

Supporting the deployment of safe Li-ion stationary  
batteries for large-scale grid applications

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## System integrator perspective

Festus Coetzee



Düsseldorf, 10 March 2015

# Overview

- » ABB at a glance
- » Challenges of future Grids and Applications
- » Energy storage is not without its technology risks
- » Safety measures considered when designing a safe battery energy storage system
- » Battery energy storage system block diagram
- » Conclusion



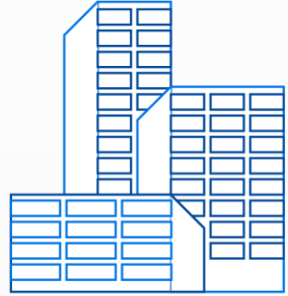
# A global leader in power and automation technologies

## Leading market positions in main businesses

~140,000   
employees

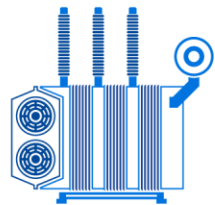
 **\$42**  
billion  
In revenue  
(2013)

Present  
in  
**+100**   
countries

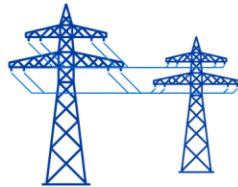
Formed  
in  
**1988**   
merger of Swiss (BBC, 1891)  
and Swedish (ASEA, 1883)  
engineering companies

# How ABB is organized

## Five global divisions



Power  
Products



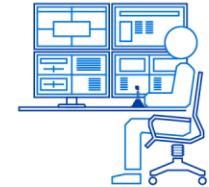
Power  
Systems



Discrete  
Automation  
and Motion



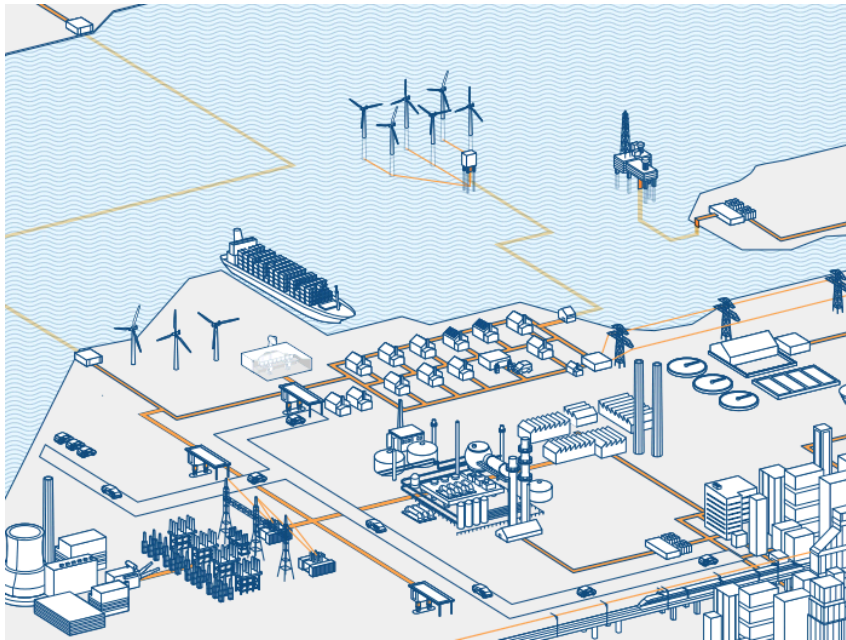
Low Voltage  
Products



Process  
Automation



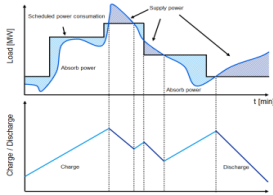
# Challenges of future power grids



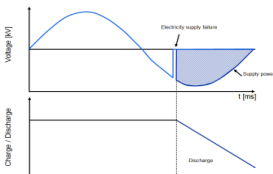
- » Wind and solar power
- » Natural gas and oil prices
- » T&D bottlenecks
- » Power quality issues
- » Ancillary services
- » Increase in Renewables
  
- » Tools for stability
  - » Interconnections
  - » T&D upgrades
  - » Flexible generation
  - » Demand-side management
  - » Energy storage

# Battery energy storage systems

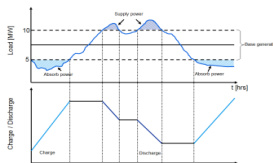
## Applications



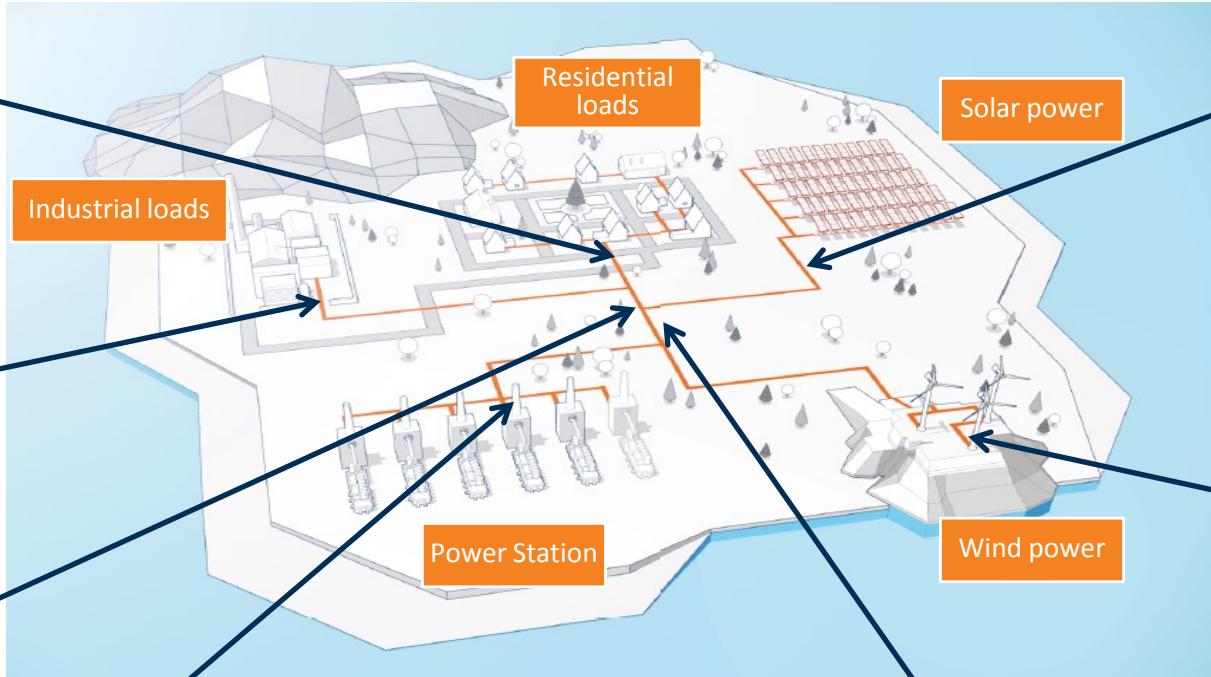
Peak shaving



Spinning reserves



Load levelling



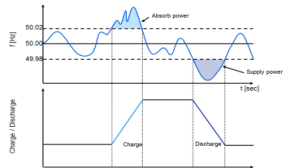
Industrial loads

Residential loads

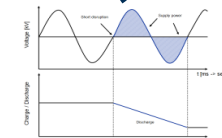
Solar power

Power Station

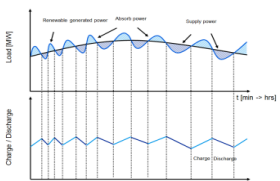
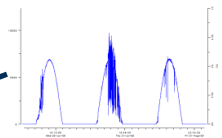
Wind power



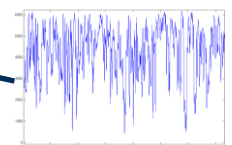
Frequency regulation



Voltage support



Capacity firming



# Technology Risks

Risk Category		PHS	CAES	A-CAES	ETES	H <sub>2</sub> & Fuel Cells	Lead Acid	NaS	Li-ion	Na-NiCl	VRB	Flywheel	SMES	Supercap	Metal-Air
Health & Safety	Fire														
	Leakage														
	Mechanical														
	Magnetic														
Environmental	Contamination														
	Visual impact														



*Fire at a battery energy storage facility*



*Rupture of the penstock/ tunnel at a pumped hydro plant under water pressure*

Intrinsic risks of energy stored in confined volume.  
Risks can be mitigated by good engineering.

# Technology Risks

Risk Category		PHS	CAES	A-CAES	ETES	H <sub>2</sub> & Fuel Cells	Lead Acid	NaS	Li-ion	Na-NiCl	VRB	Flywheel	SMES	Supercap	Metal-Air
Health & Safety	Fire		⚠					⚠	⚠	⚠				⚠	⚠
	Leakage				⚠	⚠					⚠				
	Mechanical		⚠	⚠	⚠							⚠			
	Magnetic												⚠		
Environmental	Contamination						⚠	⚠	⚠	⚠	⚠				⚠
	Visual impact	⚠													

Intrinsic risks of energy stored in confined volume.  
Risks can be mitigated by good engineering.



# Measures considered when designing a safe battery energy storage system

## » Preventative measures

- » Monitoring battery health – battery management systems is key to converting battery status to electrical signals and communicate this information to the energy storage system controller
- » Personal safety/OHS – isolation, lock out procedures, intruder control and various other measures to protect people from electrical shock
- » Training – ensuring only fully qualified and certified permit holders enter battery energy storage substations

## » Mitigation measures

- » Mechanical safety – ensuring designs are able to deal with mechanical forces due to high short circuit levels
- » Electrical safety – introducing fuses, DC breakers and AC breakers to break overload conditions and interrupt short circuit faults
- » Environmental safety – designing of buildings/containers/oil sumps to comply with building regulations, environmental impact and personal safety
- » Fire fighting – last frontier in safety measure to limit the impact of fire



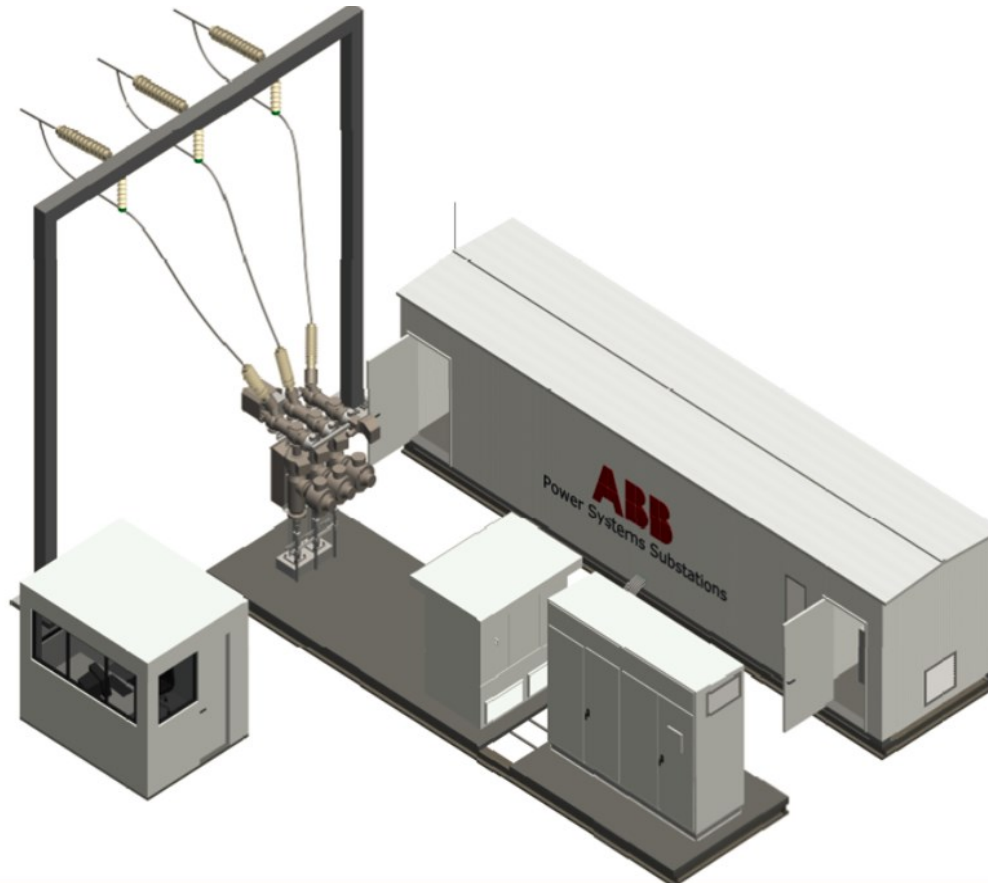
10 Mar 2015

STALLION-STABALID seminar, Düsseldorf



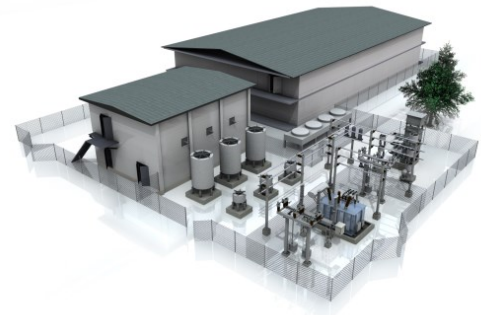
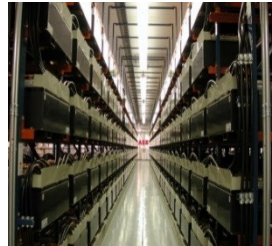
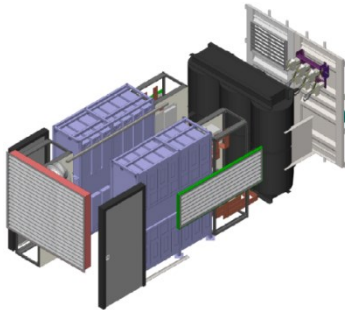
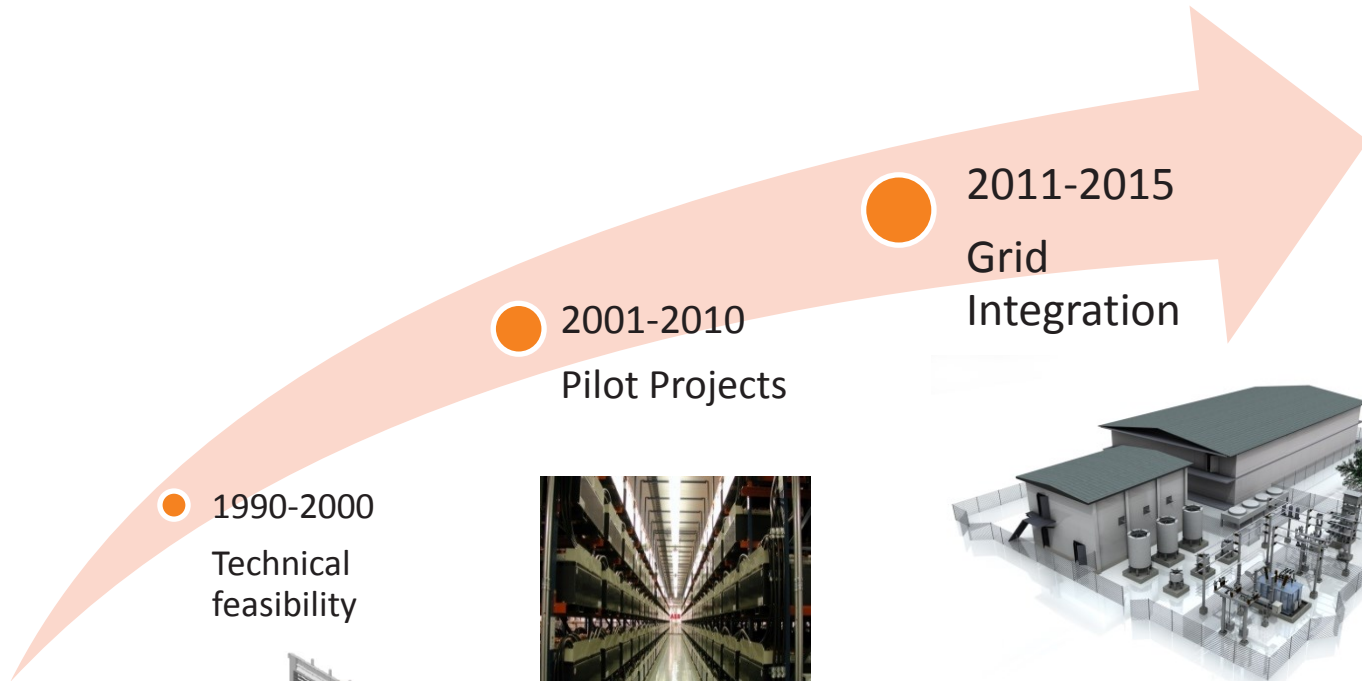
# Battery energy storage systems

## EssPro™ Grid block diagram



\* Battery management system

# Energy Storage Road to Commercialization



# Battery safety in the news

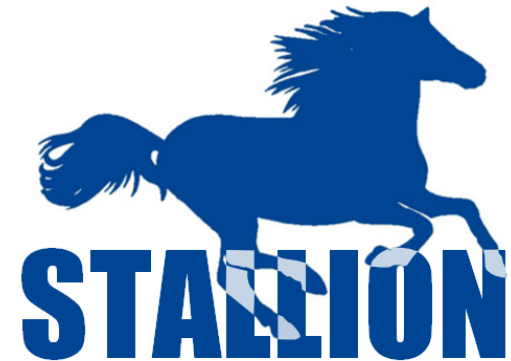
- » **Plug-in electric vehicle fire incidents – several (8) car manufacturers have had problems in recent years**
- » **Recall for overheating laptop, tablet batteries tops 300,000 – 14<sup>th</sup> November 2014**
- » **NTSB blames bad battery design—and bad management—in Boeing 787 fires – 2<sup>nd</sup> December 2014**
- » **Airlines: No rechargeable batteries:**
  - » **United Airlines – 3<sup>rd</sup> March 2015**
  - » **Delta Airlines – 1<sup>st</sup> February 2015**
  - » **American Airlines – 23<sup>rd</sup> February (some types)**
  - » **Air France stopped accepting bulk**
  - » **Still allowing batteries inside equipment (e.g. laptops) as it is creating «buffer» and protection**



# Conclusion

- » Energy storage is one method to control and manage the ever increasing demand being placed on our resources and electrical grids
- » Energy storage not new, but different storage mediums are still evolving
- » It is essential to create minimum safety standards to regulate and manage the expected increase in batteries being used as energy storage medium
- » Today there is no agreed standard (IEC, ANSI) setting out the safe design of battery energy storage systems connected to electrical grids.
- » The lack of standards will continue to put batteries and the use of batteries in applications in the news for all the wrong reasons.





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Thank you!  
System integrator perspective

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