

# Switching & Protection solutions for Power Conversion Systems in Battery Systems

## IEC/UL Utility scale



Are you searching for Switching and Protection solutions to protect and your Power Conversion System (PCS) and keep it running in your Utility Scale Battery Energy Storage System (BESS)?

For switching and to protect your BESS installation from faults, over current events and other hazards, the best product for your PCS can be easily found thanks to concrete examples.

### What is a Power Conversion System (PCS)?

If you want your Utility scale BESS (battery energy storage system) installation to function efficiently, you need a Power Conversion System to convert the power from AC to DC and vice versa. The PCS, is a bi-directional inverter that enables the batteries to charge and discharge with precision control.

### Why you need a Switching and Protection (S&P) solution

The PCS requires adequate protection and switching capability on the AC and DC side in order to switch the system - also in the load condition - and protect the entire electrical circuit from faults and overcurrent events.

Our switching and protection devices will also provide your PCS with communication connectivity to the BESS control system.

### Main benefits



#### Smarter protection

Increases 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 SPD 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

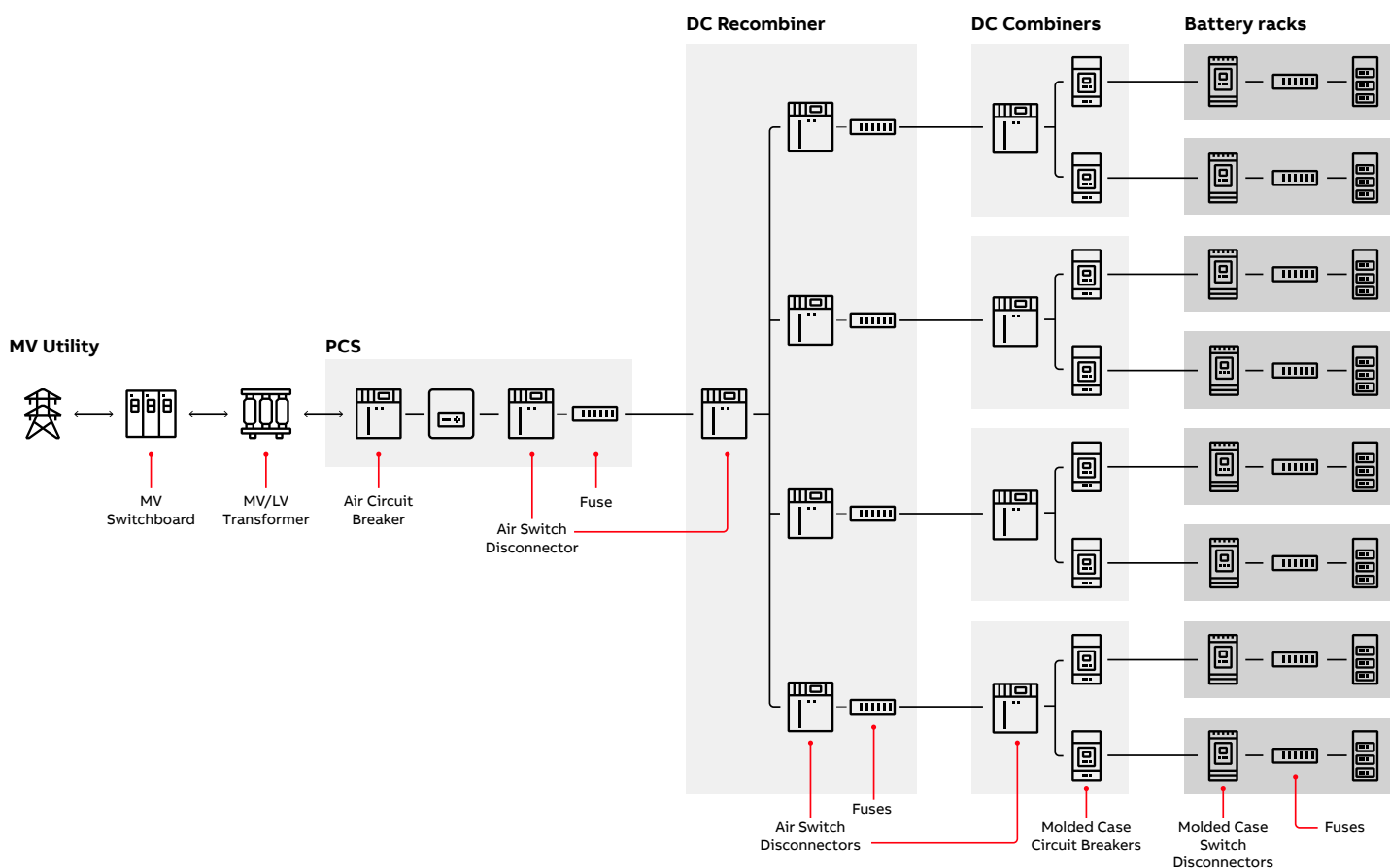
Maximizes power yield and cash generation by correct measurement of your BESS parameters.

# 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.

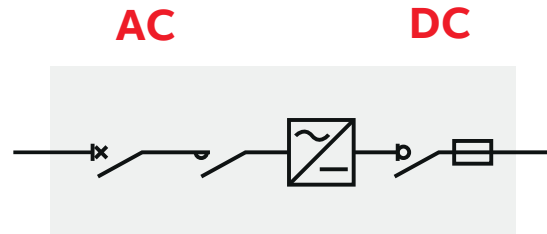


# Power Conversion System

## Fundamentals, main components & functionalities

Power is converted by an AC & DC Power Conversion System. This is a bi-directional inverter that enables the batteries to be charged/discharged with precision control.

The PCS requires appropriate protection and switching on the AC and DC side. In addition, the protection devices must provide communication connectivity with the BESS control system.



### Main subsystem functionalities

- **AC Incoming or primary switching and protection**  
A disconnect function, overcurrent protection and interfaced protection are required since the PCS is connected to a utility line in the majority of cases. The PCS can be supplied with either a fused manual disconnect switch or circuit breaker suitably rated for the incoming line voltage. The primary current and voltage transformers provided are connected to a protective relay and power metering equipment.
- **Auxiliary power**  
To provide the PCS with control and auxiliary power, an auxiliary power circuit is provided. This includes a fused disconnect switch, auxiliary power transformer, an uninterruptible power supply (UPS) and a power source for external battery heaters, if required.
- **Converter Modules**  
The converter drive modules are the heart of the power conversion unit. The modules used in this application convert DC to three-phase AC and vice versa. To achieve the total output rating required under specified conditions, twelve to sixteen identical modules are used for each 1 MW battery input. The converter modules are specifically designed for custom applications where enhanced system flexibility is needed.
- **DC switching and protection**  
The DC section of the PCS enclosure can contain either fused DC disconnect switches or DC circuit breakers, depending on the requirements of the battery supplier.
- **Local control.**

### Additional subsystem functionality

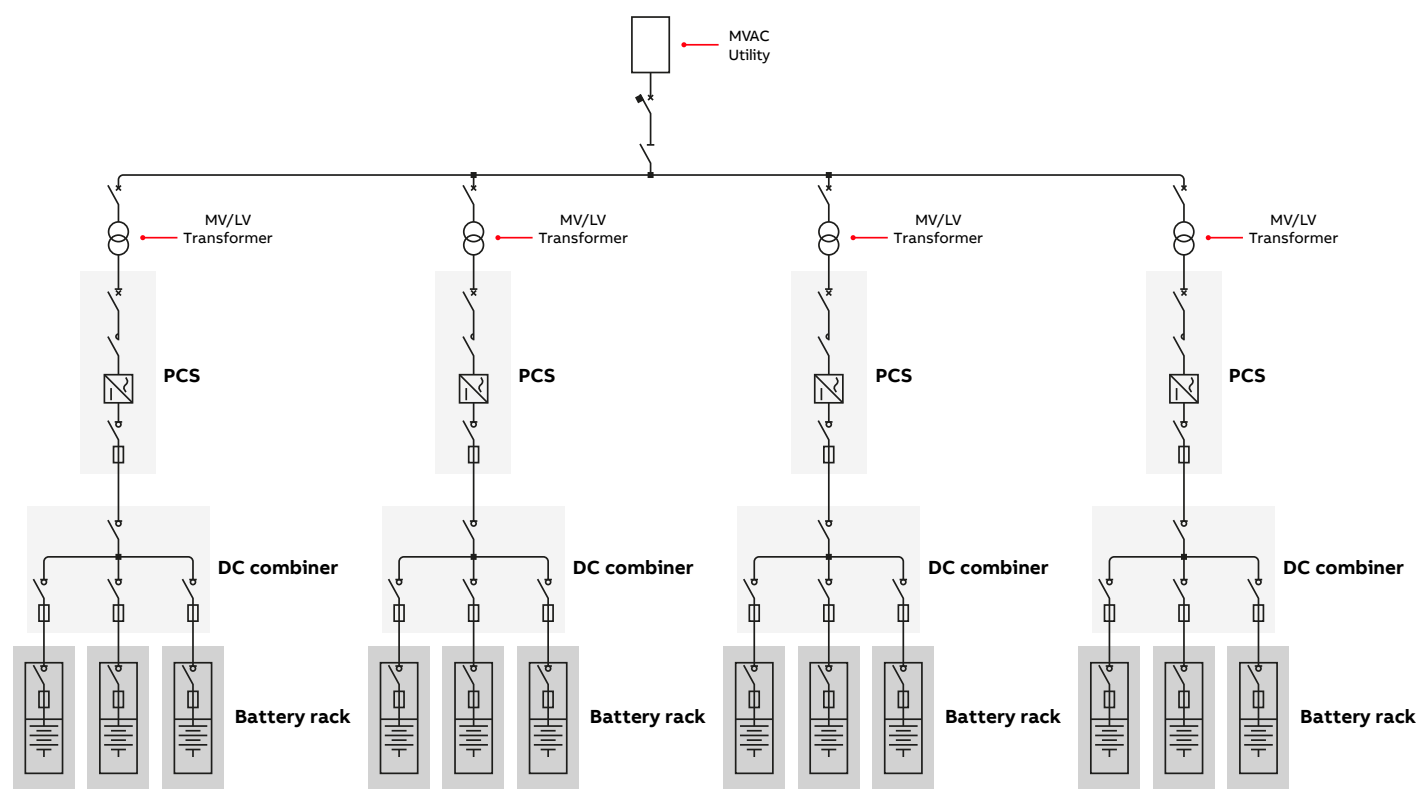
- **ARC flash mitigation:**  
Active, Passive & Preventive solutions. Surge protection device for AC and DC side, against direct lightning.



# Application Bundle 1#

Discover our switching & protection solutions for easy PCS configuration considering 4MWh BESS architecture with four 1MWh main system modules in parallel.

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



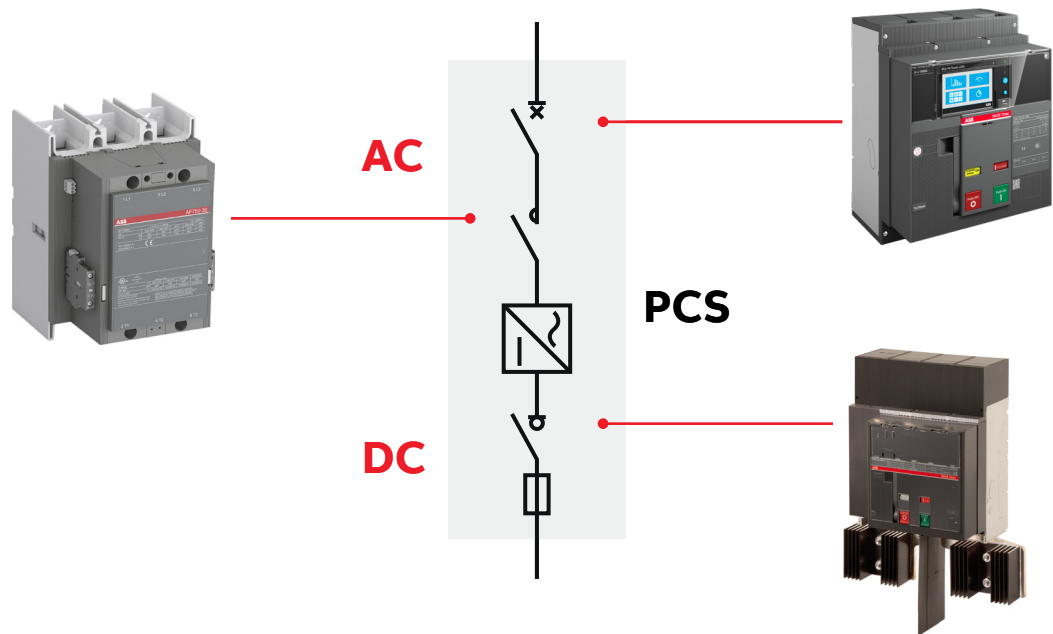
Specifications of electrical quantities with a 1500 V DC PCS

Input data		Single inverter per module	
Rated power	[MW]	4	
Rated stored energy	[MWh]	4	
Rated System module power	[MW]	1	
Rated inverter power	[MW]	1	
Rated DC voltage	[V]	1500	
Rated AC voltage	[V] IEC	690	
Rated AC voltage	[V] UL	600	
Rated AC inverter current	[A] IEC	931	
Rated AC inverter current	[A] UL	1070	
Prospective AC short circuit current	[kA]	50	
Rack max current	[A]	320	
Rack short circuit current	[kA]	15	
N. racks per combiner		3	
DC bus max current	[A]	961	
DC bus short circuit current	[kA]	45	
DC recombiner box		NO	

## ABB offering (IEC)

Based on the configuration above, the diagram below illustrates the ABB S&P devices best suited to the AC and DC side, as required by the IEC specifications.

### PCS with single inverter per module



#### AC side

**AF 750** (1050A – AC1) contactor for switching

**Tmax XT7L Tmax XT7L M 1000 3p In=1000A Ekip Dip LS/I** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7L M 1000 3p In=1000A Ekip Touch Measuring LSI** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7L M 1000 3p In=1000A Ekip Hi-Touch LSI** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**OVR T2 3L 40-600 P TS QS** to protect against overvoltages from the AC Utility

**TVOC-2 + RELT Module** for Arc Flash Mitigation

\* Shunt Opening Release (SOR)

#### DC side

**Tmax T7D/PV-E 1250 4p** switch disconnecter combined with fuses. The switch disconnecter is equipped with YU\* and motor operator to open/close remotely

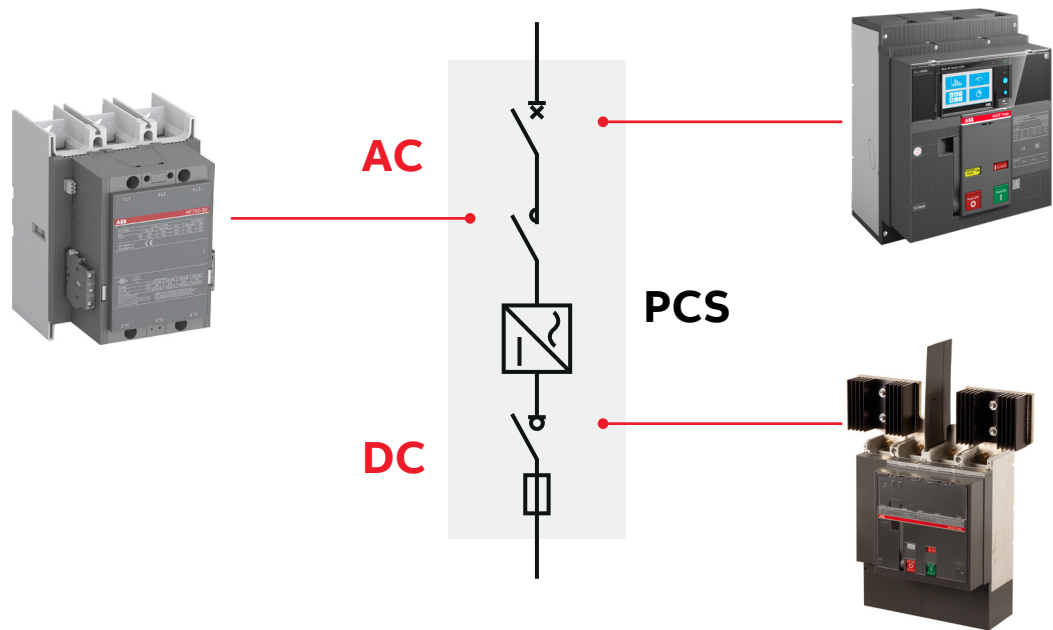
**OVR PV T1-T2 10-1500P TS QS** to protect against overvoltages

\* Undervoltage Release (YU)

## ABB offering (UL)

Based on the configuration above, the diagram below illustrates the ABB S&P devices best suited to the AC and DC side, as required by the UL specifications.

### PCS with single inverter per module



#### AC side

**AF 1250** contactor for switching

**Tmax XT7H Tmax XT7H M 1200 3p In=1200A Ekip Dip LS/I** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7H M 1200 3p In=1200A Ekip Touch Measuring LSI** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7H M 1200 3p In=1200A Ekip Hi-Touch LSI** for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**OVR T2 3L 40-600 P TS QS** to protect against overvoltages from the AC Utility

**TVOC-2 + RELT Module** for Arc Flash Mitigation

\* Shunt Opening Release (SOR)

#### DC side

**Tmax T7N-D/PV-E 1200 4p** switch disconnecter combined with fuses. The switch disconnecter is equipped with the YU\* and the motor operator to open/close remotely

**OVR PV T1-T2 10-1500P TS QS** to protect against overvoltages

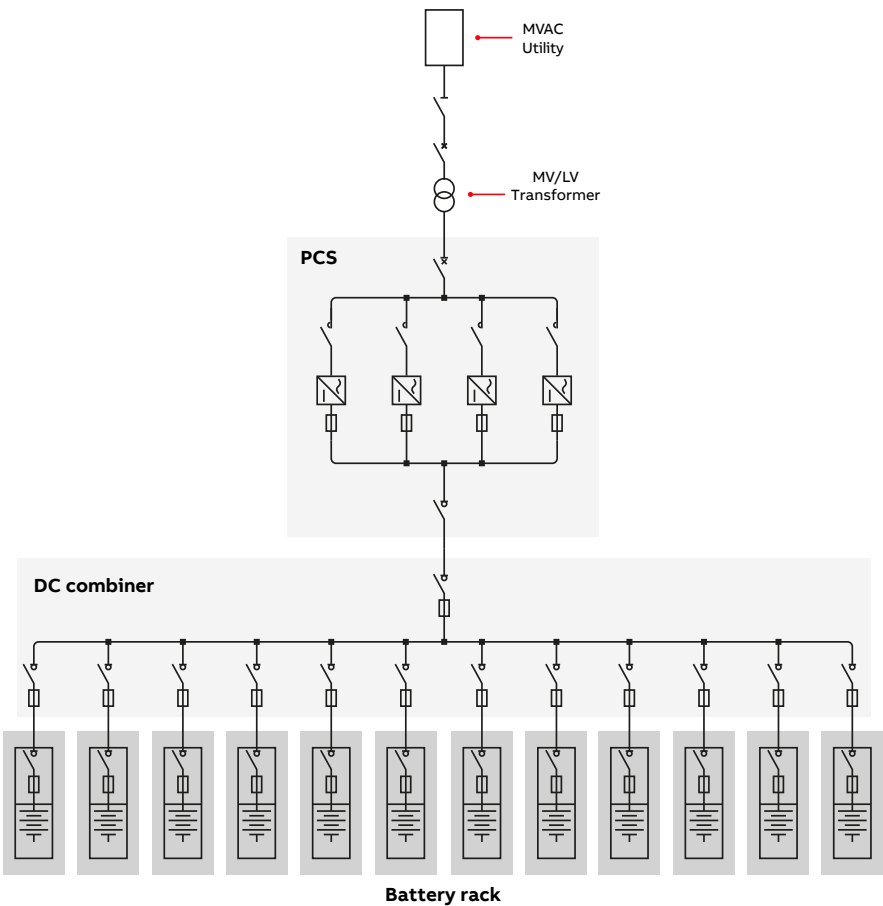
\* Undervoltage Release (YU)



# Application Bundle 2#

Discover our switching & protection solutions for easy PCS configuration considering 4MWh BESS architecture with a single 4MWh main system module.

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

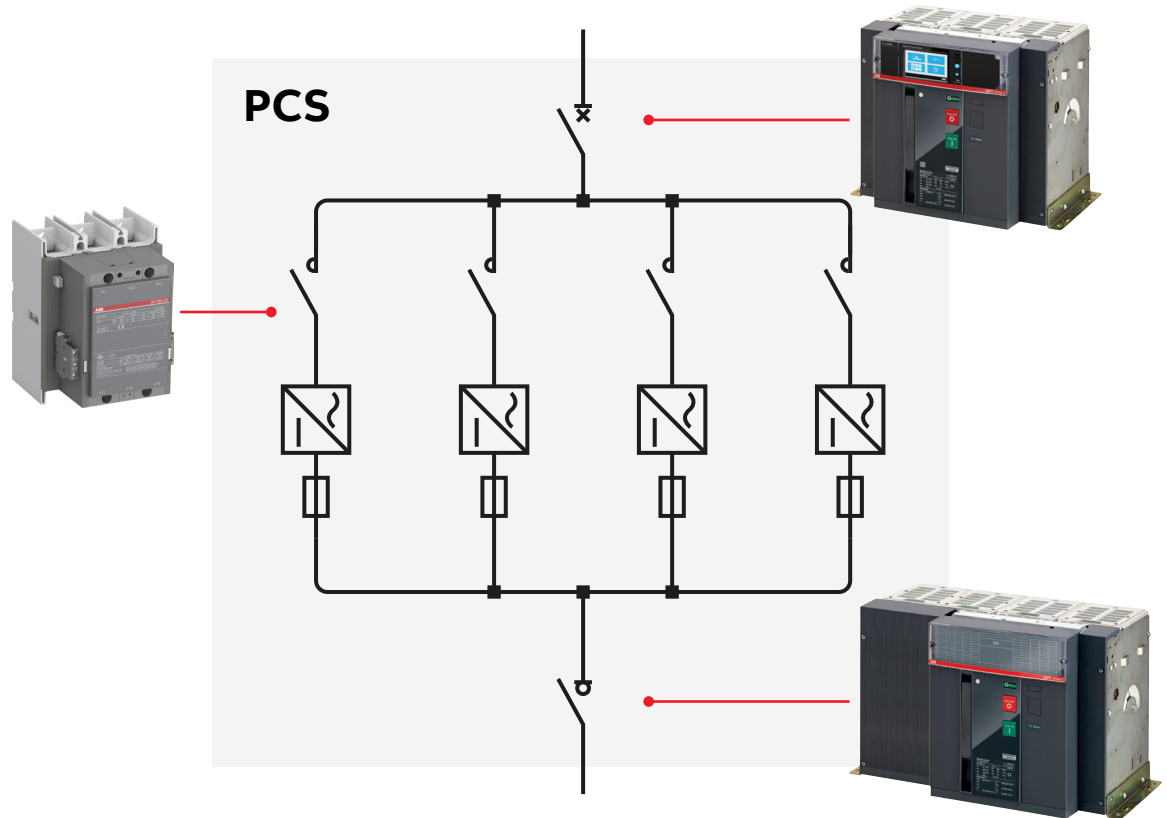


Specifications of electrical quantities with a 1500 V DC PCS

Input data		Four inverters per module	
Rated power	[MW]	4	
Rated stored energy	[MWh]	4	
Rated system module power	[MW]	4	
Rated inverter power	[MW]	1	
Rated DC voltage	[V]	1500	
Rated AC voltage	[V] IEC	690	
Rated AC inverter current	[A] IEC	931	
Total rated AC current	[A] IEC	3723	
Prospective AC short circuit current	[kA]	50	
Rack max current	[A]	320	
Rack short circuit current	[kA]	15	
N. racks		12	
DC bus max current	[A]	3845	
DC bus short circuit current	[kA]	180	
DC recombiner box		NO	

ABB's offering (IEC)

PCS with 4 inverters per 4MWh module



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#### AC side

**AF 750 (1050A – AC1)** contactor for switching on each inverter branch

**Emax E4.2N Emax E4.2N 4000 3p Ekip Dip LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**Emax E4.2N 4000 3p Ekip Touch LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**Emax E4.2N 4000 3p Ekip Hi-Touch LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**OVR T2 3L 40-600 P TS QS** to protect against overvoltages from the AC Utility

**TVOC-2 + RELT Module** for Arc Flash Mitigation

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#### DC side

Fuses installed on each inverter branch to protect the converter combined with a main **Emax E4.2S MS-DC/E 4000 4p switch disconnect** equipped with YO/YC\* and motor to open/close remotely

**OVR PV T1-T2 10-1500P TS QS** surge protection device to protect against overvoltages

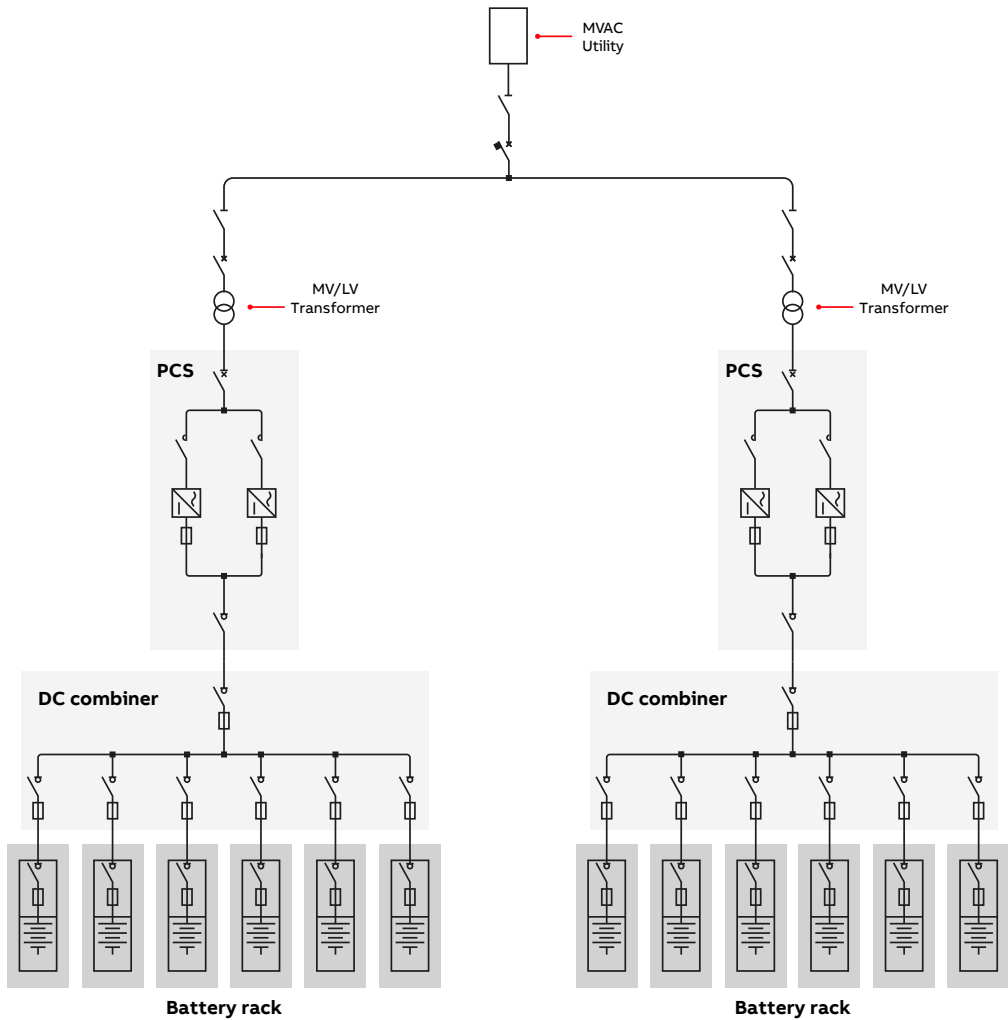
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\* Opening Release (YO); Closing Release (YC)



Discover our switching & protection solutions for easy PCS configuration considering 4MWh BESS architecture with two 2MWh main system modules in parallel.

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

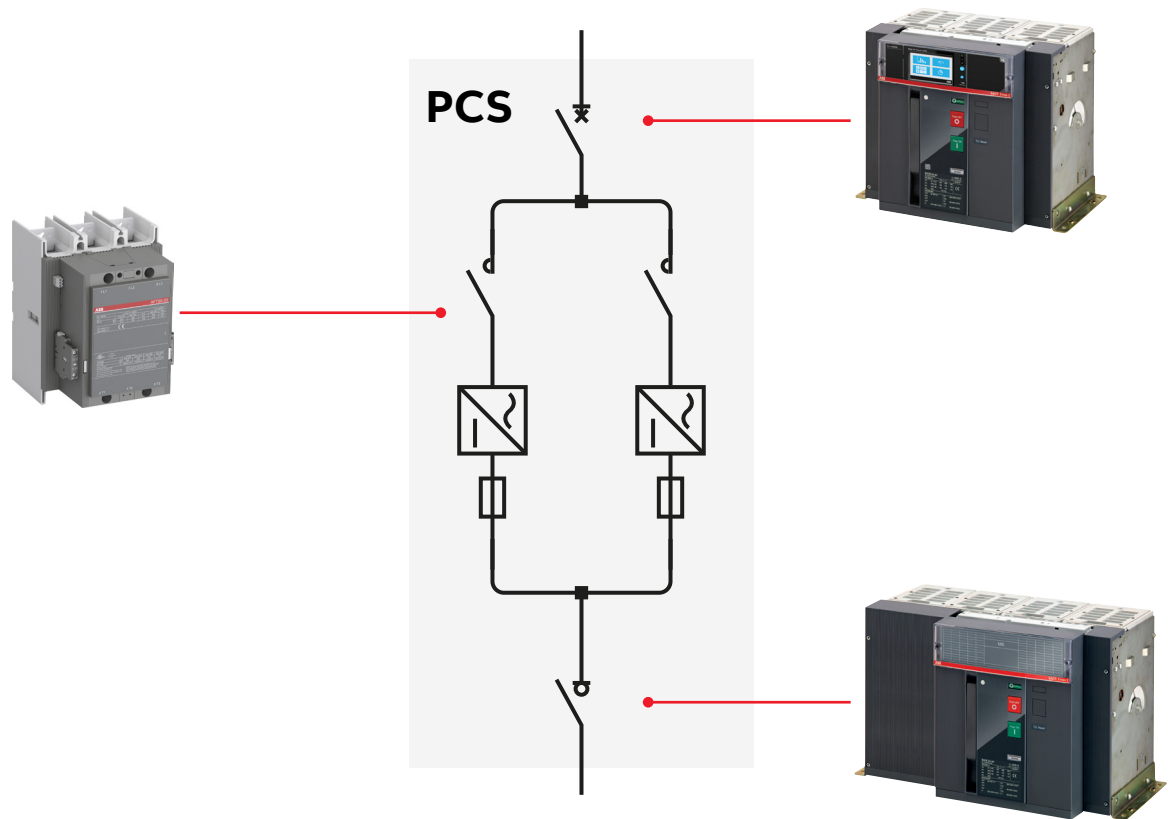


Specifications of electrical quantities with a 1500 V DC PCS

Input data		Two inverters per module	
Rated power	[MW]	4	
Rated stored energy	[MWh]	4	
Rated system module power	[MW]	2	
Rated inverter power	[MW]	1	
Rated DC voltage	[V]	1500	
Rated AC voltage	[V] UL	600	
Rated AC inverter current	[A] UL	1070	
Total rated AC current	[A] UL	2141	
Prospective AC short circuit current	[kA]	50	
Rack max current	[A]	320	
Rack short circuit current	[kA]	15	
N. racks		6	
DC bus max current	[A]	1922	
DC bus short circuit current	[kA]	90	
DC recombiner box		NO	

ABB's offering (UL)

PCS with 2 inverters per 2MWh module



#### AC side

**AF 1250 contactor** for switching on each inverter branch

**Emax E4.2S-A** **Emax E4.2S-A 2500 3p Ekip Dip LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**Emax E4.2S-A 2500 3p Ekip Touch LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**Emax E4.2S-A 2500 3p Ekip Hi-Touch LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with YO/YC\* and motor to open/close remotely

**OVR T2 3L 40-600 P TS QS** to protect against overvoltages from the AC Utility

**TVOC-2 + RELT Module** for Arc Flash Mitigation

#### DC side

Fuses installed on each module to protect the converter combined with a main **Emax E4.2S-A MS-DC/E 2000 4p switch disconnect** equipped with YO/YC\* and motor to open/close remotely

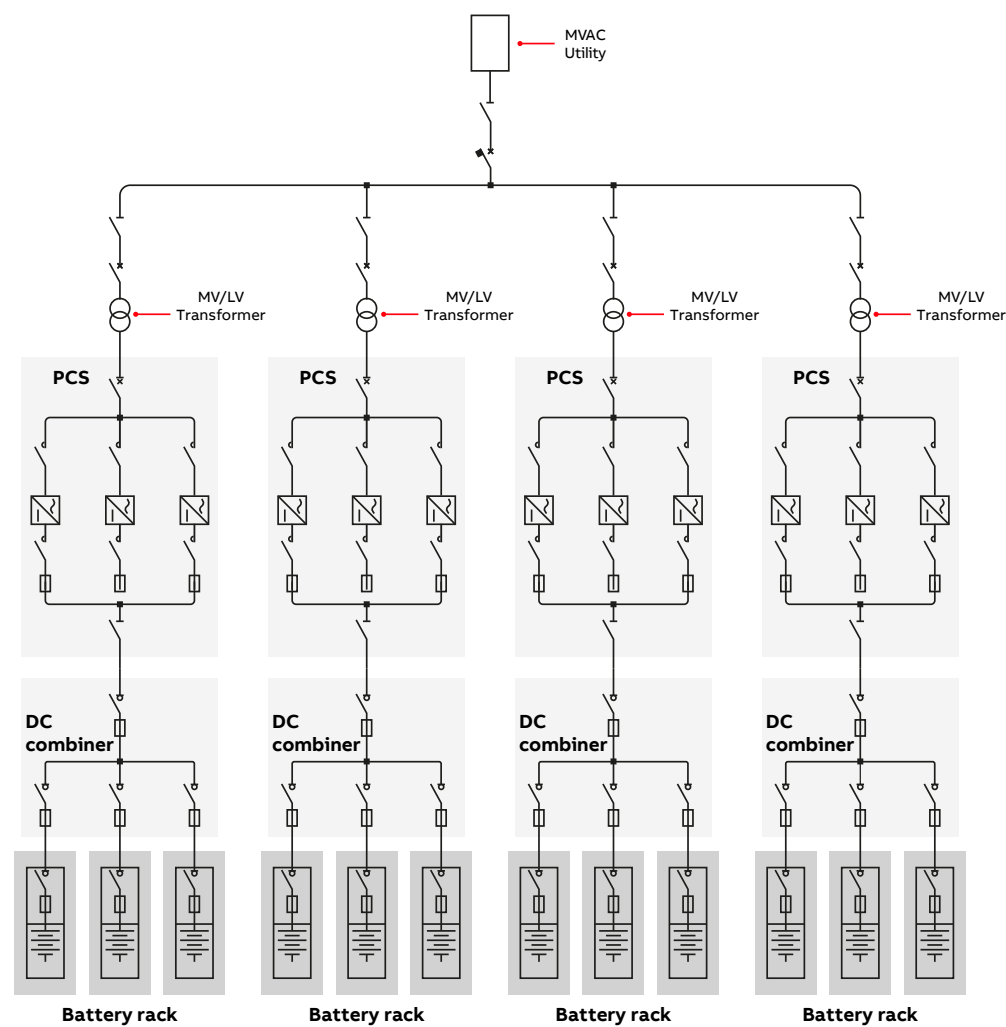
**OVR PV T1-T2 10-1500P TS QS** surge protection device to protect against overvoltages

\* Opening Release (YO); Closing Release (YC)

# Application Bundle 3#

Discover our switching & protection solutions for easy PCS configuration considering 4MWh BESS architecture with four 1MWh main system modules in parallel.

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

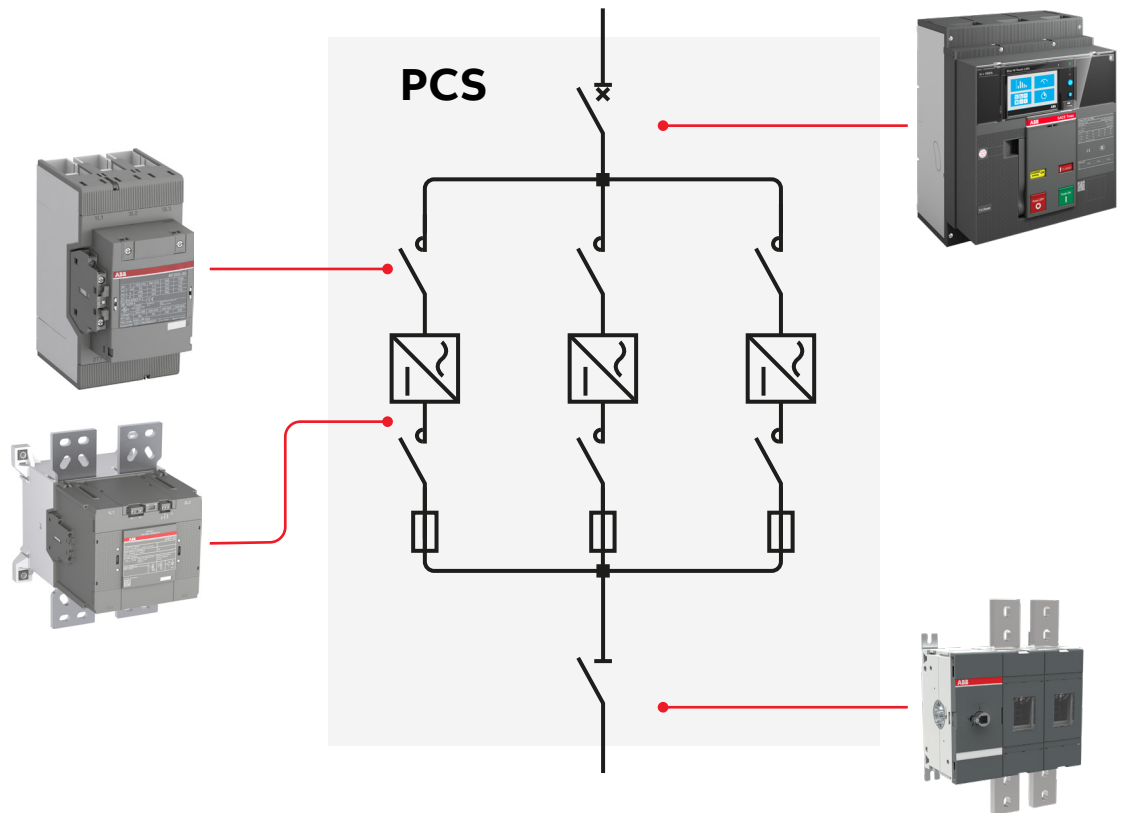


Specifications of electrical quantities with a 1500 V DC PCS

Input data		Three inverters per module	
Rated power	[MW]	4	
Rated stored energy	[MWh]	4	
Rated system module power	[MW]	1	
Rated inverter power	[MW]	0.35	
Rated DC voltage	[V]	1500	
Rated AC voltage	[V] IEC	690	
Rated AC inverter current	[A] IEC	326	
Total rated AC current	[A] IEC	977	
Prospective AC short circuit current	[kA]	50	
Rack max current	[A]	320	
Rack short circuit current	[kA]	15	
N. racks		3	
DC bus max current	[A]	961	
DC bus short circuit current	[kA]	45	
DC recombiner box		NO	

ABB's offering (IEC)

PCS with 3 inverters per 1MWh module



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#### AC side

**AF 205 (350A – AC1) contactors** for switching on each inverter branch

**Tmax XT7L Tmax XT7L M1000 3p In=1000A Ekip Dip LS/I** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7L M 1000 3p In=1000A Ekip Touch Measuring LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**Tmax XT7L M 1000 3p In=1000A Ekip Hi-Touch LSI** main circuit breaker for protection and isolation, equipped with Ekip com Modbus TCP communication module and with SOR\* and motor operator to open/close remotely

**OVR T2 3L 40-600 P TS QS** to protect against overvoltages from the AC Utility

**TVOC-2 + RELT Module** for Arc Flash Mitigation

\* Shunt Opening Release (SOR)

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#### DC side

**GF 875 contactors** for switching combined with fuses on each inverter branch. The 2 poles are fitted with special arcing contacts enabling bi-directional breaking of currents up to 750VDC per pole

**OT1600E02-135 main disconnect** for DC20 application


**OVR PV T1-T2 10-1500P TS QS** surge protection device to protect against overvoltages




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# Product offering

Contactors:



  
WEB PAGE  
  
CATALOG  
  
INTERACTIVE CATALOG

Tmax XT:



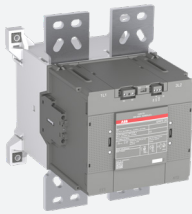
  
WEB PAGE  
  
CATALOG IEC  
  
CATALOG UL



Emax 2:




  
WEB PAGE  
  
CATALOG IEC  
  
CATALOG UL



GF Contactor:




  
WEB PAGE  
  
CATALOG



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