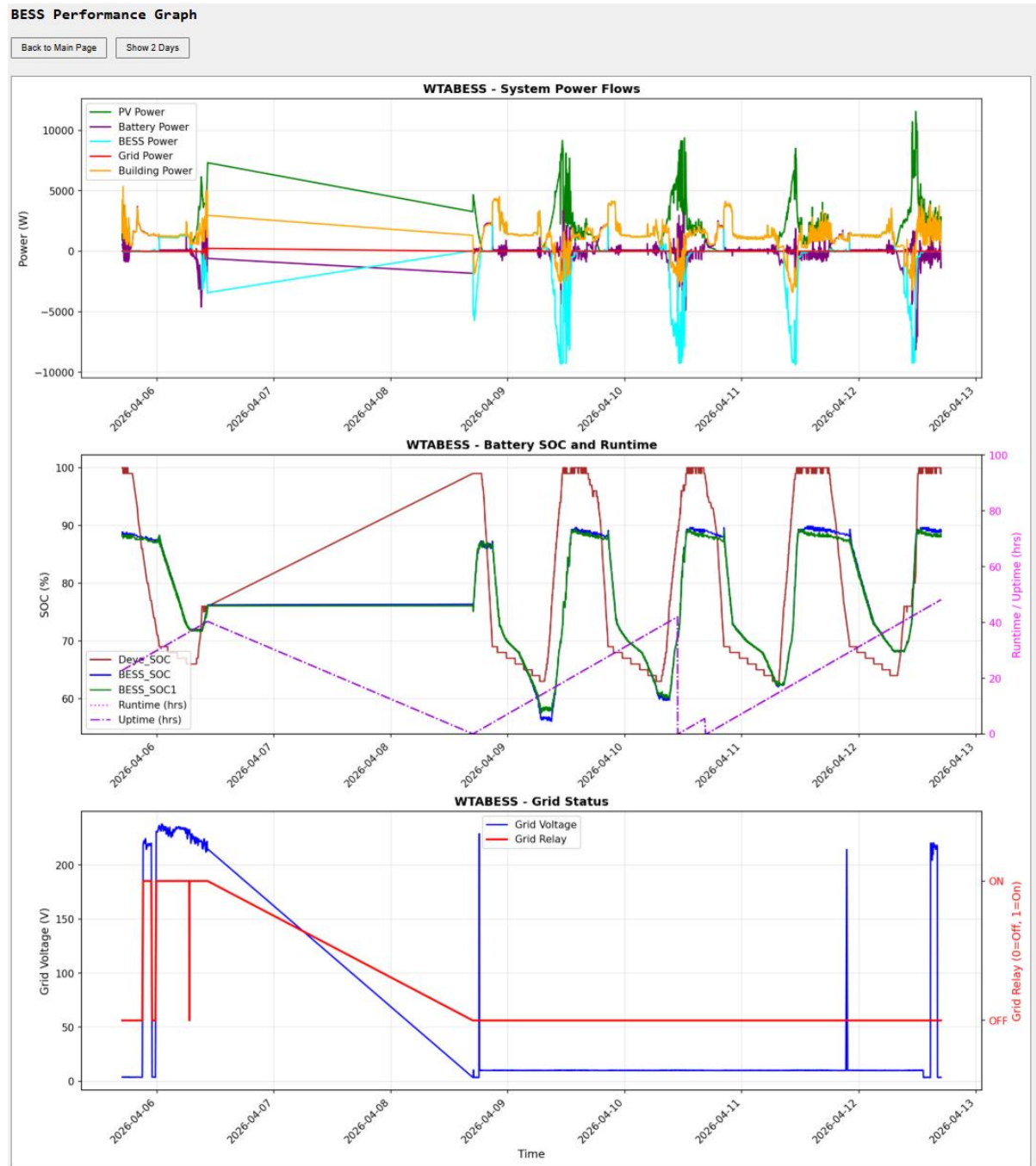
Show 7 Days Graph

Note that you also have the option to click on 'Show 7 Days' to see the above three graphs over a whole week.



Please note that the examples below cover a slightly different time period to the examples above.

This particular 7-day graph features a period of nil activity from mid-morning on 6th April to early evening on 8th April. The program has just drawn straight lines, on all three graphs, from the last known data point to the next known data point during this period.



5.7 What happens during an Internet outage?

If the neighbourhood internet is not working, for example at election time, then each StarTimes DEYE and BESS will continue to operate in whichever mode they are already

in. The BESS webserver will not update during the outage, and neither will you get a daily email. However, each StarTimes DEYE and its BESS will continue to communicate via each system's black Ethernet cable. This cable is not connected to the internet: it is just a handy way to run the Modbus/RS423 messages between each inverter and its BESS.

5.8 Daily Emails: Status Report

Each BESS sends an email to GridAI and WTA staff at the end of each day, summarising the statistics for that day. If this cannot be sent straight away (e.g. due to a wifi connection failure) it will retry every half hour, if necessary, until the next daily summary is ready to be sent. During normal operation, three emails, one from each BESS, will be sent per day.

The email is currently sent to Grid AI staff, but additional email addresses to receive this can easily be added, on request to Grid AI.

5.9 BESS Control – VPN for development purposes only

The BESS has an encrypted VPN (Virtual Private Network) connection which allows it to be controlled and monitored by Grid AI from anywhere in the world, as long as the site wifi is functional (and the BESS has been updated by GridAI with any wifi changes that you have made), and the BESS is connected to it.

During normal operation, BESS controller runs a continuous control loop, which monitors the system, and directs the BESS to charge or discharge as needed. Via the VPN connection, this loop can be interrupted to read more detailed data and change settings. Log files can be retrieved and software can be upgraded.

Control via the VPN is only for Grid AI support and is not needed by users.

6. Safety Information

6.1 For your safety and to protect the equipment

- **The HV box: Never open the HV box** – there are no parts needing maintenance inside it, just connectors. **It should not need to be opened. 400V DC can kill you!** Even using insulated tools may not be safe on live wiring, as electricity can jump across inadequate insulation. Always ask a professional in the very rare case that opening the box is absolutely necessary.

- All other DC cables are well insulated.
- Note that the DC voltage is only present when the system is in operation.

6.2 Regular Inspections and Good Practice

- **Inspect buildings, roofs, cables, and units weekly** for any signs of damage or loose connections.
- **Keep the systems dry** and ensure there is **good ventilation** around the units.
- Do **not place items on top** of the batteries.
- Do **not store flammable materials** in the BESS huts.
- Do **not repair the BESS huts with flammable materials**, especially the roof.
- If you notice **burning smells, smoke, or unusual noises**, turn off the system if it is safe to do so, and contact support immediately.
- Keep **children and animals** away from all battery units.
- **Do not open or dismantle** any part of the systems.
- **Do not touch any battery cables: while in operation, they carry very high voltages, which can be extremely dangerous.**
- Do not attempt repairs yourself; contact trained personnel.

6.3 In case of fire or other emergency:

- Lithium batteries, like the EV batteries used in BESS, can (rarely) overheat and catch fire. Batteries are monitored continuously for temperature and voltage. The system will automatically shut down if limits are exceeded. However, it is possible that internal shorts in the battery may cause temperatures to continue to rise even when there is no charge or discharge taking place.
- **We recommend installing a smoke alarm near each BESS.** Also **keep a Lithium-Ion fire extinguisher near, but not in, the battery hut or room**, and make sure everyone knows where they are.
- **If a fire does occur, remain at a safe distance, use extinguishers if possible but allow the fire to burn out if it cannot be stopped: instead, focus on avoiding the fire spreading to other buildings.**

6.4 How to Switch off BESS Units IN AN EMERGENCY ONLY

Normally you would restart one or more BESS systems as follows:

- via the webserver (Section 5.5)
- by powering down the inverters and then controllers (Section 5.6)
- contacting GridAi in the case of a wifi change.

However, in an emergency you may need to switch off a BESS urgently.

Either the Circuit Breaker or Changeover Switch will cause the BESS system to shut down, disconnect the HV (high voltage feed to/from each battery), and disconnect the BESS from the building electricity system.

Note that switching off a BESS which has power running through it may permanently damage that battery.

Switching off manually is strictly for emergencies only.

6.4.1 Emergency Shutdown – Circuit Breakers – EMERGENCIES ONLY

Switching off a BESS which has power running through it may permanently damage that battery. Switching off manually is strictly for emergencies only.

WTA

The Circuit Breaker is inside the Consumer Unit, which is in the Technical Room of the WTA building, in the back right corner, high up on the wall.



Lift the Consumer Unit's lid, and flick the last switch on the left DOWN to switch off the power to the BESS

The Rock

The Rock's Consumer Unit is in the corridor: go into main entrance, then follow the corridor round to the right, and look for the Consumer Unit high up on the wall on the right.



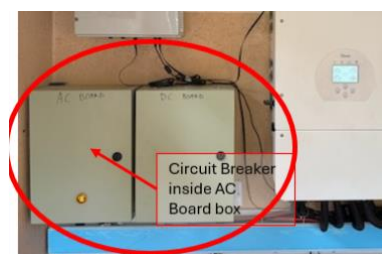
Lift the Consumer Unit's lid, and flick the third breaker from the right (ie next to the double red breaker) DOWN to switch off the power to the BESS



Mirembe

The Consumer Unit is in the AC Board box.

Open the AC Board box, and flick the BESS Circuit Breaker DOWN to switch off the power to the BESS



6.4.2 Emergency Shutdown – Changeover Switch – EMERGENCIES ONLY

Switching off a BESS which has power running through it may permanently damage that battery. Switching off manually is strictly for emergencies only.

- Use the large black Changeover switch located next to each BESS

Changeover Switch BESS

This photo shows the Changeover Switch for WTA BESS. The Changeover Switches for The Rock and Mirembé are very similar.

Location of BESS systems:

- WTA and The Rock – inside the hut.
- Mirembé – inside the garage.

Pull up the large handle on the ON/OFF Changeover Switch, to the 'OFF' position.



7. Troubleshooting Guide

First, perform all the checks listed below to identify the problem.

You may be able to fix the problem without restarting the BESS manually, as it will often restart itself after a little while.

If you do need to restart a BESS yourself, then you should do it from the webserver (or contact GridAi in the case of a wifi change).

WTA: <https://bit.ly/wtabess>

Rock: <https://bit.ly/rockbess>

Miremba: <https://bit.ly/mirembess>

However, in an emergency you may need to switch off a BESS immediately without going to the webserver.

Note that manually switching off a BESS which has power running through it may permanently damage that battery. Switching off manually (ie using the Changeover Switch or Circuit breaker) is strictly for emergencies only.

7.1 How do you know if there is a problem?

Generally, you will become aware of a problem if:

- **The electricity stops working** in one or more buildings.
- **You don't receive the daily emails** from the BESS systems - you should receive three emails each day – one for each system. NB usually a temporary wifi problem. If you can access the webserver, then then emails will restart automatically.
- You notice that the **StarTimes DEYE batteries have unexpectedly low charge levels**
- **The inverter status on a BESS controller display or the BESS website is not showing “Normal” or “Normal (R)”**

7.2 What caused the fault?

There are three main types of cause:

- **Something that turns off the electricity in all the buildings on the entire site,** such as:
 - A problem with the grid – which is also likely to affect other local properties
 - A widespread fire or other serious event

- **Something that turns off the electricity in just one or two buildings,** such as:
 - The StarTimes DEYE battery for that building has been drained to 20% charge, due to:
 - Too many electrical items plugged in
 - Too long since the grid or solar power was able to recharge
 - Damage or maintenance requirement.

 - The BESS system will be switched off by the StarTimes DEYE if its battery drains to 20%. This will typically happen if the grid has been down for several hours.
 - The StarTimes DEYE system will then shut down the building electricity which will also shut down the BESS system for that building.
 - Power will resume when the StarTimes DEYE system has sufficiently recharged, either from solar or the grid.

 - The BESS system or StarTimes DEYE system for that building has been switched off by mistake.

 - There is damage to the BESS system or to the StarTimes DEYE system.

 - A fire or other serious event affecting just that building. Note that if something damages the courtyard hut which houses the BESS systems for both WTA and The Rock, then both systems, and therefore both WTA and The Rock buildings may be affected.

- **Something that affects the wifi in one or more buildings:**
 - **A change of wifi password in any of the three site systems will affect the BESS connected to that system. The BESS system must be updated with the new wifi password or other changes. To do so, contact Grid AI.**
 - There are three wifi systems on site: 'WTA LAB MESH', 'ROCK HEALTH CENTRE', and 'mirembe'

- The BESS systems connect to wifi as follows:
 - BESS 1 – WTA is connected to ‘WTA LAB MESH’
 - BESS 2 - The Rock can connect to either ‘WTA LAB MESH’ or ‘ROCK HEALTH CENTRE’
 - BESS 3 – Mirembe is connected to ‘mirembe’
 - Note that BESS 2 - The Rock, will keep its internet connection even if the WTA building loses power, by connecting to ‘ROCK HEALTH
-

7.3 What to check

What to check depends on whether all three BESS systems are not working, or just one.

- If all BESS systems are not working, check the wi-fi system.
- If one BESS is not working, check other items listed below.
- If those don’t resolve the issue, try restarting the BESS from the webserver.
- If this still doesn’t resolve the issue, contact GridAI.

7.3.1 Check the Wi-Fi System

If no BESS is working in ANY building:

The BESS units all buildings rely on the site Wi-Fi to operate correctly.

If:

- the Wi-Fi password has been changed, or
- the Wi-Fi system has been replaced, reset or damaged,

then all BESS units may need **reprogramming**. **Contact GridAI support.**

Don’t switch off the BESS systems.

If only one BESS is not working, it may be a problem with that BESS’s local wifi network (WTA LAB MESH or The Rock or mirembe).

7.3.2 Check StarTimes DEYE Inverter

Note that a BESS will not work if the building’s StarTimes DEYE inverter does not initialise (ie there is nothing, or something unusual, on its display screen). If the StarTimes DEYE inverter is not working, contact StarTimes for support.

7.3.3 Check StarTimes DEYE Battery Levels

Check the battery level on the display on the StarTimes DEYE inverter

The StarTimes DEYE may have switched the building electricity off because the StarTimes DEYE battery for that building has fallen below 20% charge.

=> Wait for the grid or solar panels to recharge the battery

=> Wait for StarTimes DEYE to restart automatically

=> don't switch off the BESS systems

When the StarTimes DEYE system restarts, it will wait for the next available grid or solar power to start recharging its own battery.

The attached BESS system will wait for the next available solar power to start recharging its own battery. At present, BESS will not recharge from the grid: it must wait until enough solar power is available.

This may mean waiting until there is enough solar power (plus grid power if available) to recharge the StarTimes DEYE system AND enough spare solar power to recharge the BESS.

7.3.4 Check BESS battery levels

Check the display on the BESS Controller



The last line of the display shows the battery charge. In this example, there are two batteries: the top battery is at 34% and temp 5 degrees C, while the bottom battery is at 62% and temp 6 degrees C.

7.3.5 Check if a BESS battery is not working

Check the controller display:

‘I Idle Normal’ This readout refers to the status of two batteries: it would mean that the battery showing as ‘Idle’ is not working. In this case, this readout means that the top battery is Idle, i.e not working, while the bottom battery is working as normal.

Note that Mirembe’s controller display will only show results for its one battery.

‘P 0Wr 0W 0W’ would mean that there is zero power requested by the controller, zero power coming from the top battery, and zero power coming from the bottom battery.

If a battery is not working, please contact GridAI so that they can run remote diagnostics and advise on action.

Note that the system will still carry on working with one battery while GridAI performs remote diagnostics.

7.3.6 Check the Changeover Switch and Controller Power Switch

- Check that the Changeover Switch’s black handle is pushed down as far as it will go to the ‘ON’ position.
- Check that the Controller Power Switch is in the ‘ON’ position.
If so, then visit the website for that BESS to perform a reset (see BESS Webserver section in this manual):
 - WTA: <https://bit.ly/wtabess>
 - Rock: <https://bit.ly/rockbess>
 - Mirembe: <https://bit.ly/mirembess>
- **In case of emergency, flip the circuit breaker or Changeover Switch – see the Emergency Shutdown section. Avoid switching the Controller switch OFF, as this can permanently damage the batteries, unless the third line of the Controller display reads ‘P 0Wr 0W 0W’.**

7.3.7 Check the Circuit Breaker in the Consumer Unit

If there is no electricity in the building, check to see if the circuit breaker for the BESS has tripped. NB You may also wish to check the circuit breaker switch for the StarTimes DEYE system at the same time.

There is a separate Consumer Unit in each building. It is usually a pale-coloured box on a wall somewhere inside the building.

WTA:

The Consumer Unit is located in Technical room of the WTA building. When you walk in, it is in the back right corner, high up on the wall.

Inside the Consumer Unit, you will see the BESS circuit breaker switch at far left, which should be up. If it's down, flick it up again. If it will not stay up, then carry out the other checks in this section to find out what is causing the switch to trip.

Note that in the WTA Consumer Unit, the trip switch has 63A capacity.



The Rock:

Inside The Rock's Consumer Unit, the BESS circuit breaker switch is third from the right: it should be up. If it's down, flick it up again. If it will not stay up, then carry out the other checks in this section to find out what is causing the switch to trip.

(Trip switch has 32A capacity).



Mirembe:

The Consumer Unit in Mirembe is located with the StarTimes DEYE and BESS units.

There are two boxes below the BESS controller – see pic below. The left one, labelled ‘AC Board’, contains the Consumer Unit for Mirembe. Inside this box, the BESS power is controlled by a circuit breaker switch that should be labelled ‘BESS’. This should be up. If it’s down, flick it up again. If it will not stay up, then carry out the other checks in this section to find out what is causing the switch to trip. Note that this trip switch has 32A capacity.



7.3.8 Check Device Load

Ask:

- Are too many devices plugged in and switched on?
- Are one or more high-power appliances (such as a kettle, water heater, oven, or air cooler) being used?

High loads (too many devices, especially high-power ones) may cause the inverter to shut down temporarily, even if the StarTimes DEYE battery is above 20% charge.

Action: switch off a few devices.

7.3.9 Check All Cables

Look for loose connections or damage.

Inspect:

- Power cables (**caution: the thick orange battery cables may be carrying up to 400V. If one looks loose, seek advice from an electrician**).
- Underground cable entry points i.e. where the cables go underground and come out again.
- All other visible connections

7.3.10 Check for Physical Damage

Make sure the BESS is switched off before investigating beyond a visual inspection.

Look carefully for signs of:

- Tampering
- Impact or mechanical damage
- Water leaks or moisture
- Dust buildup
- Animal interference (chewing, nesting, etc.)
- Overheating marks (brown or black marks on cables, plugs, sockets, outside of units or insides).

7.3.11 Check Internal Building Wiring

If **only one building** has lost power, the issue may be:

- A tripped breaker
- Damaged wiring
- A local fault unrelated to the BESS systems

7.4 Manually Restarting the BESS – see section 5.6

7.5 If none of the above resolves the issue

- Consult a local professional electrician
- Consult Grid AI
- Don't open any BESS units until you have tried everything else, and consulted Grid AI.
- Never open any 400V HV box unless you are a qualified professional, and you have tried all other options.

8. Contact and Support Information

Please note that your BESS systems are demonstration systems and not commercial products. The intention is to provide support for the estimated 5 year life of the system, but this cannot be guaranteed. However, none of the parts in the BESS systems will need to be routinely replaced.

If there is a problem with any BESS, first contact an authorised person on site:

Arumadri Baptist +256 774 833858

Sekubunga Bob +256 784 287865

For BESS technical support, repairs, or system programming, please ask an authorised person to contact Grid AI:

Contact Details

Young Edward edward.young@gridai.org +44 7971 060390 (expensive) or WhatsApp (free)

Walsh Chris chris.walsh@gridai.org +44 7810 800272 (expensive) or WhatsApp (free)