



xelectrix
POWER

POWER BOX

SAFETY ASPECTS OF XPB ENERGY STORAGE SYSTEMS

Discover new energy



XELECTRIX POWER

WHERE WE COME FROM.....



- “Hartl” – three generations of design, production and distribution of premium construction equipment
 - ... mobile crushing and screening units
 - ... for quarries, recycling yards, construction sites
- Idea **Hybridization of Diesel Generators** – increase efficiency and reduce emissions
 - ... Development of the xelectrix Power Box



XELECTRIX POWER

WHAT DO WE STAND FOR ?

- Innovation, research und development
- **System developer** for new Energy Storage solutions



ENGINEERED
IN AUSTRIA



XELECTRIX POWER

WHAT MAKES US DIFFERENT ?



We are Developers / Technology Provider and quality Producers.

Unique Power Electronic Technology

- Bi-directional inverter system (from 11 kW to 1 MW)
- 3-phase, 100 % unbalanced load acceptance
- Grid Parallel
- Island and backup mode
- Multi-functional: Frequency regulation, Voltage regulation, Reactive Power compensation, Peak Shaving, ...

↳ **Only one Power Converter** – simplified operation and construction

↳ **Unique Inverter Technology***

* patent pending



↳ flexible, modular
Energy Storage – as a complete system

XELECTRIX POWER

WHAT MAKES US DIFFERENT ?



We are Developers / Technology Provider and quality Producers.



Unique Storage Technology

- Active Battery Management System by XP ensuring long battery life and highest efficiency
- Intrinsically safe cells – highest safety standards and features
- Integrated thermally activated fire protection system
- Innovative connection technology

↳ flexible, modular

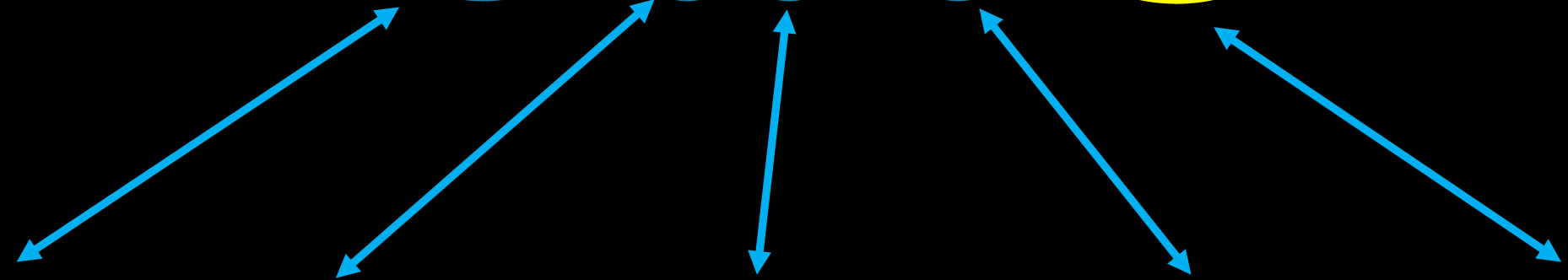
Energy Storage – as a complete system



POWER BOX
NAMING PLATFORM



XPB – W35 – 80 – M10



xelectrix Power Box

W = Wall
P = Pro
B = Basic
U = Unlimited

**Inverter
power in kW**

**Battery storage
capacity in kWh**

**Container sizes
for U Range**

POWER BOX
PRODUCTS



2020



WALL RANGE

(on-board transformer and switch function)

XPB-W11 and XPB-W35

11 kW (20 – 40 kWh) 35 kW (40 kWh)

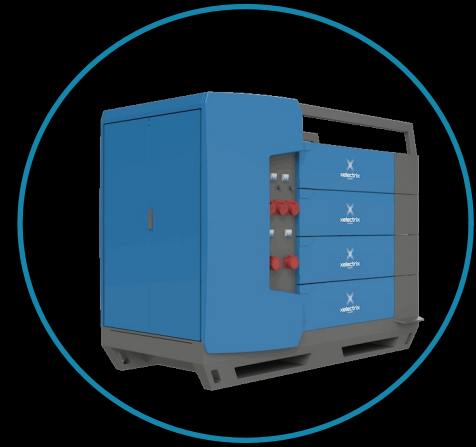


PRO RANGE

(on-board transformer and switch function)

XPB-P11 and XPB-P35

11 kW (20 – 120 kWh) 35 kW (40 – 120 kWh)



UNLIMITED RANGE

(on-board transformer and switch function)



M40 (40ft container)

250 kW (240 – 1000 kWh)
500 kW (480 – 1000 kWh)

BASIC RANGE

(no transformer or switch function, indoor only)

XPB-B35 and XPB-B80

35 kW (40 – 140 kWh) 80 kW (80 – 140 kWh)



XPB-B80-80 and B80-100 available with transformer and switch function as option

OPTIONS



Trailer



Crawler

VARIATIONS



M10 (10ft container)
35 kW (100 – 240 kWh)
80 kW (100 – 240 kWh)
150 kW (140 – 240 kWh)



M20 (20ft container)
150 kW (140 – 480 kWh)
250 kW (240 – 480 kWh)
500 kW (480 kWh)

MX750

750 kW Power Electronics Box with corresponding Battery BOX (MB40-740 to 1000 kWh)

MX1000

1000 kW Power Electronics Box with corresponding Battery BOX (MB40-1000 kWh)

POWER BOX APPLICATIONS



XPB OFF-GRID

XPB ON-GRID



◆ Construction



◆ Telecommunication



◆ Mining



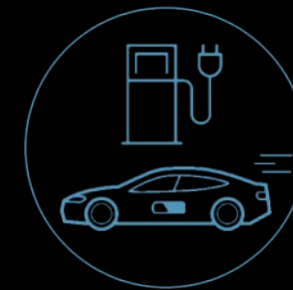
◆ Governmental
◆ Emergency
Services



◆ Energy Providers
◆ Grid Operators



◆ Industry & Business
◆ Public entities



◆ Charging
infrastructure



◆ LEC – Local Energy
Community
◆ Centralized Storage





TOPIC
SAFETY



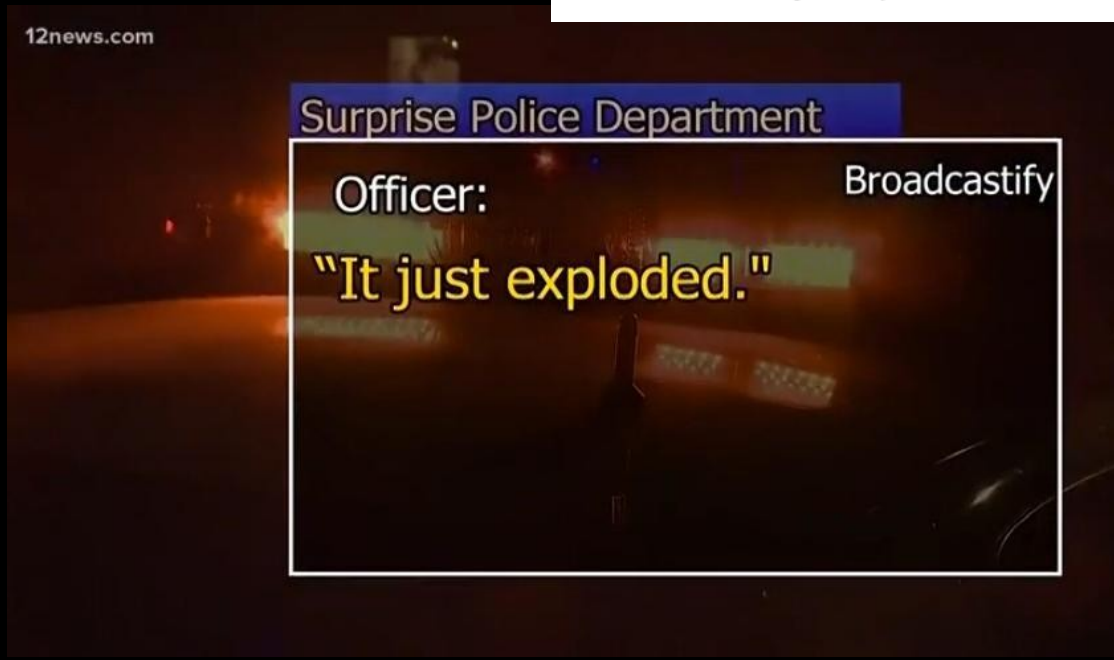
Everyone's Favorite Climate Solution Has a Fire Problem

Bloomberg David R Baker and Mark Chediak

Bloomberg January 28, 2020



arirang NEWS Moscow 06:12 **ADDRESSING ENERGY STORAGE SYSTEMS**
Trade ministry lays out plans to address energy storage systems fires



12news.com

Surprise Police Department

Officer: Broadcastify
"It just exploded."

On-fire and exploding ESS's (Arizona, Süd-Korea)



TOPIC
SAFETY REQUIREMENTS



Why are there high safety requirements ?

- Protection of lives
- Protection of the emergency services
→ Firefighters, rescue workers, executive, military, civil protection
- Protection of property → low risk rating for insurance
- Use in harsh environments → Construction sites
- Use in dangerous environments → Tunnels / Mines
- Transportation

The design principle should be:

→ **a system layout optimized for safety**



DESIGN
SYSTEM LEVEL



XPB Design Principles

→ a system layout optimized for safety at all system levels

Cells



Containers Housings



Battery Modules





CELL LEVEL INTRINSICALLY SAFE CELL



- Cell chemistry: lithium iron phosphate (LiFePO₄ / LFP) → is considered very safe.
- Comparison: nail penetration test nickel-cobalt-aluminum (NCA) ↔ LFP



Quelle: Sonnen
<<https://youtu.be/7eKGF2PtQoY>>





CELL LEVEL

INTRINSICALLY SAFE CELL (CONT.)



- Cells
 - manufactured according to xelectrix design
- Cell Cup Class 32650
 - technically possible cell capacity : 12 Ah
 - „Only“ 6 Ah built in
- Hollow wrapped cells
 - Space for material expansion (in the event of a short circuit)

Cells

Cup Class: 32650

Nominal Voltage: 3,2 V

Capacity: 6 Ah





CELL LEVEL

INTRINSICALLY SAFE CELL (CONT.)



- Decontacting in the event of overpressure (safety strip breaks)
- Thermo-electrical isolation (fuse strip burns off)
 - in the event of excessive current or arcing in the cell
- Exhaust chamber for fire suppression
 - Suppression of sparking should gases exhaust (through overpressure pre-chamber)
 - temporary decoupling of the arc for possible blowing off

Cells

Cup Class: 32650

Nominal Voltage: 3,2 V

Capacity: 6 Ah





CELL LEVEL

INTRINSICALLY SAFE CELL (CONT.)



Irreversible chemical overload protection

- Overloading leads to chemical destruction of the anode material
- Increase in internal resistance
- Limitation of the charging current
- Prevention of a cell "runaway"

Laboratory tests 5 V charging voltage over a week

- without negative reactions such as outgassing, leakage of the electrolyte, fire etc.

Cells

Cup Class: 32650
Nominal Voltage: 3,2 V
Capacity: 6 Ah





CELL LEVEL SCREWED CELLS



Numerous advantages

- Manufacture
 - No heat input after the cell has been manufactured
- Repair
 - Exchange of defective cells
- Recycling & sustainability
 - Cell can be easily removed from the battery pack
 - The cell can subsequently be opened and thus dismantled
→ recycling of the content



BATTERY MODULE SAFETY MEASURES



Battery Modules

Capacity: 20 kWh

Dimensions: 153 x 75 x 25,3 cm

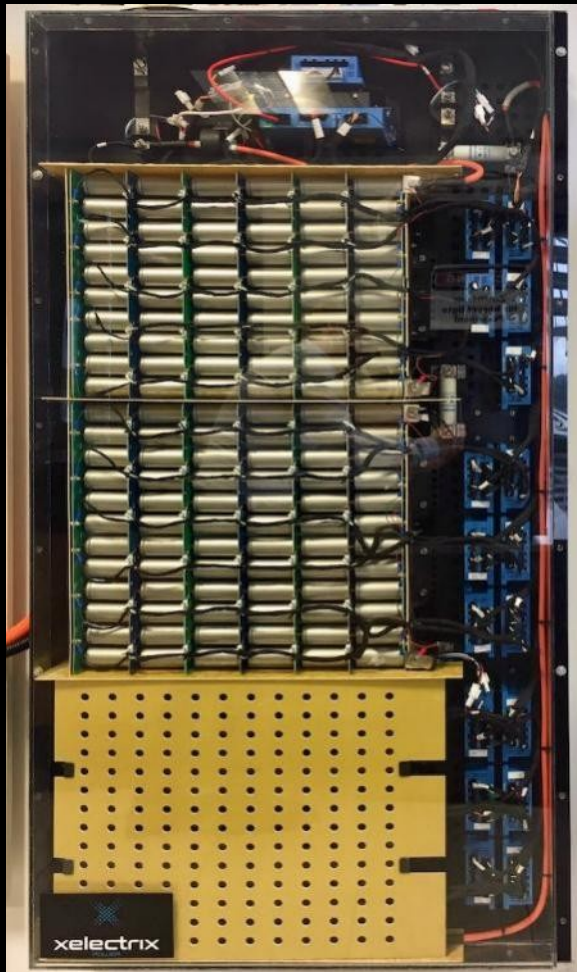
Weight: 260 kg

- Encapsulated battery pack / steel housing
- IP68 with connected connections

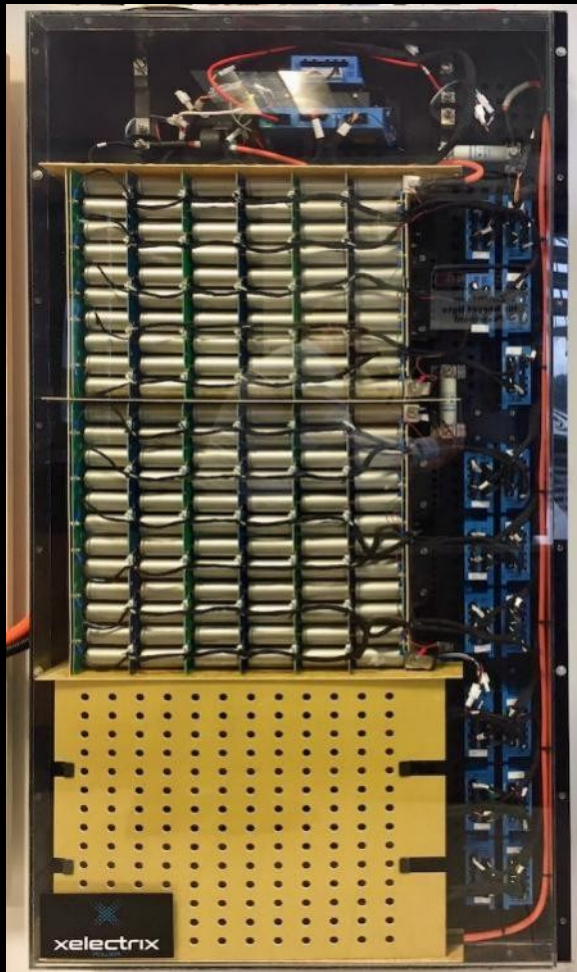


BATTERY MODULE

ELECTRICAL SAFETY MEASURES

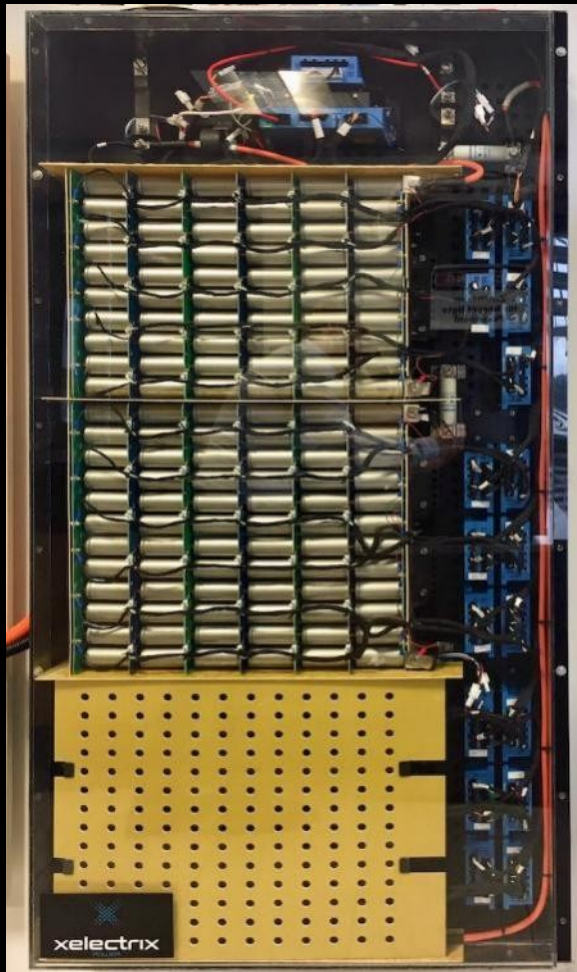


- Complete safety shutdown when LVDC supply is shut down (24 V)
 - no function of a battery pack
 - no discharge of the stored electricity
- With recurring LVDC supply, no switching on without CAN BUS connection and active control



- Vacuum contactor technology (vacuum HV DC contactors) for safe, almost wear-free switching
- Multiple separation using 3 vacuum HV-DC contactors
- Contact chamber monitoring of all 3 vacuum HV-DC contactors
- Failsafe function through 2 HVDC fuses (encapsulated fuses / with silicone overlay → no ceramic splinters when bursting)
- Technical short-circuit current of max. 20 kA
 - At 650 V results in a short-circuit power of 13 MW.
 - Must be suppressed in the HVDC fuse.

BATTERY MODULE FIRE PROTECTION



CO₂ / N₂ gas generator as extinguishing device

→ thermal release by means of a sensor cord

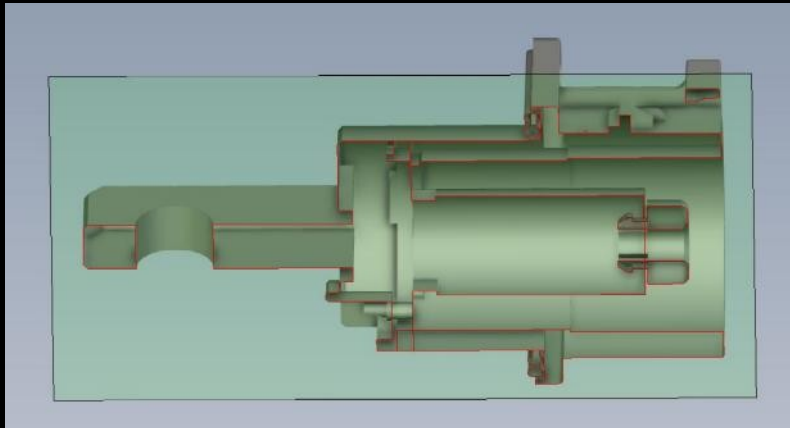
→ at temperature > 180 °C

I.e. no additional fire load if there is damage from inside or surrounding fires

Volume increase by 0.3 m³ → valve for blowing out



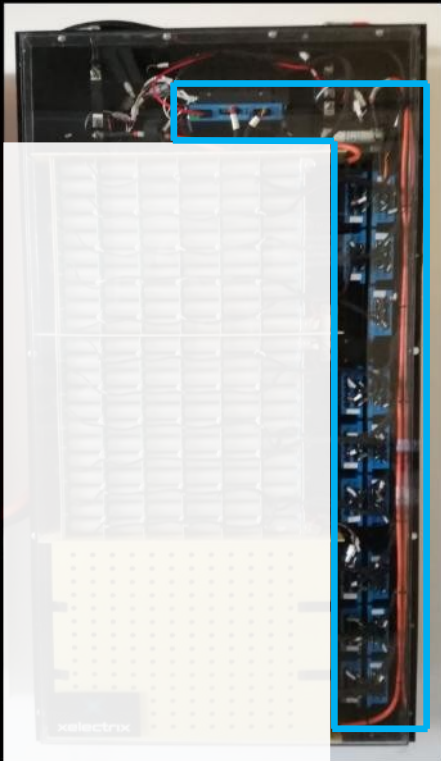
BATTERY MODULE HVDC-CONNECTOR



- Tamper-proof HVDC LINK SAFE connector
- Contact monitoring of the HVDC LINK SAFE connector
- Arc suppression of the HVDC LINK SAFE connector in the event of incorrect operation
- HVDC LINK SAFE when plugged in IP68, when open IP67

BATTERY MODULE

ACTIVE BATTERY MANAGEMENT SYSTEM



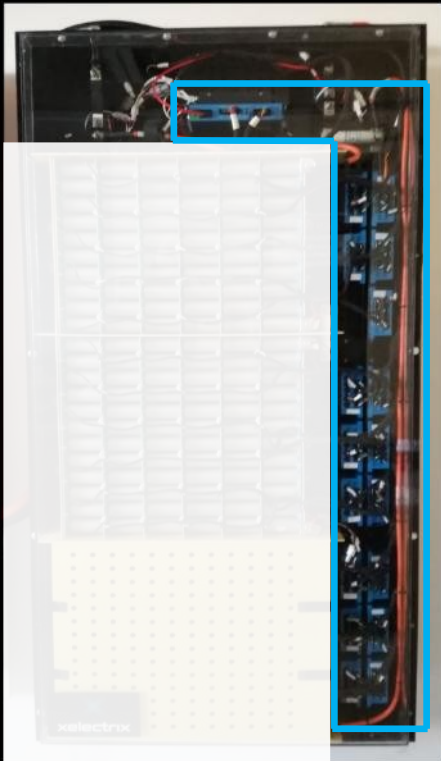
- Monitoring of over-voltage and under-voltage
 - at the single cell level and
 - at the level of the battery pack
- Pre-charge test (pre-charge circuit) with Bus monitoring and pre-balancing
- Pre-charge function means that the DC intermediate circuit is pre-charged with a reduced current before the HVDC contactors are switched on. If a certain minimum voltage is reached after a certain time, the main breakers are closed. This prevents short circuits or errors.

aBMS

- Active Cell Balancing
- Channels: 12
- Equalizing current : 2,5 A
- CAN-Communication

BATTERY MODULE

ACTIVE BATTERY MANAGEMENT SYSTEM



- Over-current detection and short circuit (early) detection (battery pack)
- Single cell monitoring of internal resistance
- Over / Under temperature monitoring (51 sensors)
- Insulation monitoring
- Asymmetry detection

aBMS

- Active Cell Balancing
- Channels: 12
- Equalizing current : 2,5 A
- CAN-Communication

CONTAINER LEVEL SAFETY MEASURES



- Container-Systems
- Redundant air conditioners (for both heating and cooling)

CONTAINER LEVEL SAFETY MEASURES

Loschmittlerdruck nicht in diesem Bereich liegt, ist zur Nachrüstung des Löschmittlers umgehend mit xelectrix Power GmbH Kontakt aufzunehmen.



Abbildung 9: Kontrollfenster mit Manometer.

- Fire extinguishing system for the battery and inverter rooms

CONTAINER LEVEL SAFETY MEASURES



- Fuses on package busbars



SAFETY SUMMARY



- ✓ Introduction of security measures on three levels
→ a system layout optimized for security at all system levels

Cells



Units



Battery Modules





xelectrix
POWER

Discover new energy