The World's Largest Micro-grid BESS 1300MWh Red Sea Project

Smart String Energy Storage System Application Case

Project Information:

Owner: Saudi Red Sea Development Company, Developer: ACWA Power, EPC: SEPCOIII

Location: Saudi Arabia · Red Sea New Future City

Capacity: 1300MWh BESS

COD: 2023.03

Smart String ESS **Smart PCS** **STS**

The Red Sea New City is sitting on the Saudi Arabian Red Sea coast, with a population of approximately one million, and the entire city will be 100% powered by new energy sources. The Red Sea 1300MWh BESS project is the world's largest micro-grid energy storage project, as a priority in the Kingdom's 2030 carbon neutral vision plan. Huawei provides Smart String ESS Solution in this project, bringing customers the values such as grid forming, higher discharge capacity, simple O&M, safe and reliable.

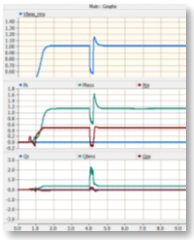
[Dubai, 16 October 2021] Huawei Digital Power and SEPCOIII signed a contract for the Red Sea BESS Project

Case Study

As the world's first 100% new energy powered GWh-scale micro-grid project, the local grid is fully supported by solar, wind energy ,and energy storage system. The ability of the grid to maintain stability is therefore crucial.
High temperatures, high humidity, and high salinity are the main features of the natural conditions in the Red Sea region of the Middle East. Therefore, the available capacity, operation lifespan, transportation, site construction ,and O&M become the main challenges.

1 Grid Forming – Supporting Stable Operation Under All Grid Scenarios

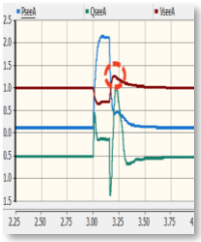
Saudi Arabian power grid is dominated by fuel and gas-fired power generation, while synchronous generators feature voltage sources that support independent grid integration with rotational inertia and reliable frequency and peak regulation capabilities to maintain grid stability. However, photovoltaic and conventional energy storage are current sources and do not have the capability to be grid-independent and stabilize the grid.



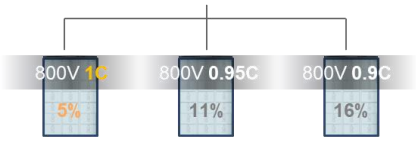
SCR = 1 weak grid Fault Ride Through

Grid Forming algorithm enables the PV & energy storage system to become a reliable voltage source and establish a stable grid. At the same time, the system has equivalent rotational inertia and maintains grid frequency stability with the primary frequency regulation capability. Facing the complex grid environment of Red Sea New City, the Huawei team has successfully modeled and passed the grid models simulation test within only a month. Smart String ESS with Grid Forming algorithm is capable of supporting both extremely weak and strong grids.

Continuous high and low voltage Ride Through



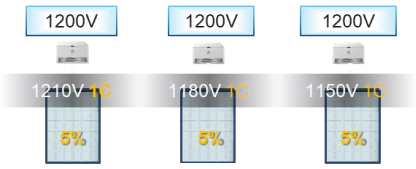
2 Rack-level Optimization – Ensures all racks are simultaneously fully charged or discharged, to avoid parallel mismatch, enable phased battery deployment



SOC of racks

Direct parallel connection of racks: inter-cluster bias current affects available capacity

Traditional ESS battery racks are directly connected in parallel, due to the difference in internal resistance between the racks, there is the bias current problem between the racks during charging and discharging, which reduces the available capacity of the system. Long-term bias current will also aggravate battery aging and pose a safety hazard. In terms of phased deployment, the direct parallel connection between racks does not support the mixing of old and new batteries, which requires additional PCS and transformers, which increases the investment.

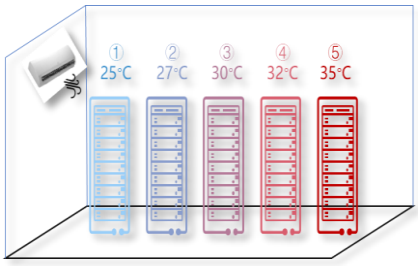


SOC of racks

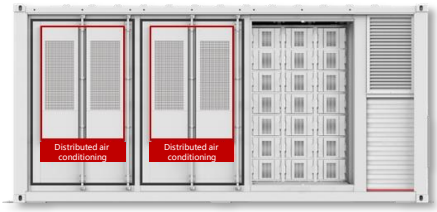
Smart cluster controller: guaranteeing a full charge and discharge per cluster

Huawei Smart String ESS is equipped with smart rack controllers, which can flexibly adjust the voltage of each battery rack, avoid parallel mismatch caused by bias current, and increase the available capacity of the system by more than 8%. Old and new batteries can be mixed, allowing for the phased deployment of batteries, which reduces the initial capacity configuration.

3 Distributed temperature control – Reliable operation in high-temperature scenarios and extent battery lifespan



Traditional ESS is equipped with a central air conditioner to dissipate heat throughout the system. When the air conditioner is far away from the rack, the temperature difference between batteries in the container might be greater than 10℃. The temperature difference will exacerbate the inconsistency between the cells and affect the system discharge capacity. In addition, high temperatures will cause a reduction in the active material within the cells, accelerating the aging and SOH decay of the cells and shortening the system life.



Huawei Smart String ESS is equipped with distributed air conditioning and each battery pack is equipped with the patented tree bionic hybrid air duct, which enables the independent and uniform heat dissipation for each rack, reducing the difference in temperature rise between racks. The HVAC is also equipped with a dust and sand extraction device for extreme sandy conditions in the Middle East. In addition, the cabinet is protected with a special coating to achieve the industry's high level of C5-m corrosion protection.

4 Pallet transportation - no internal installation on-site, saving 3 months construction time

Traditional ESS requires independent transportation, manual on-site installation, and commissioning of battery packs due to the container structure design. For the GWh-scale power station, with 250+ packs per container and 27 people/day required for installation, the installation of the packs alone takes about 3 months.

Huawei Smart String ESS supports pallet transportation, eliminating on-site battery installation work, shortening the construction period, and reducing construction costs. In addition, pallet transportation reduces the decay of the cells during transport, and the system is easier to be stored and guarantees performance once it reaches the customer's site.

❺ Rack-free SOC calibration- No need for experts on site, reducing O&M costs

Traditional ESS are unable to fully charge and discharge for each battery rack, so the only way to measure rack SOC is to use the Ampere-Hour Integral estimation method. Due to the accumulation of sensor sampling deviations over time, the SOC differences between racks increase, causing system downtime and requiring experts to visit the station every 6 months for SOC calibration.

Huawei Smart String ESS allows each rack to be fully charged and discharged through a smart rack controller. It enables automatic SOC calibration via the BMS through the voltage method with the minimum calibration unit being the battery pack and without the need for an expert on-site. As the Huawei solution has the smart rack controllers, the calibration of a single battery rack does not affect other racks.

❻ Active safety – Proactive Alarm, no fire, no explosion

Safety is pivotal for energy storage systems. Thermal runaway caused by internal short-circuiting and external faults in the cells is the main cause of accidents. Huawei Smart String ESS provides end-to-end safety measures from the cell level to the system level.

(1) Smart Internal Short-circuit Diagnosis: cell-level voltage, current and temperature sampling, through the analysis of the charge and discharge curve comparison, accurate identification of lithium precipitation, dendrite puncture, and other internal short circuit risks, early warning of failures.

(2) Double safety protection at the battery rack-level: in the event of a short circuit, the battery packs are protected by two-level fault isolation via circuit breaker + fuse, and the faulty rack is shut down actively by the smart rack controller, so that a single rack failure does not affect the whole system.

(3) System level protection: The energy storage system accurately senses environmental changes through sensors for combustible gases, smoke sensing, temperature sensing and water flooding. When combustible gases are detected, the system is protected from fire and explosion through thermal runaway detection, shutdown control, system exhaust and fire suppression system linkage.