Capture Controller Technical Specification

Summary

This document contains information about the Capture Energy component called Capture Controller. It is a component inside the BESS with several important functions, such as the controlling the operational state of the BESS, connecting it to the cloud, and logging data. It provides secure and redundant communication (both internally within the BESS and externally to outside systems), as well as provide measurements fulfilling the technical requirements set by the market (e.g., the transmission system operators).

Its functionality and relationship to the other systems in the BESS are detailed in the document.

Revision

Date	Revision	Release note
2023-10-31	1	First release
2024-01-09	2	Updated name to Capture Controller Added information about UPS

Abbreviations

BESS	Battery Energy Storage System
EMS	Energy Management System
ENTSO-E	European Network of Transmission System Operators
FSS	Fire Supression System
GPC	Grid Point Controller
LER	Limited Energy Reserve
OMS	Operation and Maintenance System
PCS	Power Conditioning System (Inverter)
SOC	State of Charge
SOH	State of Health
THD	Total Harmonic Distortion
TSO	Transmission System Operator
UPS	Uninterrupted Power Supply
VPN	Virtual Private Network

Introduction

The Battery Energy Storage Systems (BESS) from Capture Energy contain a component called Capture Controller providing several important functions, such as executing operational commands, providing internet access to the BESS, and logging data. The Capture Controller is not an energy management system (EMS), but a system to cater functions surrounding an external EMS and the BESS for efficient integration. One or more local control units/energy management systems need to be installed to operate the battery. This can be provided by Capture Energy.

The location of the Capture Controller in the BESS depends on the model. A sketch showing its location in the BESS Powerbox 1 MW/1.1 MWh is shown in Figure 1. The placement of the Capture Controller is the same for the 500 kW/552 kWh and 500 kW/1.1 MWh containers. The preliminary location for the 1.2 MW/2 MWh container is displayed in Figure 2.

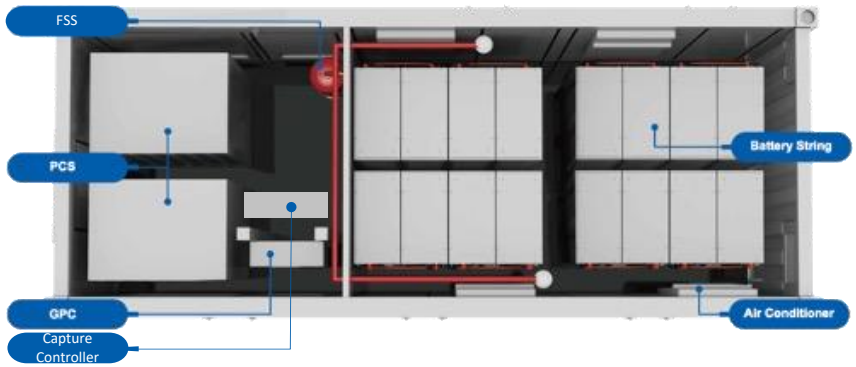

Figure 1: Sketch of Capture Energy PowerBox 1 MW/ 1.1 MWh showing placement of the Capture Controller. The placement of the Capture Controller is the same for the 500 kW/552 kWh and 500 kW/1.1 MWh products.

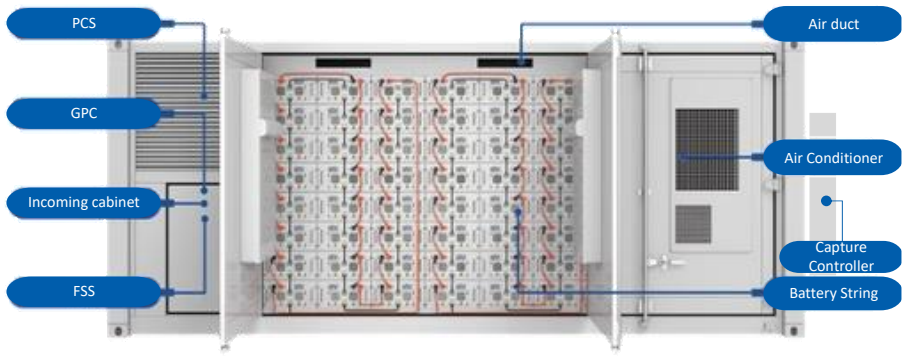

*Figure 2: Sketch of Capture Energy PowerBox 1.2 MW/2 MWh showing preliminary placement of Capture Controller. *Note: Design is not final and may change.*

It is not possible to operate the BESS without the Capture Controller.

An image of the first generation of the Capture Controller can be seen in Figure 3.

Figure 3: Picture of the first generation Capture Controller (with Capture Energy logo) inside a 1 MW/1.1 MWh container.

All functions provided by the Capture Controller described in this document are covered by the service agreement. Additional features can be added upon request, e.g., aggregator service.

Access to the inside of the Capture Controller is restricted to authorized personnel only.

Functions and components

Control system

The BESS control system is located in the Capture Controller. It is not an energy management system (EMS), instead catering functions to such a system and the BESS for efficient integration and control. The Capture Controller is responsible for receiving commands from the aggregators or energy management systems and deciding how the BESS shall act based on those commands depending on the status of the BESS. It is possible to install multiple aggregators' hardware or energy management systems.

The control system provides secure and redundant communication between the BESS and external systems. Through the communication of all internal components, it can provide reports related to the operation of the BESS, as well as provide alarms when a critical state is triggered.

With the logic inside the control system, it can ensure that the system operates withing specified limits in case of any system failure or if the external control system sends incorrect commands, to prevent events like deep discharge, incorrect pre-conditioning, or erroneous setpoints during operation. It can also define performance limits required by the transmission system operators (TSO), e.g., when classified as a limited energy reserve (LER), during such operation.

The control system also acts as a traffic controller, dividing access to the control of the BESS, to prevent multiple parties from sending commands simultaneously and continuously overwriting the current command state.

The control system is equipped with several sensors to measure operational parameters of the BESS, to be used to determine the how the BESS shall operate. The control system measures current and voltage for each phase independently and based on those measurements it calculates active power, reactive power, apparent power, frequency, energy, Cos ϕ, and total harmonic distortion (THD).

The measurement accuracy for voltage and current is 0.2 %, resulting in an accuracy for the calculated values (except frequency) of 0.4 %, see supplier documentation [1]. The measurement accuracy for frequency is based on the sampling speed and the measurement accuracy of the internal clock and will depend on the power quality. For an ideal case, where the voltage is close to a sine wave, the accuracy is < 0.01 % (<5 mHz at 50 Hz).

These measurement accuracies fulfill the requirements for Category D (>10 MW) production units set out by TSOs in the Nordics, part of the European Network of Transmission System Operators (ENTSO-E) [2].

Operation and Maintenance system

The Operation and Maintenance System (OMS) is an edge device that communicates with the internal components of the BESS and a cloud-based service set up by Capture Energy. It collects data from the internal components and uploads it to the cloud for monitoring and analysis. The OMS data can be used for service and warranty.

The OMS is based on hardware and software from ENcombi.

The OMS platform is not designed to control the BESS, only to provide supervision and analysis of its operation. It can provide alarms when the BESS is operation in deviating states, such as low state-of-

charge (SOC), low state-of-health (SOH), high/low temperature, or when a planned or unplanned event occurs.

The cloud platform is described in more detail in a separate document [3] and in the supplier documentation [4].

Gateway

The Capture Controller also contain a gateway. It provides internet access to the BESS, both through a wired connect and through a mobile connection (with a SIM-card). These systems are designed with a failover, to ensure that there is internet access if anything happens to one of the individual systems.

The gateway is equipped with a firewall to protect the BESS from intrusion.

A virtual private network (VPN) service is available in the gateway, to allow for remote access of the BESS during, e.g., maintenance or commissioning.

External systems

The Capture Controller contain space for external systems, such as aggregators or EMS, to be installed within in a plug and play manner. It supports installing multiple aggregator's hardware within the same BESS for service provider flexibility if required, as well as to reduce risk and cost.

Uninterupted power sypply

The Capture Controller contain an uninterrupted power supply (UPS) to provide power to the components inside it in the event of grid failure.

Modbus register

All communication to the BESS is done through the Capture Controller. It has a separate Modbus register to handle all internal and external communications, and to provide separate access and addressing with multiple external parties. The Modbus register map is available as a separate document [5].

Referenced documents

Number	Title	Revision	Link
[1]	Beckhoff EL3783 Power Monitoring Oversampling Terminal for 690 V	-	https://download.beckhoff.com/download/Document/io/ethercat-terminals/el3783en.pdf
[2]	Technical Requirements for Frequency Containment Reserve Provision in the Nordic Synchronous Area	-	https://www.svk.se/siteassets/aktorsportalen/bidra-med-reserver/om-olika-reserver/fcr/fcr-technical-requirements-may-23.pdf
[3]	Capture Energy Cloud Platform Manual	1	-
[4]	Encombi ECpvx User Manual	-	https://www.encombi.com/wp-content/uploads/2023/10/ECpvx_user_manual-1.pdf
[5]	Capture Energy Capture Controller Modbus specification	1	-