APPLICATION NOTE

Switching & Protection solutions for DC Combiners in Battery Systems
UL Utility scale

Are you searching for Switching and Protection solutions to protect and secure DC combiners and keep them running in Utility Scale Battery Energy Storage Systems (BESS)?
You can easily find the best solution to fit in your DC combiner and quickly configure your BESS installation thanks to our Application Bundle based on concrete examples.

What is a DC Combiner?
If you want to connect several battery racks in parallel prior to connecting to the DC side of the Power Conversion System (PCS) or to the DC Recombiner, you need a DC Combiner. The DC Combiner is a switchboard where switching and protective devices are installed along with auxiliary and/or communication circuits.

Why you need Switching & Protection solutions
Every feeder supplying the relative battery rack requires adequate disconnecting means and overcurrent protective device (OCPD) to guard against faults and overloads, which can also come from the other battery racks connected in parallel.

Main benefits

Smarter protection
Increases the power in your installation and reduces CAPEX by using the full range of 1500 VDC LV components.

Safety
Avoids the risk of fire in your facility and loss of valuable assets by using a complete range of Surge Protection Devices (SPDs) to protect the whole electrical system from lightning and surges.

Speeds up your projects
Reduces CAPEX and speeds up your projects by using a range of products in compact sizes able to provide excellent performance at different temperatures and humidity ratings.
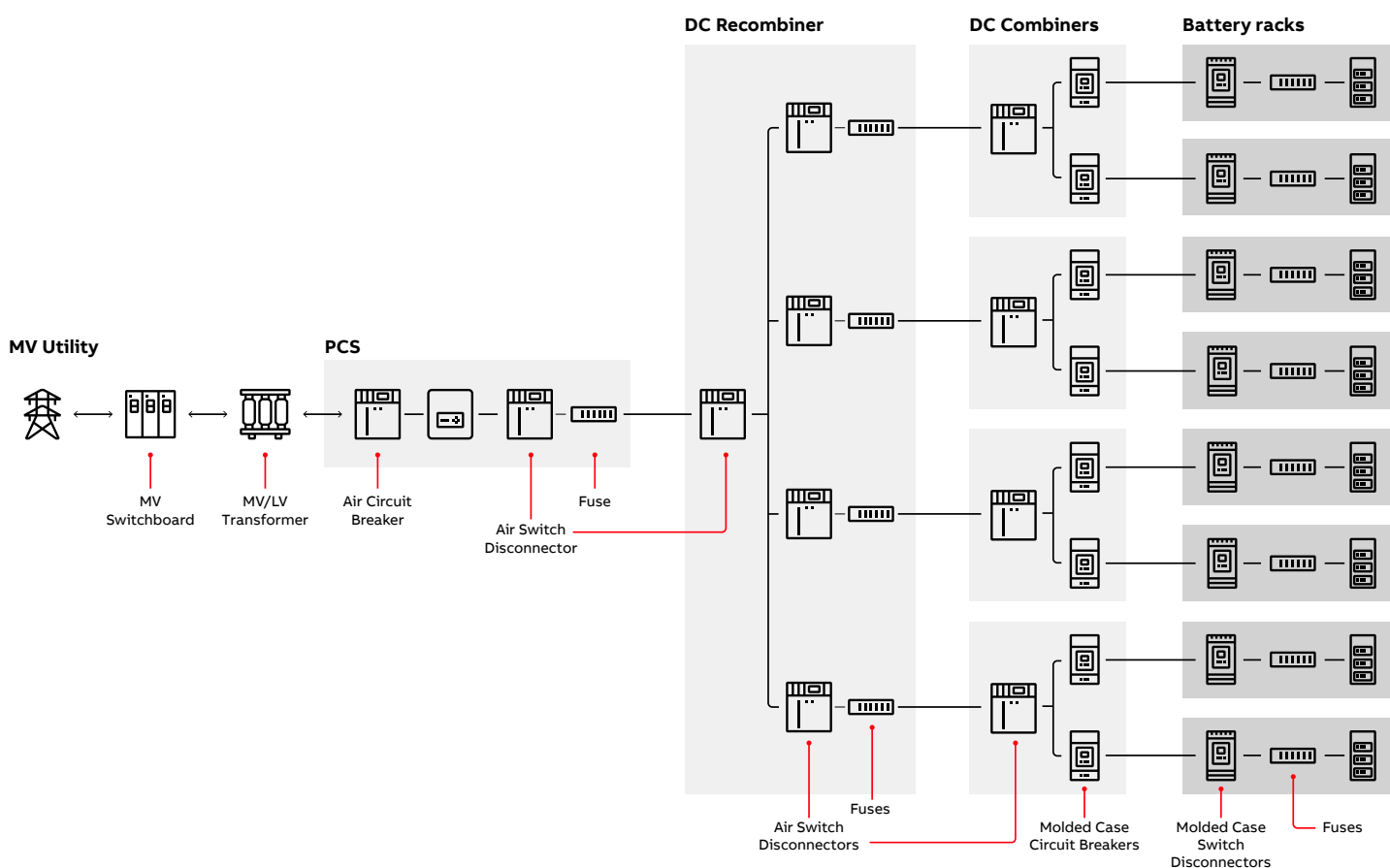
Smarter metering & monitoring
Maximizes power yield and cash generation by correct measurement of your BESS parameters.

Utility Scale Battery Systems

Utility scale stationary battery storage systems, also known as grid-scale front-of-the-meter storage systems, play a key role in integrating variable energy resources while providing the required flexibility. Battery storage increases flexibility in power systems, enabling an optimal use of variable electricity sources like photovoltaic and wind energy. Batteries can provide services for system operation, defer investments in peak generation and grid reinforcement.

Key characteristics of BESS in a Front-of-the-meter configuration:
- Direct connection to the AC Utility without the User's plant in parallel
- Grid support (ancillary services, fast power injection for peak requirements)
- Storage capacity typically ranging from just a few, to hundreds of MWh.

DC Recombiner

DC Combiners

Battery racks

MV Utility

PCS

MV Switchboard

MV/LV Transformer

Air Circuit Breaker

Air Switch Disconnector

Fuse

Air Switch Disconnectors

Fuses

Molded Case Circuit Breakers

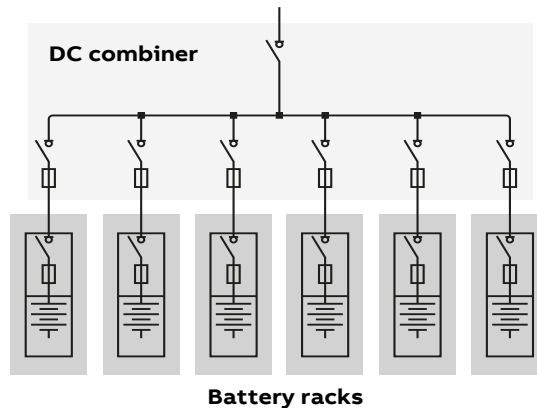Molded Case Switch Disconnectors

Fuses

DC Combiner
Fundamentals, main components & functionalities

The power stored in battery racks and re-injected into the Utility through the Power Conversion System is collected by DC Combiners (in some cases also by a DC Recombiner).

The DC Combiner is a switchboard where several battery racks are placed in parallel by the relative feeder. Every feeder requires adequate switching and protection against overcurrents.

Battery racks

DC combiner components
• Main Switch: Air switch disconnectors (E4.2 MS/DC-E)
• Surge Protection Device: OVR PV T1-T2
• Feeder switch disconnector: OTDC400UFV11-ESS
• ARC flash mitigation: Active, Passive & Preventive solutions

Main subsystem functionalities
- Combining of battery racks (range of hundreds of A)
- Overcurrent Protection of battery rack feeder
- Switching of battery rack feeder
- Main Switching to segregate the group of battery racks from the rest of the BESS (range of thousands of A)
- Surge Protection to protect against voltage spikes, such as those caused by lightning

Additional subsystem functionalites
- Monitoring: mainly where any drop in BESS plant performance may represent a significant economic loss
- Voltage, current, or temperature monitoring
- Communication: for communicating parameters to a centralized monitoring system.
- Remote-operation: when remote control is required
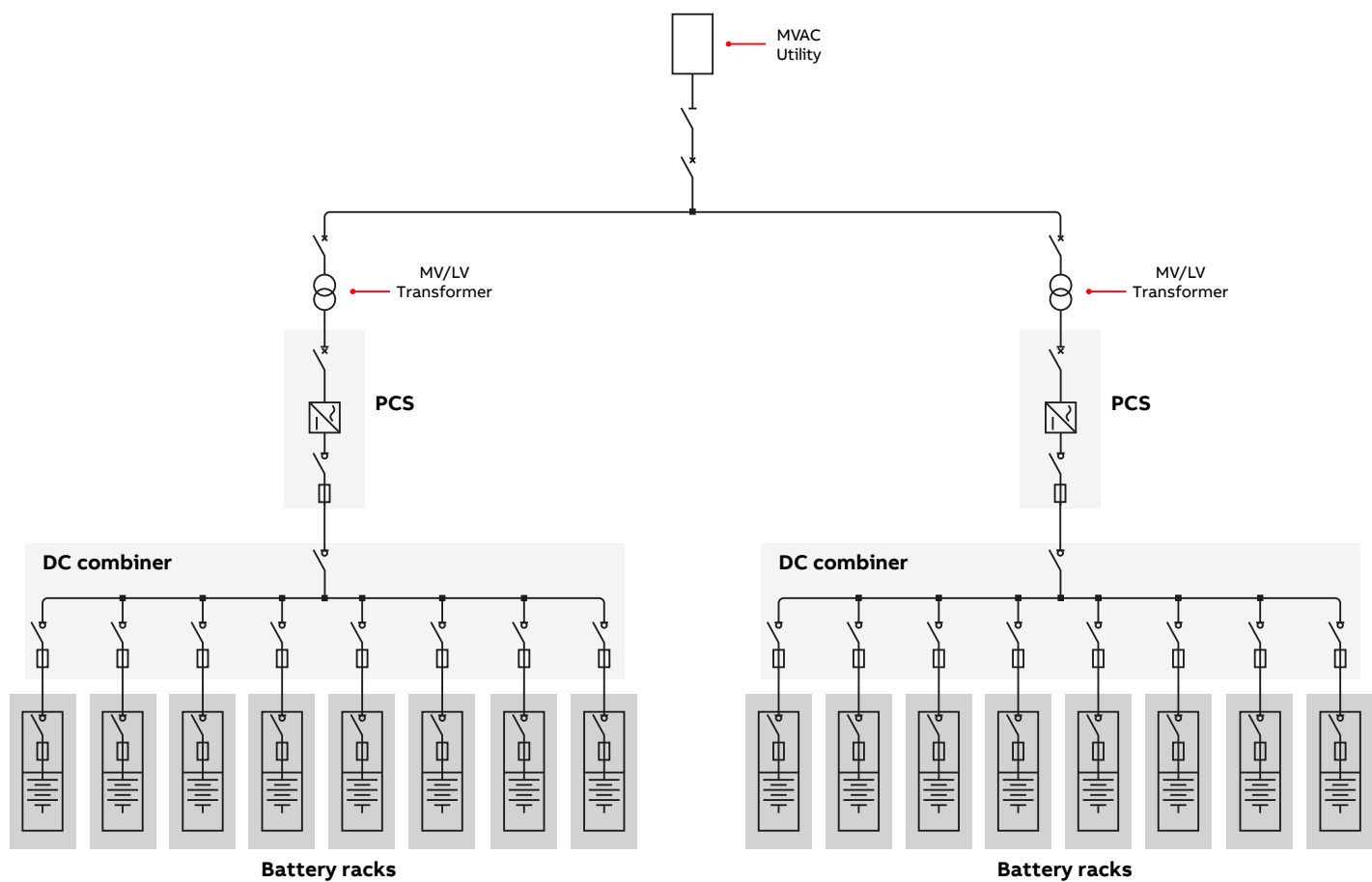- Arc flash mitigation

Switching & Protection solutions for DC Combiners
Application Bundle

Discover our Switching & Protection solutions for easy DC combiner configuration considering 4MWh BESS architecture with two 2MWh main system modules in parallel

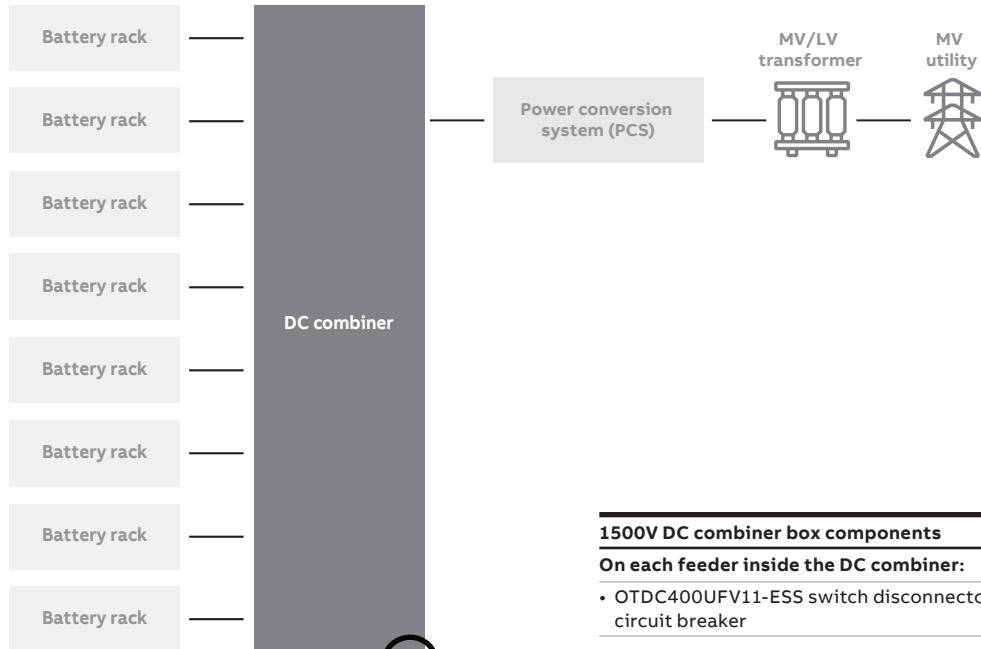**Single-line diagram of a 4MWh, 4MW Utility Scale application**

Specifications of electrical quantities for a 2MWh, 2MW module

Input data		
Rated power	[MW]	1.5
Rated stored energy	[MWh]	1.5
Rated DC voltage	[V]	1500
Rated AC voltage	[V]	600
Rated AC current	[A]	1445
Prospective AC short circuit current	[kA]	50
Rack rated current	[A]	320
Rack short circuit current	[kA]	15
N. containers		10
N. racks per container		6
DC bus max current	[A]	1720
DC bus short circuit current	[kA]	60
DC recombiner box		NO

DC combiner panel

Battery rack	
Battery rack	
Battery rack	
Battery rack	DC combiner
Battery rack	
Battery rack	
Battery rack	
Battery rack	

MV/LV transformer

MV utility

Power conversion system (PCS)
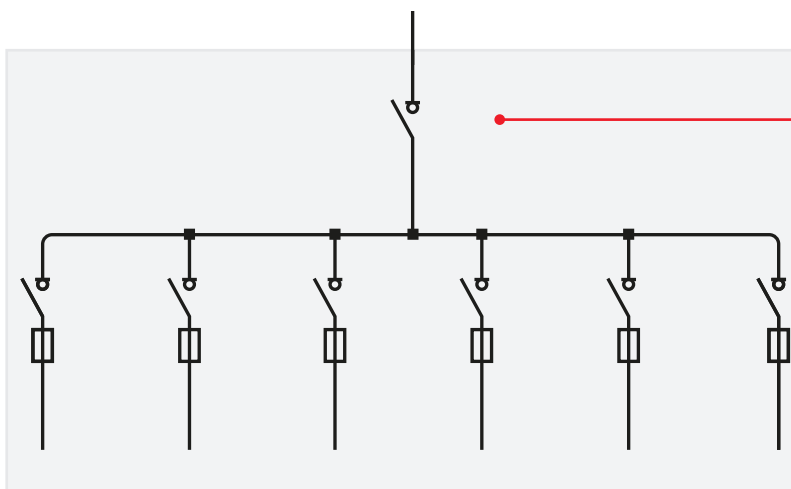
1500V DC combiner box components
On each feeder inside the DC combiner:
• OTDC400UFV11-ESS switch disconnector combined with any suitable PV fuse or PV circuit breaker
As main combiner switch:
• Emax 2 E4.2V-A MS/DC-E 1500V DC 2000A is installed for combiner switching function. The switch disconnector is installed in the fixed version and is equipped with undervoltage release YU and motor operator to open/close remotely.
• Protection against overvoltages: OVR PV T1-T2 10-1500P QS
• Arc flash mitigation solution: TVOC-2 + shunt opening release YO installed in Emax 2

DC combiner

Air switch-disconnector

Switch-disconnector

List of components - Part number & Quantity

Main components

Device	Part number	Total quantity
E4.2V-A MS/DC-E 2000 VR	1SDA115449R1	2
KitJumpE4.2 1600-2000 UL-B-2psUS INST	1SDA115489R1	2
M E2.2..E6.2 24-30V AC/DC + MC 24V	1SDA073729R1	2
YU E1.2..E6.2 24V AC/DC	1SDA073694R1	2
AUX 4Q 24V E2.2..E6.2	1SDA073754R1	2
OTDC400UFV11-ESS	1SCA158216R1001	12
OVR PV T1-T2 10-1500P QS	2CTB812100R1500	2

Optional components

Device	Part number	Total quantity
YO E1.2..E6.2 24 Vac/dc	1SDA073668R1	2
TVOC-2-48C	1SFA664001R1004	2
CSU-2LV	1SFA664002R5001	2
TVOC-2-DP2	1SFA664003R1020	2
TVOC-2-OP2	1SFA664004R1020	2

Product offering

Emax 2

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📖 **CATALOG**

OVR

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TVOC

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DC switch-disconnectors

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