AWEA Pre Show, New Orleans, LA

May 23, 2016

Wind Generation Best Practice Series

Technical Training

Power and productivity for a better world™

Wind Generation Best Practices
Agenda and Speakers

1:00-2:20 - Electrical balance of plant panel discussion moderated by Benny Nyberg

Matthew Vaughn

Business Development, Substations

Khundmir Syed

Technical Sales and Applications Engineer, Power Conversion Systems

Pat Hayes

Business Development, Energy Storage

2:20 – 2:40 – Break

2:40-3:00 – Life cycle management

Jeff Peterson

Global Product Line Manager - Wind Service

Marzio Zambetti

Global Renewable Segment Manager, Electrification Products

Part 1: Power Grid Integration

Raleigh, NC

Electrical balance of plant Technologies and best practices

Collector Substation Challenges and Pitfalls

- Overall substation construction lead-times.
  - Developers often under estimate the time and logistics required to execute the substation portion of the project.
  - Time required to fully execute the substation can be equal to or even longer than the time to complete that actual renewable facility.
  - This is very common in the solar industry due to highly efficient methods of design and install in the solar market.

Interconnection / collector substation
Project execution pitfalls

Goal:
Highlight pitfalls of renewable projects that developers and EPC's commonly stumble into, which can be avoided with some up front awareness & planning, and avoid catastrophic schedule issues that could potentially endanger your PPA back feed dates.

Interconnection / collector substation
Project execution pitfalls

Overall substation construction lead-times

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Interconnection / collector substation
Project execution pitfalls

Substation site location

- Logistics - Consider access of large and heavy equipment to be shipped to site..
- Site conditions - Some investigation and a small shift in site location can save 100's of thousand in site preparation and shorten overall lead-time.
  - Note: If you see large visible rock sticking out of the ground, please try to relocate the substation site!
- Utilities – Remote Sites can require long lead-times for utility access.

Interconnection / collector substation
Project execution pitfalls

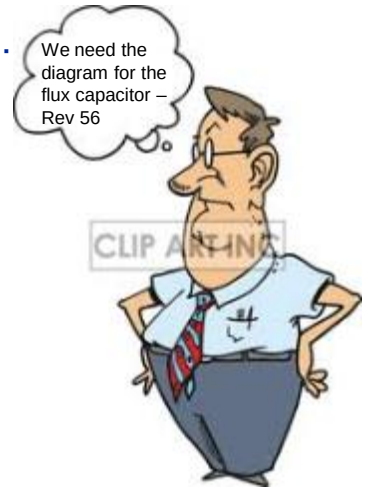
Engineering will take longer than you think!

- Required engineering studies require time and information from the developer/ EPC and utility.
- The equipment used within the Wind/Solar system impacts everything inside of the substation.
- Equipment selection early is crucial to maintaining the schedule.
- Changing equipment during the preconstruction stage could trigger the requirement of a new system study and delay the delivery of your substation as well as add significant cost.
  - Example: Inverter selection affects power quality and will likely change the capacitor bank sizing, reactor sizing and controls
- Substation require a multi-layered engineering review cycle from many parties.
  - Examples: Developer / EPC / Serving Utility / Locality issuing permits.
- Reviews and approvals require a minimum of 10 days to approve PER LEVEL OF APPROVAL

Interconnection / collector substation
Project execution pitfalls

Local permitting

- Depending on the locality and their relationship to the project this can be an easy process or become bureaucratic nightmare.
- Consider that the level of review and lead-time involved will vary greatly from location to location and consider a contingency for this potential delay.
- Substation engineering deliverables will be required to meet the localities requirements.



Part 1: Power Grid Integration

Raleigh, NC

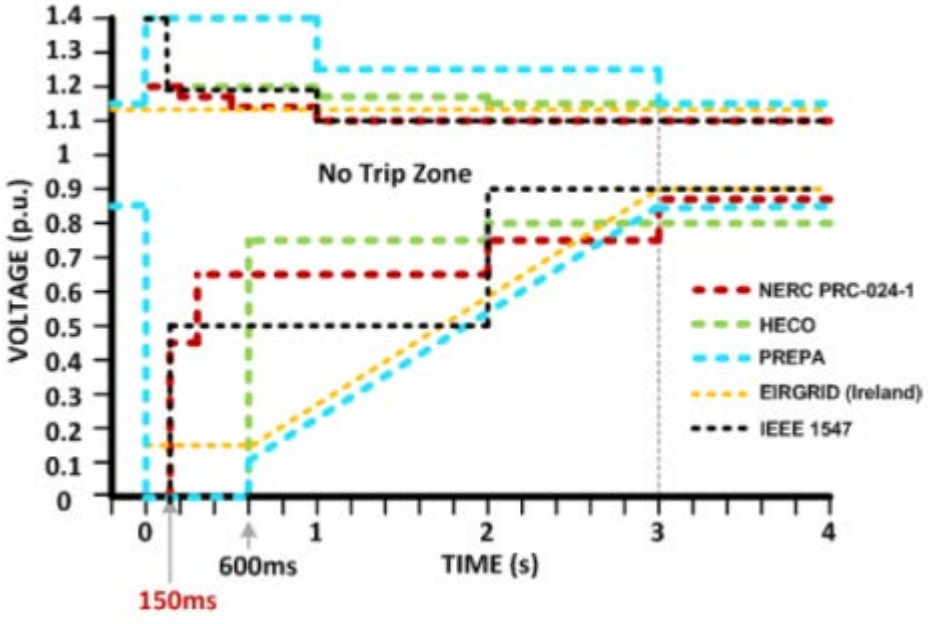
Wind Grid Integration Technologies
Reactive power compensation at POI

Challenges facing project developers

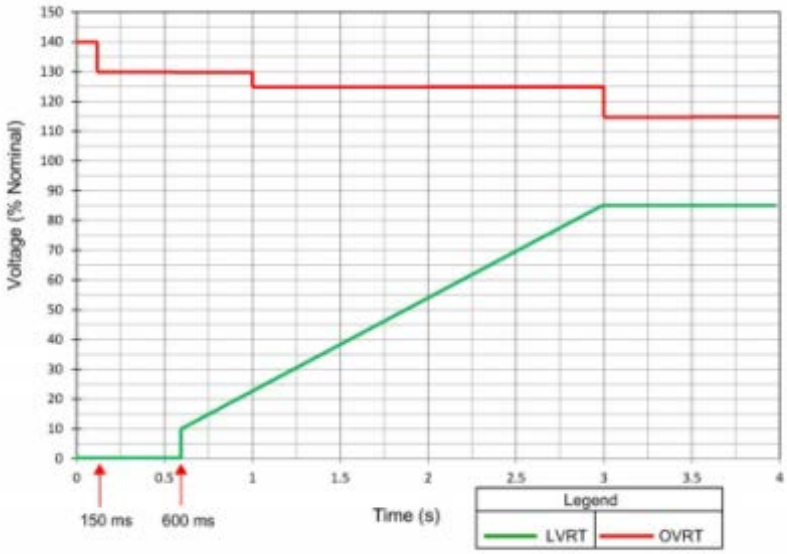
- Guidelines to connect wind farms or solar plants are implemented throughout the world
- Level of complexity vary by country and/or by region
- In some cases, advanced wind turbine converters or solar inverters can satisfy grid requirements
- In other regions, dynamic reactive power control is needed
- Typical requirements include:
  - HVRT or LVRT
  - Power Factor Control
- Need to complete a system impact study and understand what requirements your wind farm must meet to safely connect to the grid

Example Interconnection Requirements
HVRT & LVRT

Comparison of HVRT and LVRT Requirements



PREPA's Voltage Ride-Through Requirements



Courtesy: National Renewable Energy Laboratories (NREL) and Puerto Rico Electric Power Authority (PREPA)

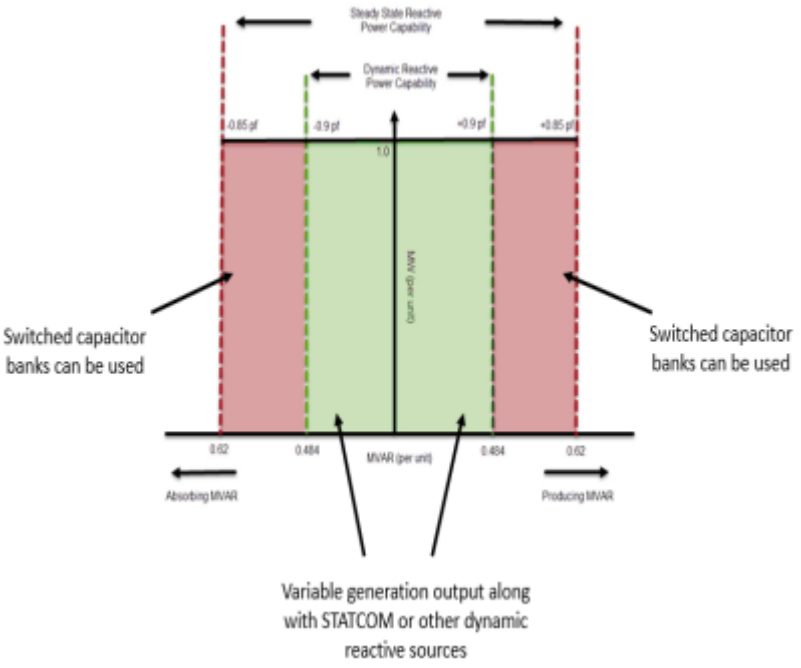
Example Interconnection Requirements
Voltage Regulation System (VRS)

Voltage Regulation System (VRS):

- Wind Generation facilities must have a continuously variable closed loop control VRS.
- VRS set-point shall be adjusted between 95%-105% of rated voltage at POI. Set-point shall be controllable by SCADA.
- Voltage droop shall be adjustable between 0 to 10%.
- The VRS dead band shall not exceed 0.1%.

Example Interconnection Requirements
Reactive Power Capability

- Wind Generation Facility shall be able to smoothly ramp the reactive power from 0.85 lagging to 0.85 leading at the point of interconnection (POI).
- A part of that power factor range is usually expected to be dynamic. This dynamic range is generally determined based on studies.
- The requirement of MVAR capability at maximum output shall be sustained throughout the complete range of the WGF as shown in the adjacent figure.



Dynamic reactive power control
What is a STATCOM?

- A member of the Flexible Alternating Current Transmission Systems (FACTS) family of devices used on alternating current electricity transmission networks
- Is a power electronic based device (also referred to as a voltage-source converter)
- Acts as either a SOURCE or SINK of reactive AC power to an electricity network for purpose of controlling voltage or power factor

STATCOM – Major Components

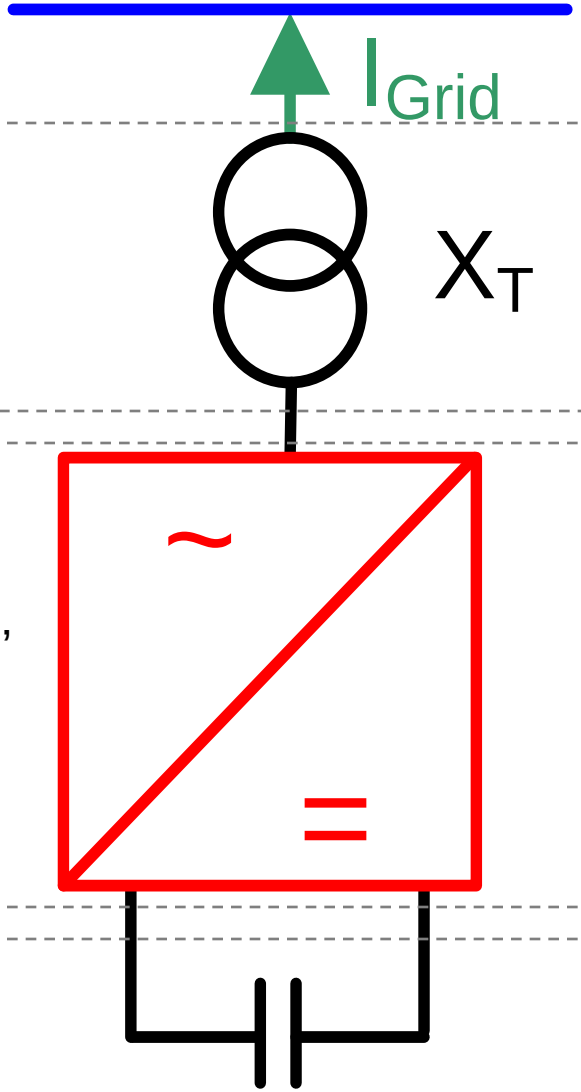
AC Step-Up Transformer

- From 480 V to MV

Power Converters

- IGBT power electronic ‘switches’
- Controls and Aux Power

DC Capacitor



Principle of Operation

V_1/δ_1

Power flow P

V_2/δ_2

If $V_{conv} > V_2$, **Q** Capacitive

$V_{conv} < V_2$, **Q** Inductive

$$P = \frac{V_1 V_2}{X_{12}} \sin(\delta_1 - \delta_2) - \frac{V_2^2}{X}$$

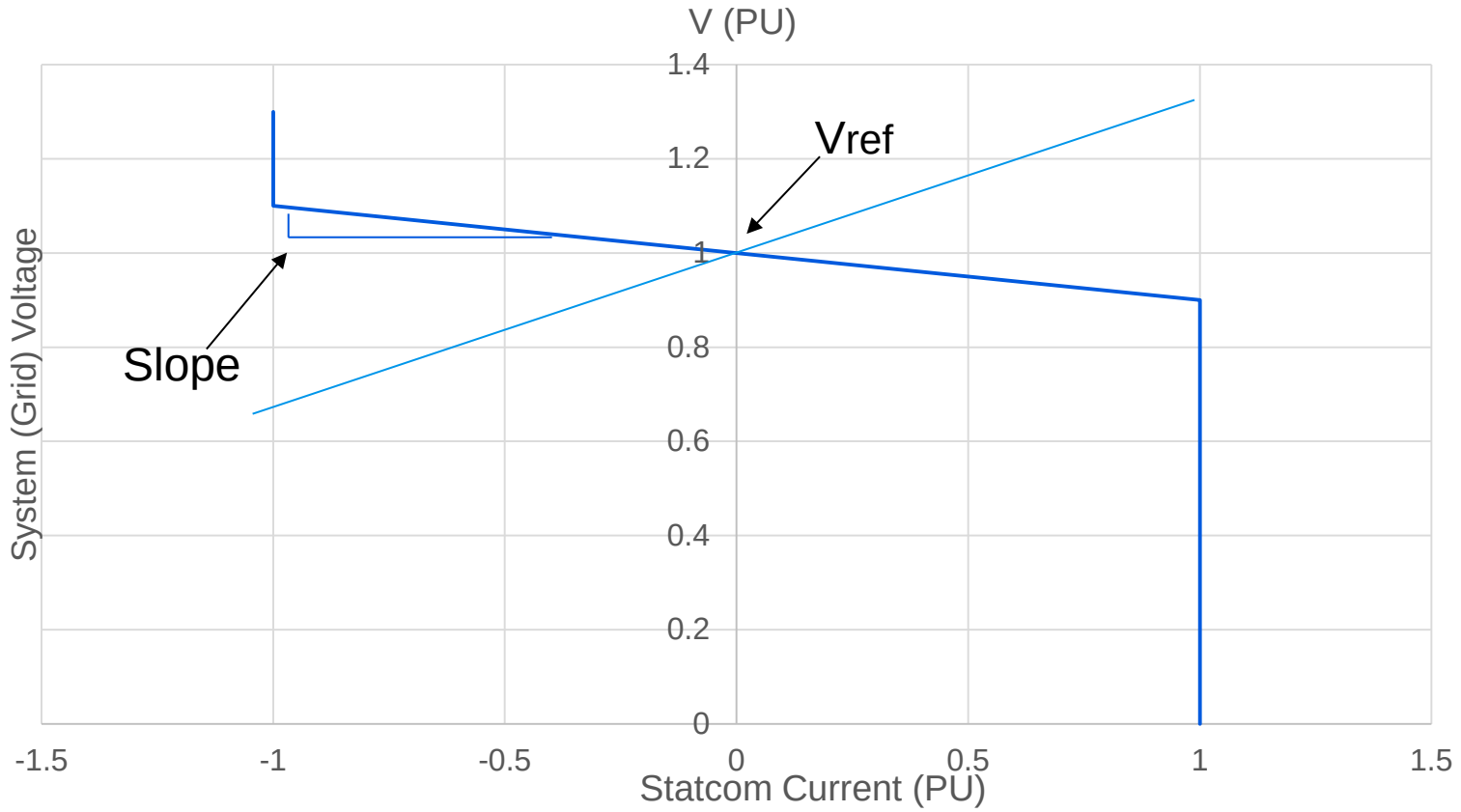
Vconv

STATCOM

STATCOM
SVC

SC
TCSC

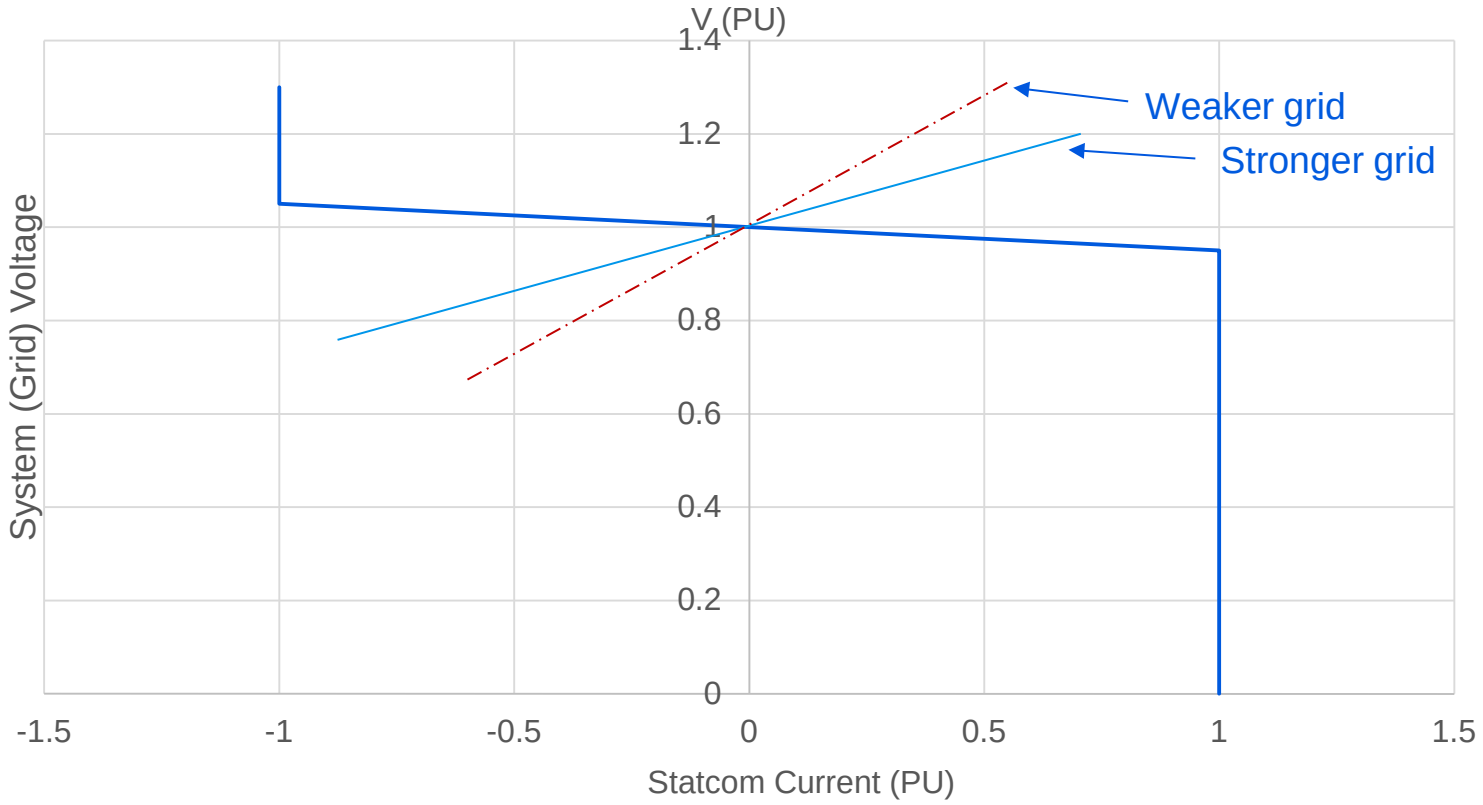
STATCOM V-I CHARACTERISTICS



INDUCTIVE

CAPACITIVE

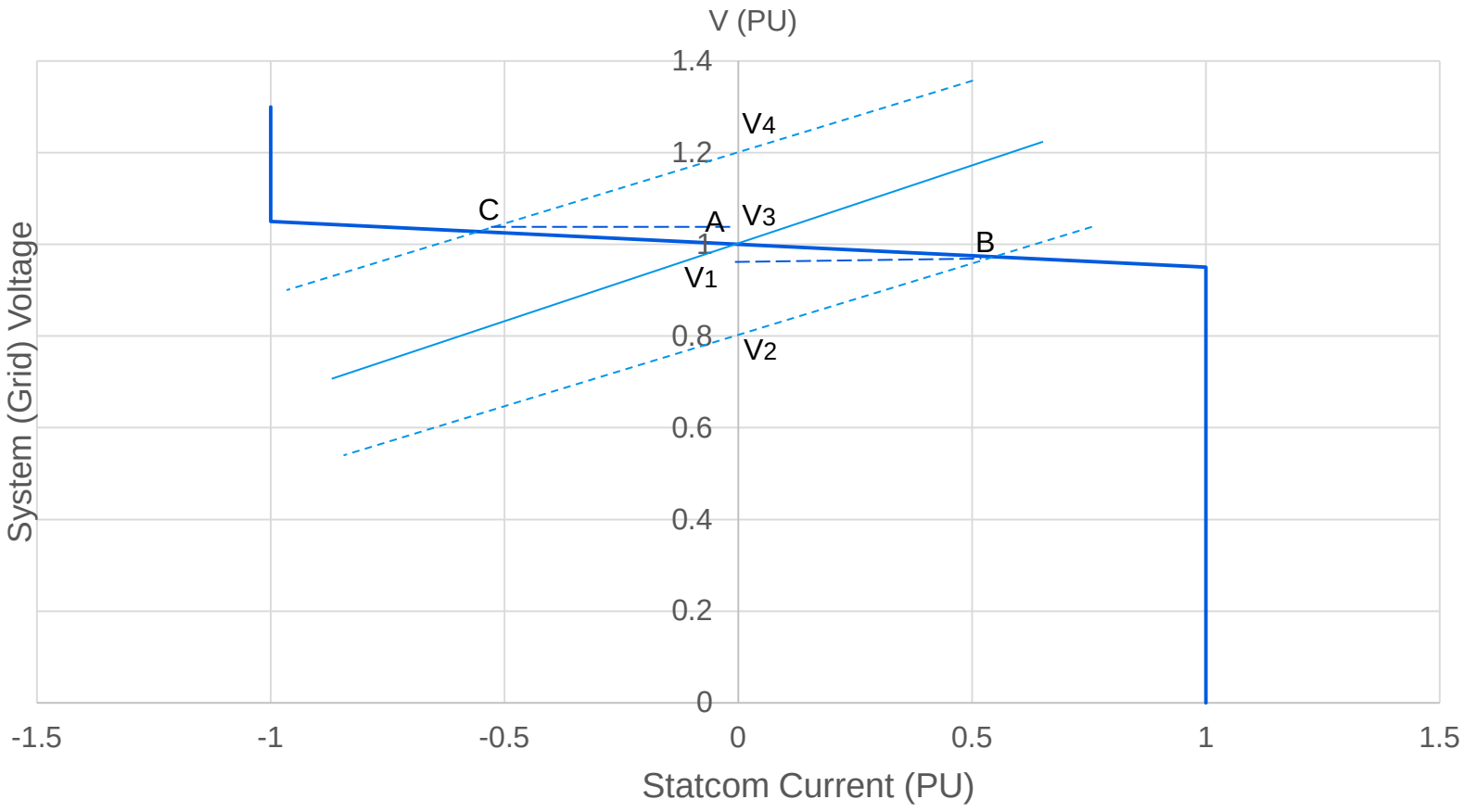
STATCOM V-I CHARACTERISTICS



INDUCTIVE

CAPACITIVE

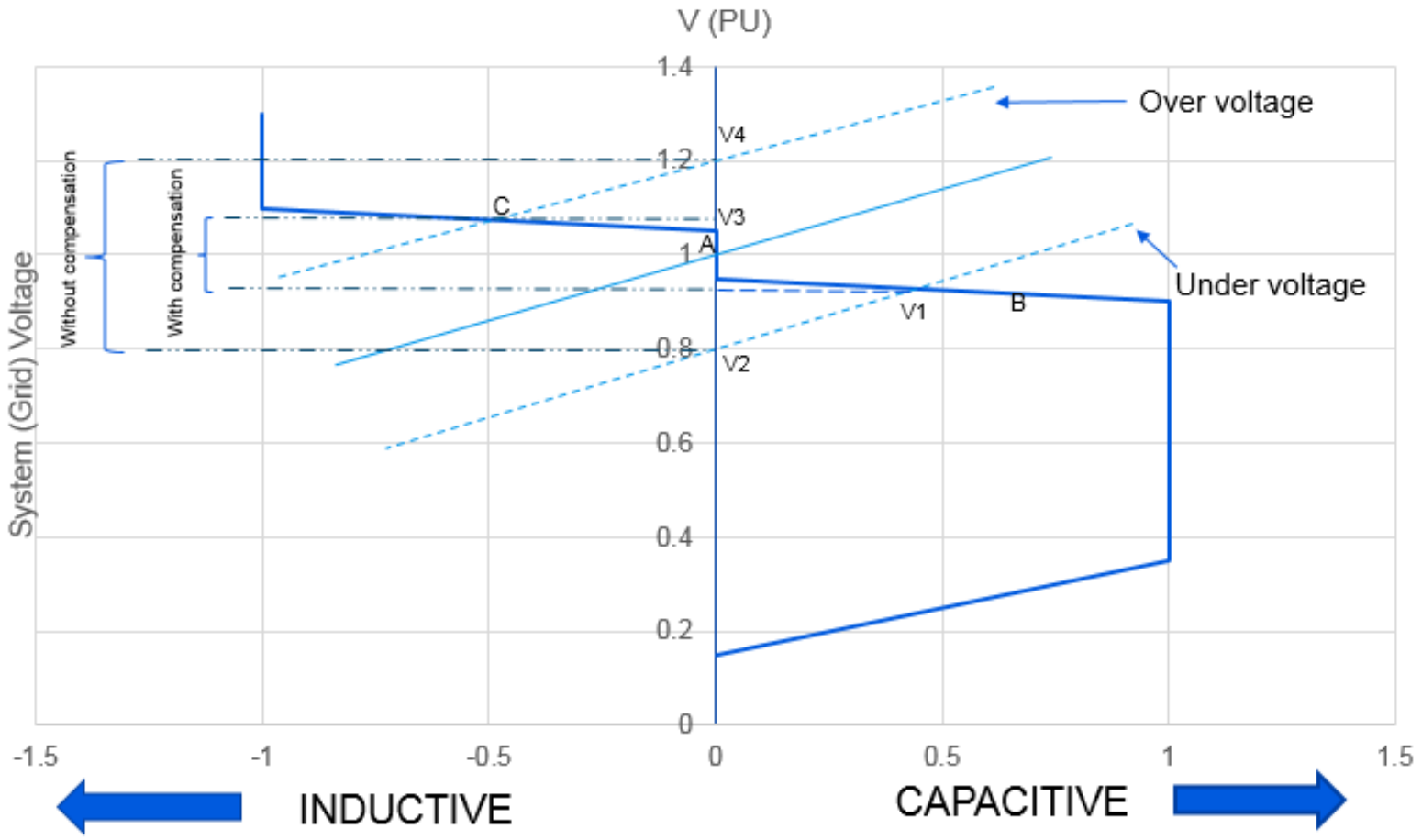
STATCOM V-I CHARACTERISTICS



INDUCTIVE

CAPACITIVE

STATCOM V-I CHARACTERISTICS

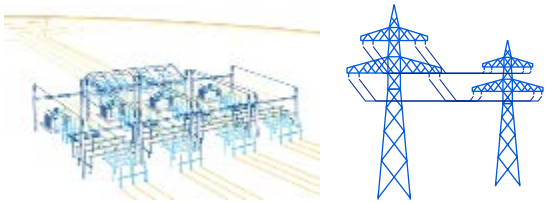


Applications of STATCOMs
Voltage control and reactive power management

Renewables

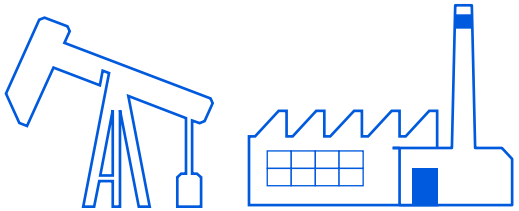
- Enables grid code compliance in wind and solar plants

Utilities



- Utility grid compensation for fluctuating loads, particularly in remote locations

Industrial



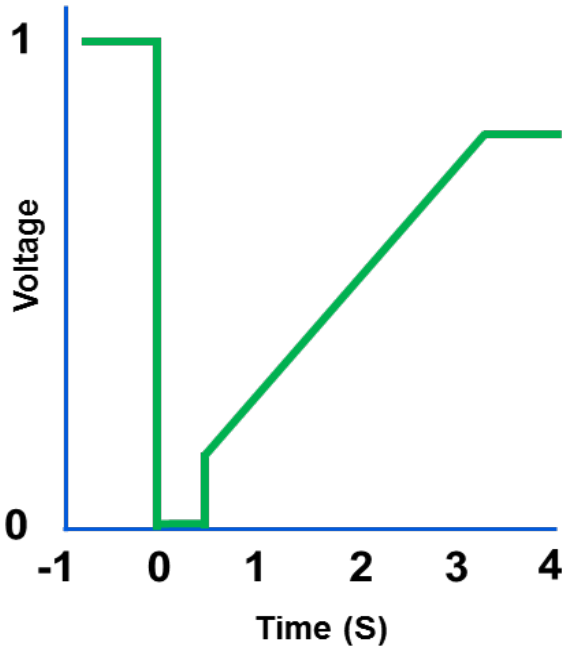
- Industrial grid support and power quality enhancement

ABB's STATCOM Solution Applied
Naguabo, Puerto Rico

- A Puerto Rican wind farm required dynamic reactive compensation support for power factor and voltage control
- System comprised of
  13 x 1.8 MW wind turbines
  connected to a 34.5 kV collector grid
  for a total capacity of 23.4 MW
- Dynamic simulations showed the ABB STATCOM voltage control system was able to meet PREPA's Minimum Technical Requirements

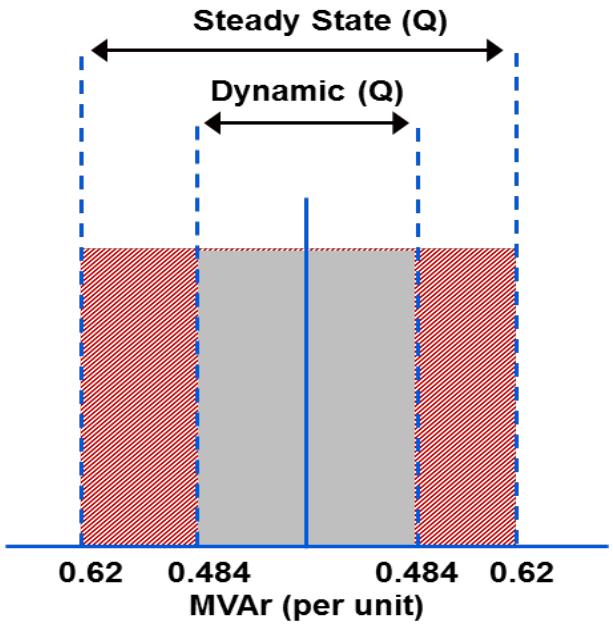
ABB's STATCOM Solution Applied
PREPA Performance Requirements

LVRT



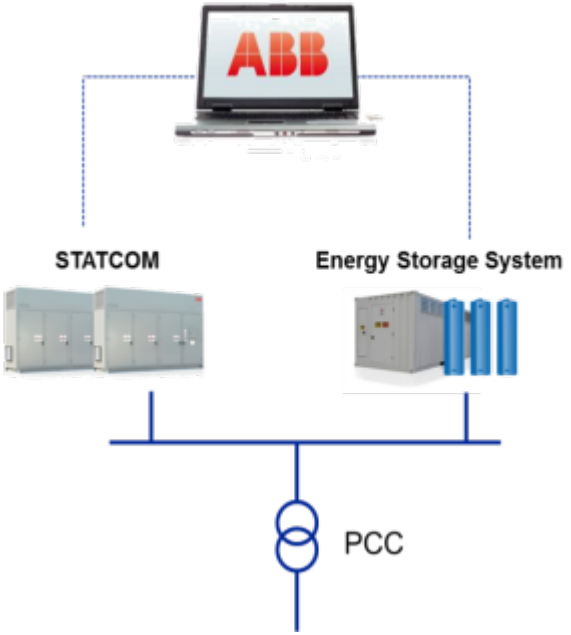
- All generation to remain online and be able to ride-through faults down to 0.0 per-unit

Reactive Power



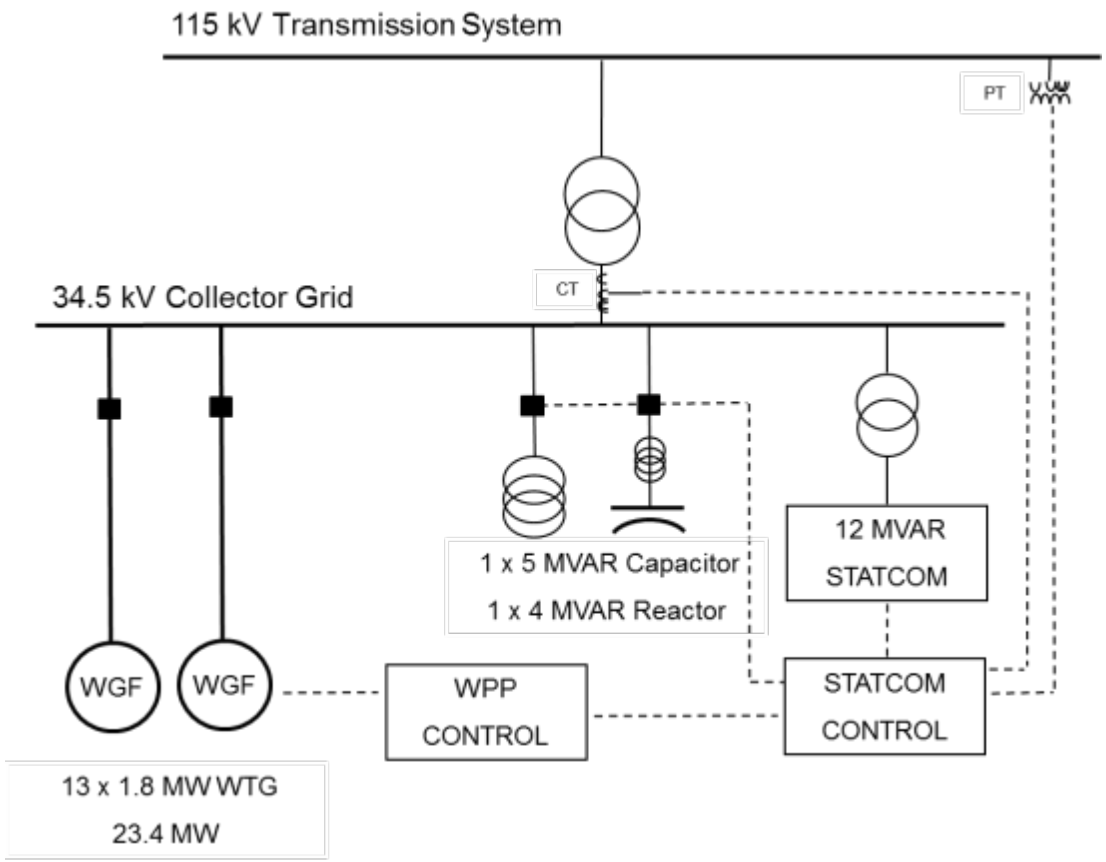
- The total power factor range shall be from 0.85 lagging to 0.85 leading.

Controls



- STATCOM system control is coordinated with the wind park power controller

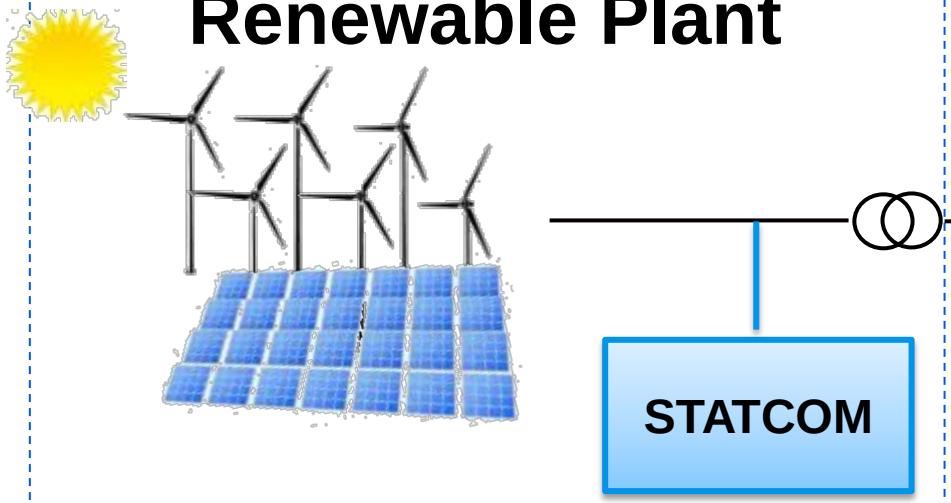
ABB's STATCOM Solution Applied
Naguabo, Puerto Rico



- ±12 MVAR ABB STATCOM
- 1 x 5 MVAR Switched Capacitor Bank
- 1 x 4 MVAR Reactor
- STATCOM system provided reactive power and voltage control
- Automatically used its rapid speed of response and overload to assist in LVRT and HVRT

ABB's STATCOM Solution
Benefits both plant and network performance

Renewable Plant



Solving problems in the Wind Farm . . .

- Grid Interconnection Requirements
- Fault Ride Through (LVRT & HVRT)
- Power Factor (voltage regulations)
- Power Quality (harmonics)

Grid

And solving problems on the grid . . .

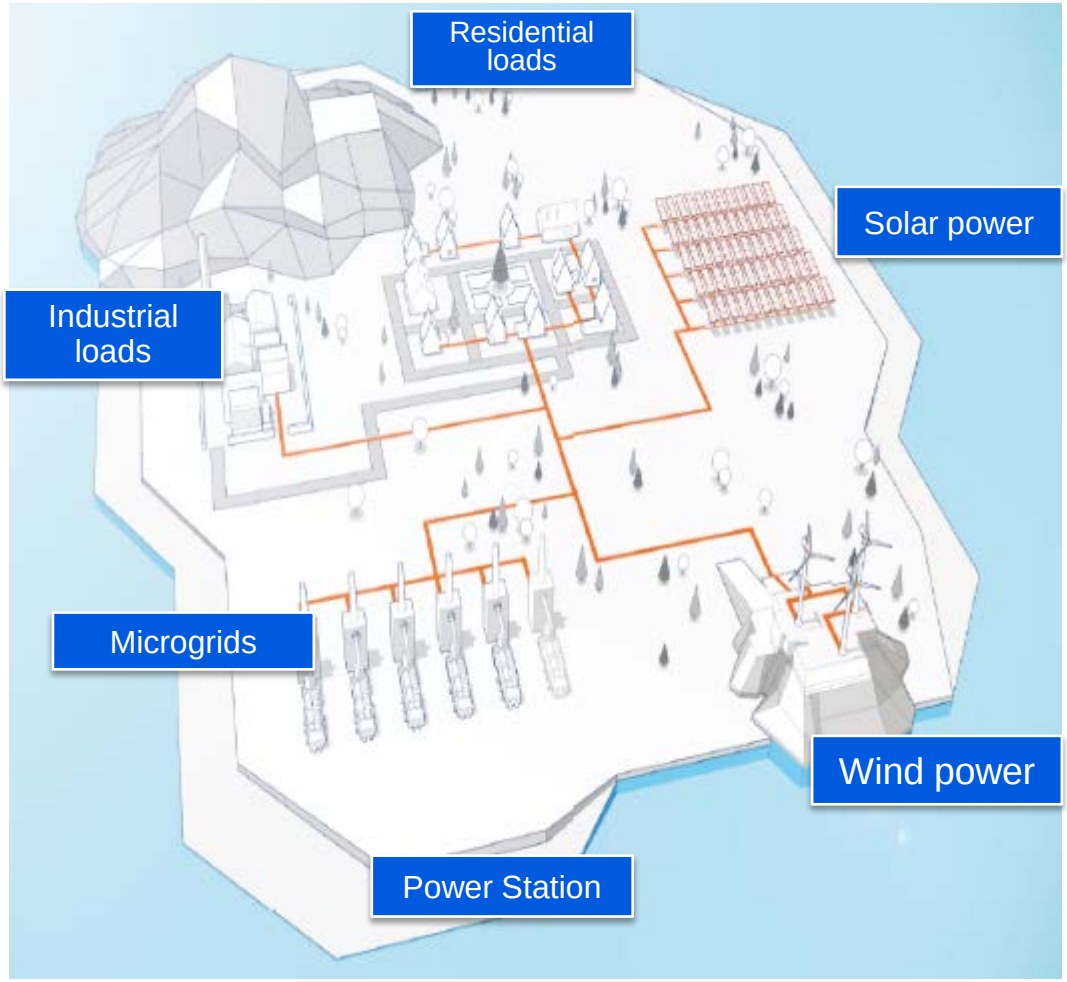
- Prevent grid system instability & network imbalances
- Provide frequency and voltage control
- Reactive power control
- Active power regulation

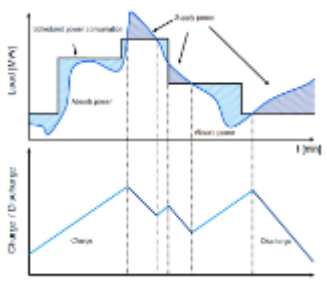
Part 1: Power Grid Integration

Raleigh, NC

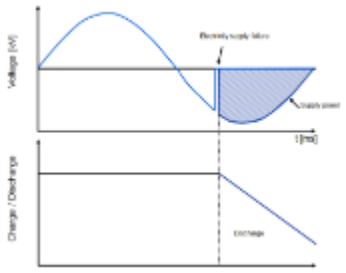
Battery Energy Storage in Wind Farms
Applications and case studies

EssPro™ Energy Storage Capabilities

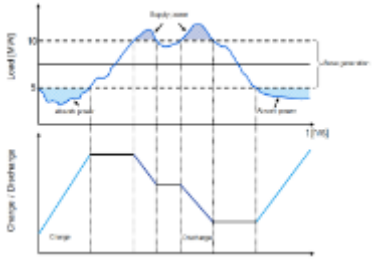




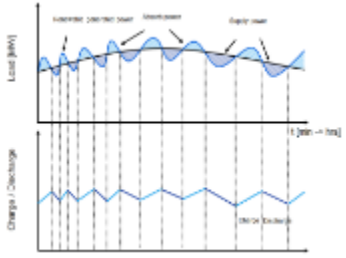
Peak Shaving



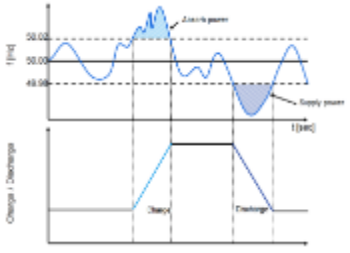
UPS



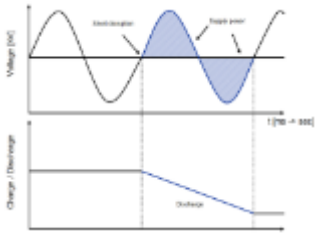
Load Levelling



Capacity firming



Frequency Regulation



Voltage Support

ABB Energy Storage Experience
Saft / Cowessess Nation / SRC

Saft's IM 20E Container
(1) X 200 kW / 372 kWHr

(Inside)

Customer needs

- 400 kW / 744 kWh BESS
- Wind Integration.
- Customer wanted BESS to smooth out wind turbine output.
- Demand Response
- Demonstrate Anti-Islanding functionality

Project Details

- Li-ion batteries
- Installed in 2012

ABB Scope

- 400 kW PCS including (2) x 200 kW Indoor units
- Includes inverters, dc contactors, ac circuit breakers, control and external isolation/step-up transformer to 23kV grid

ABB Energy Storage Experience
Saft / Cowessess Nation / SRC BESS

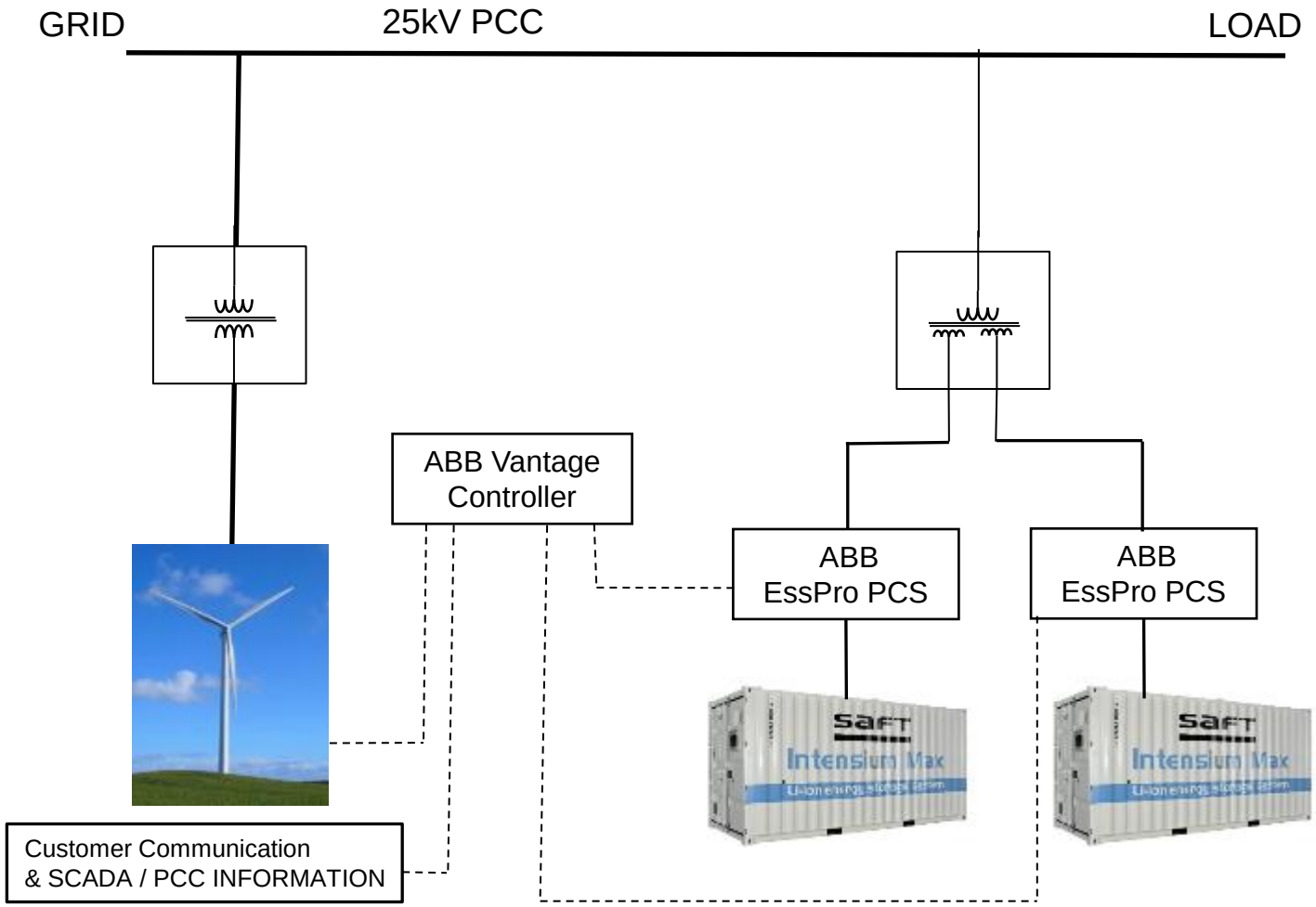
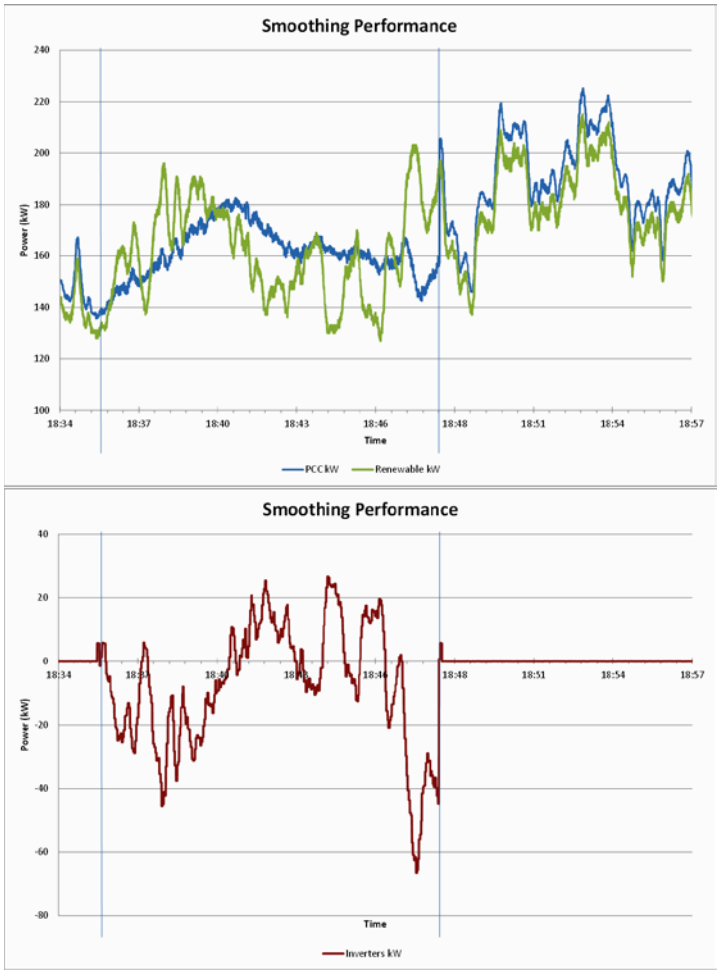


ABB Energy Storage Experience
Saft / Cowessess Nation / SRC

Courtesy of SRC

Case study results: Canadian wind facility
Energy storage & power conversion system



Field Results - Smoothing

- Volatility was reduced by 64%
- Smoothing algorithm based on user settable ramp rate limitations (i.e. 10% over 1 minute)
- Ramp rates were shown to be limited by a factor of 20
- Improved capacity factor and availability

ABB Energy Storage Experience
SCE, LG Chem 8 MW / 9 MVA PCS

8 MW / 32 MWHr Tehachapi Storage Project

Customer needs

- DOE Smart Grid Program
  - ARRA funds

ABB Scope

- (2) x 4 MW / 4.5 MVA PCS100 for BESS
- EssPro Vantage Controller
- DC Bus and Protection Circuit Breakers
- Mini-PCS System (100kW Indoor) w/ Site Energy Control
- System Models, RTDS and Simulations
- Commissioning, Training and Installation Supervision
- Li-Ion Batteries
- Installed in 2013

ABB Energy Storage Experience
SCE, LG Chem 8 MW / 9 MVA PCS

ABB Energy Storage Experience
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ABB Energy Storage Experience
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8 MW / 32 MWHr Tehachapi Storage Project

ABB Energy Storage Experience
SCE / LG Chem BESS

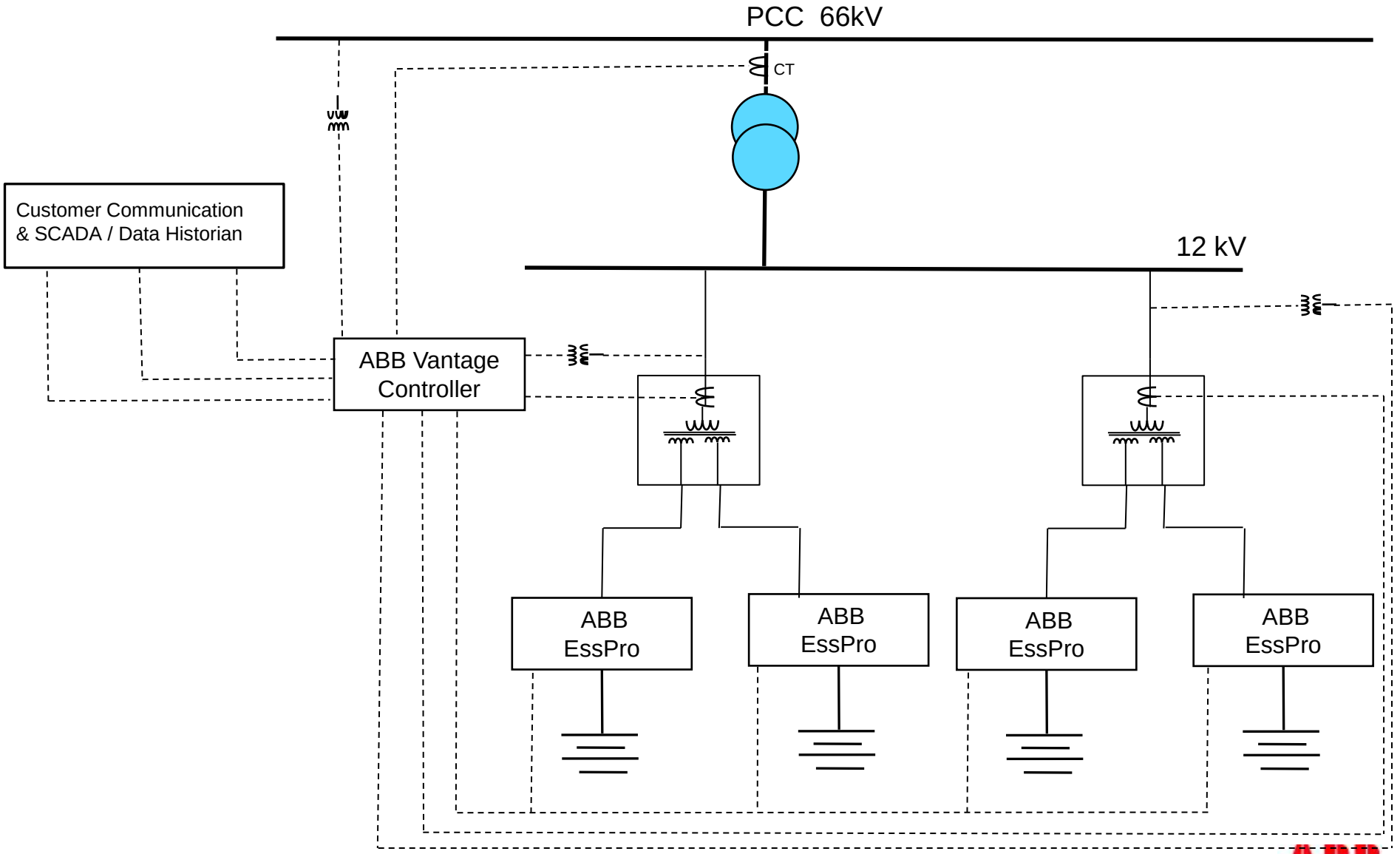

ABB Energy Storage Experience
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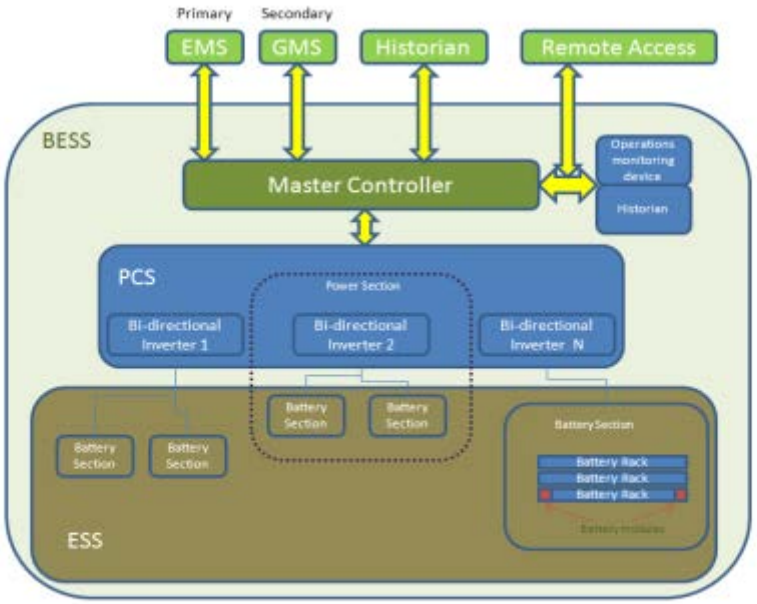


Courtesy of SCE

EssPro Vantage Controller

- Multiple Protocols
- Data Management
- Metering

Modes of Operation (8)

- Voltage Support / Grid Stabilization
- T-Line congestion mitigation
- Load Shifting
- RE Capacity Firming, Ramp Rates
- Frequency Regulation
- Spinning Reserve
- Energy Price Arbitrage

ABB Energy Storage Experience
BESS Integrator / PJM (20 MW PCS)

(1) X 5000 kW PCS

Customer needs

- PJM Regulation Market

Project Details

- Li-ion batteries
- Installed in 2014

ABB Scope for Project Containing:

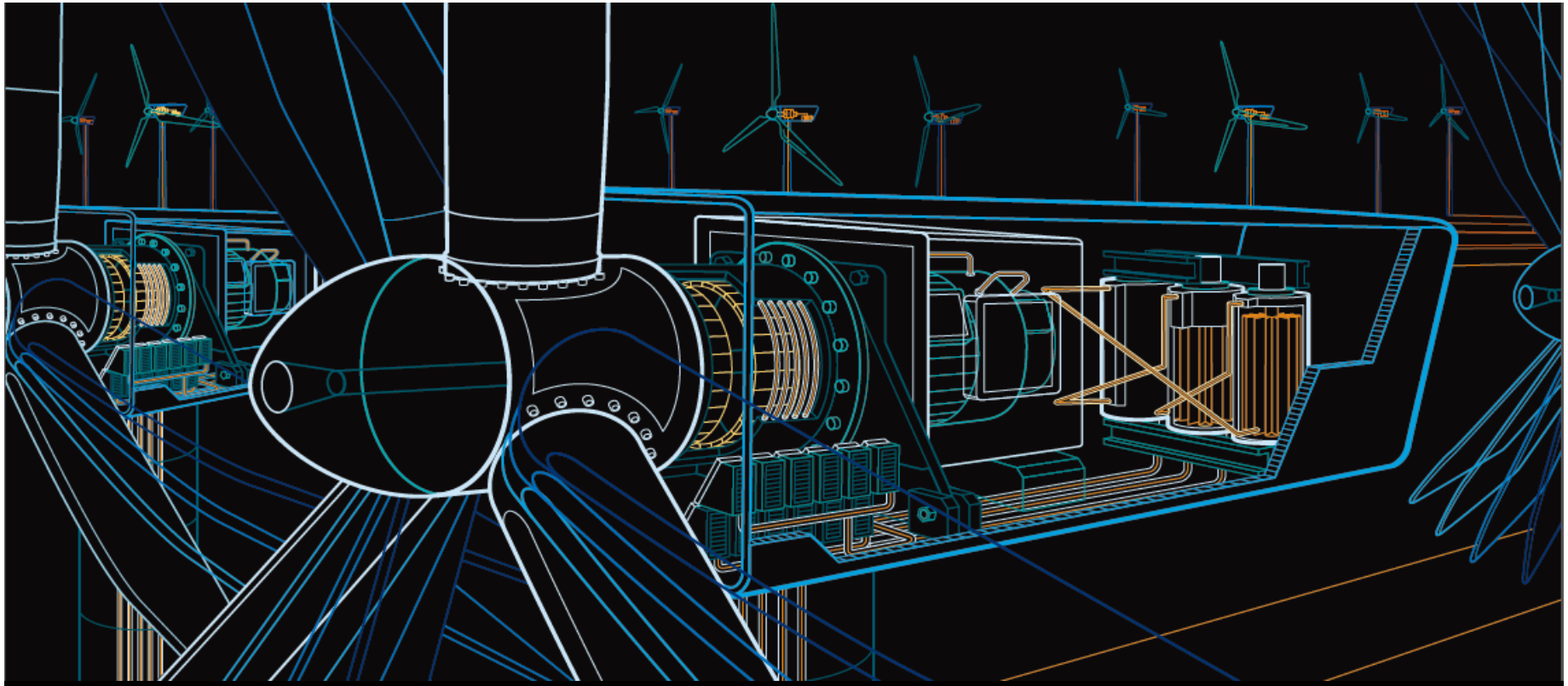
- (4) x 5000 kW Outdoor PCS / 35kV
- Includes inverters, dc circuit breakers, ac circuit breakers, control, protection and external isolation / step-up transformer to 35kV grid
- Metering / Data Management
- Noise suppression

ABB Energy Storage Experience
BESS Integrator / PJM (20 MW PCS)

(4) X 5000 kW PCS

Questions?

Break

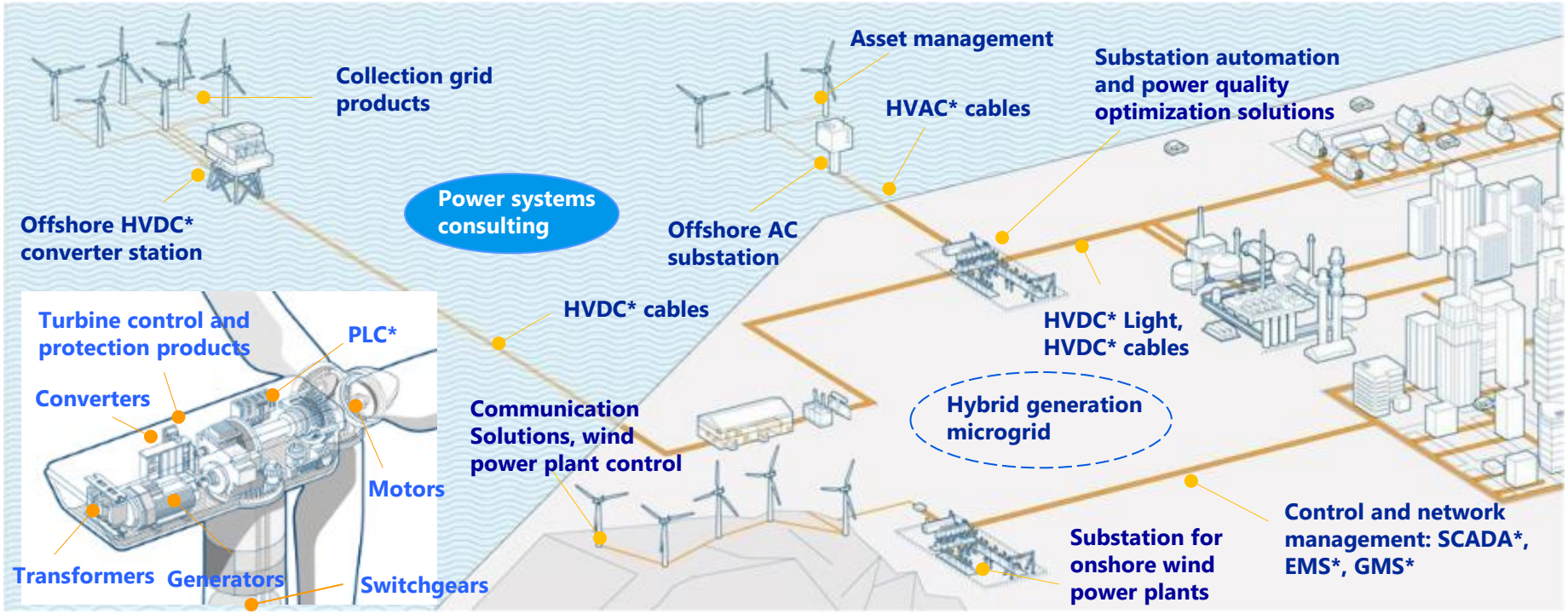


AWEA 2016
Turbine Retrofit/Upgrades

AWEA 2016
Agenda – ABB Wind Turbine Retrofit/Upgrades

- ABB Company Overview
- Fixed Speed Turbine Retrofit
- Other Wind Services

ABB in the Wind Power Industry
Full Electrical-only Supplier



EMS: Energy Management System
GMS: Generation Mangement System
HVAC: High-voltage Alternating Current
HVDC: High-voltage Direct Current
PLC: Programmable Logic Controller
SCADA: Supervisory Control And Data Acquisition

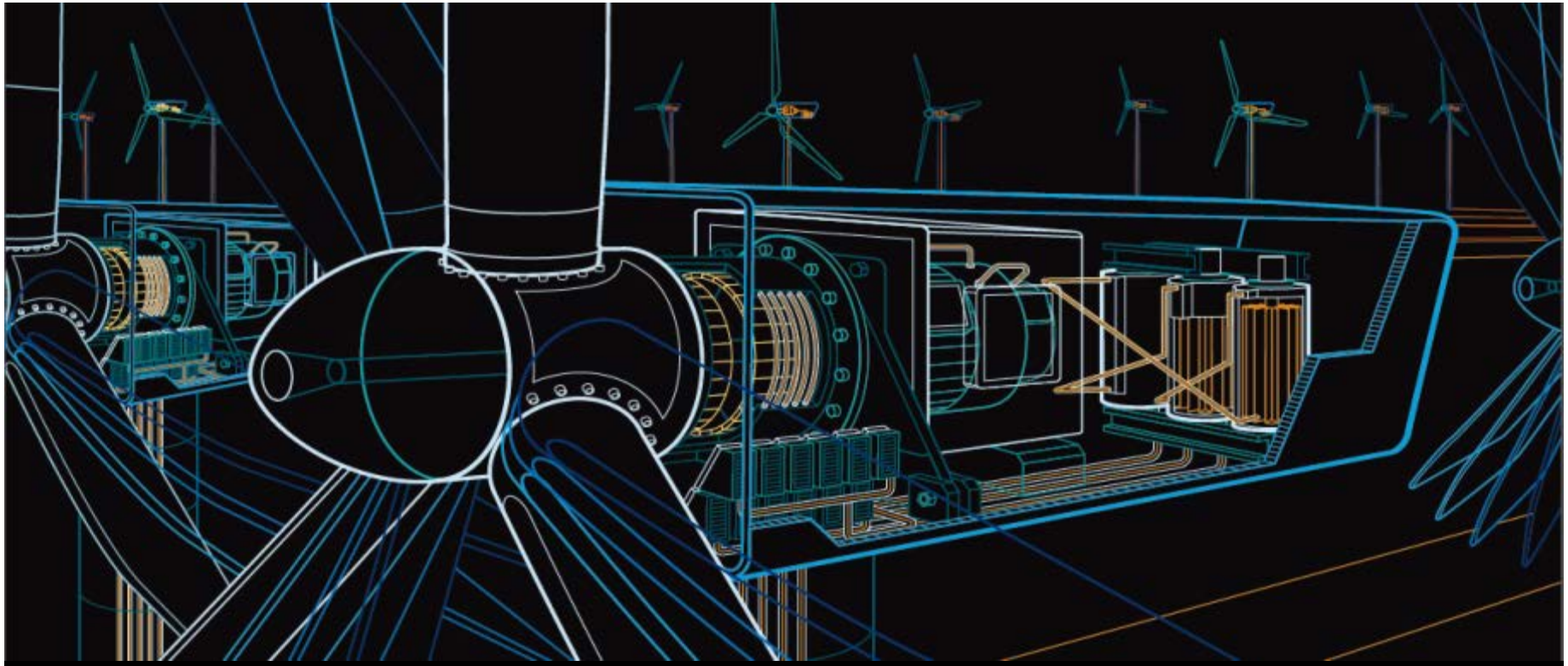


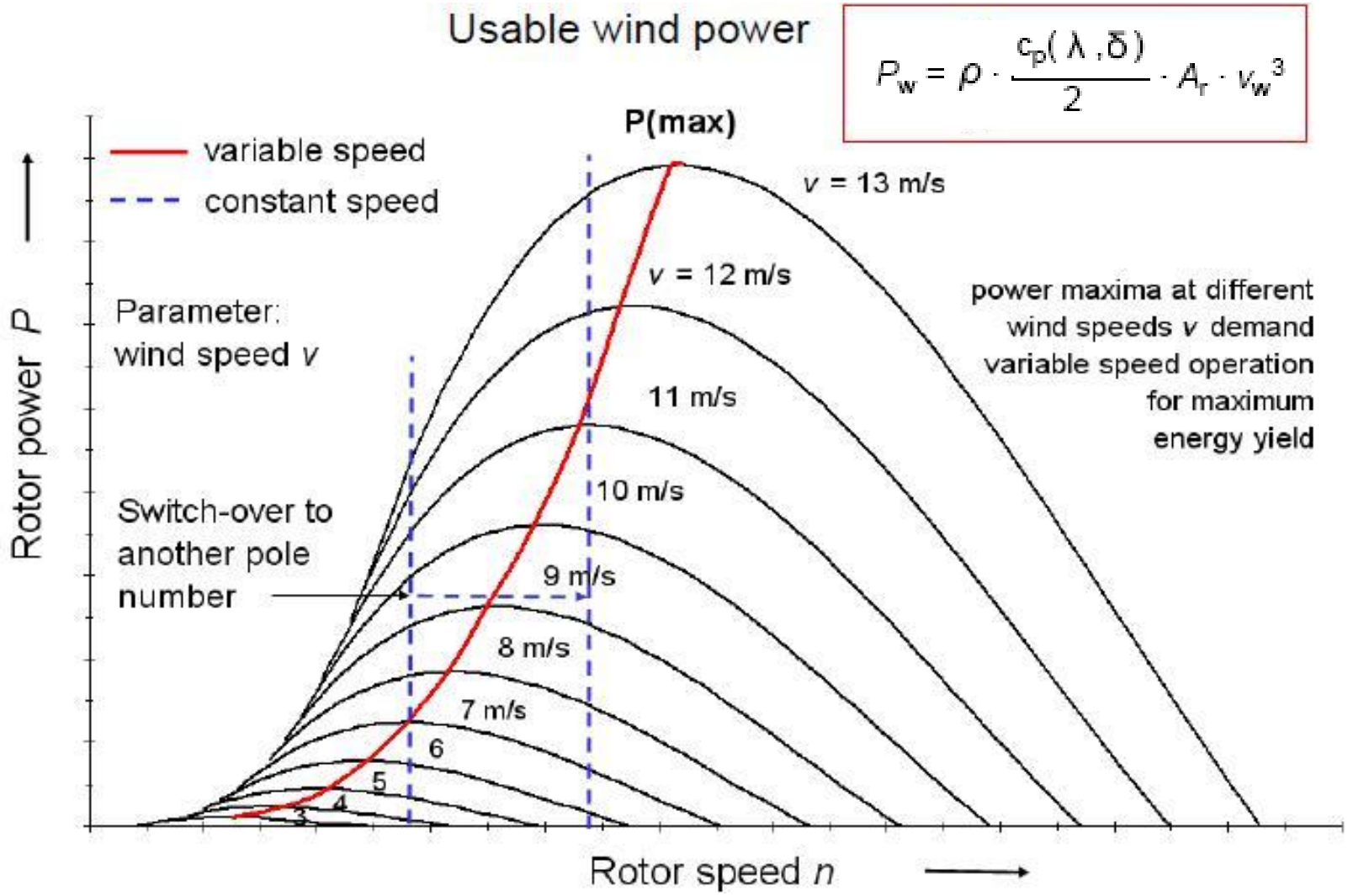
ABB Wind Retrofit

Enable your fixed speed turbine to work at variable speed, increasing efficiency and lifetime

ABB Wind Retrofit
Offering Description

- ABB can improve the wind performance and lifetime of an old turbine by using new components and technologies
- Upgrade from stall/pitch controlled fixed speed to stall/pitch controlled variable speed
- Wide power range : 200kW to 1300kW+
- Available for all turbine trademarks

ABB Wind Retrofit
Constant vs Variable Speed



SOURCE: http://www.iqwind.com/index.php?categoryId=43263

ABB Wind Retrofit
Increase efficiency and turbine lifetime

Scope

- Analysis
- Consulting
- Engineering
- Design
- Project management
- Field commissioning

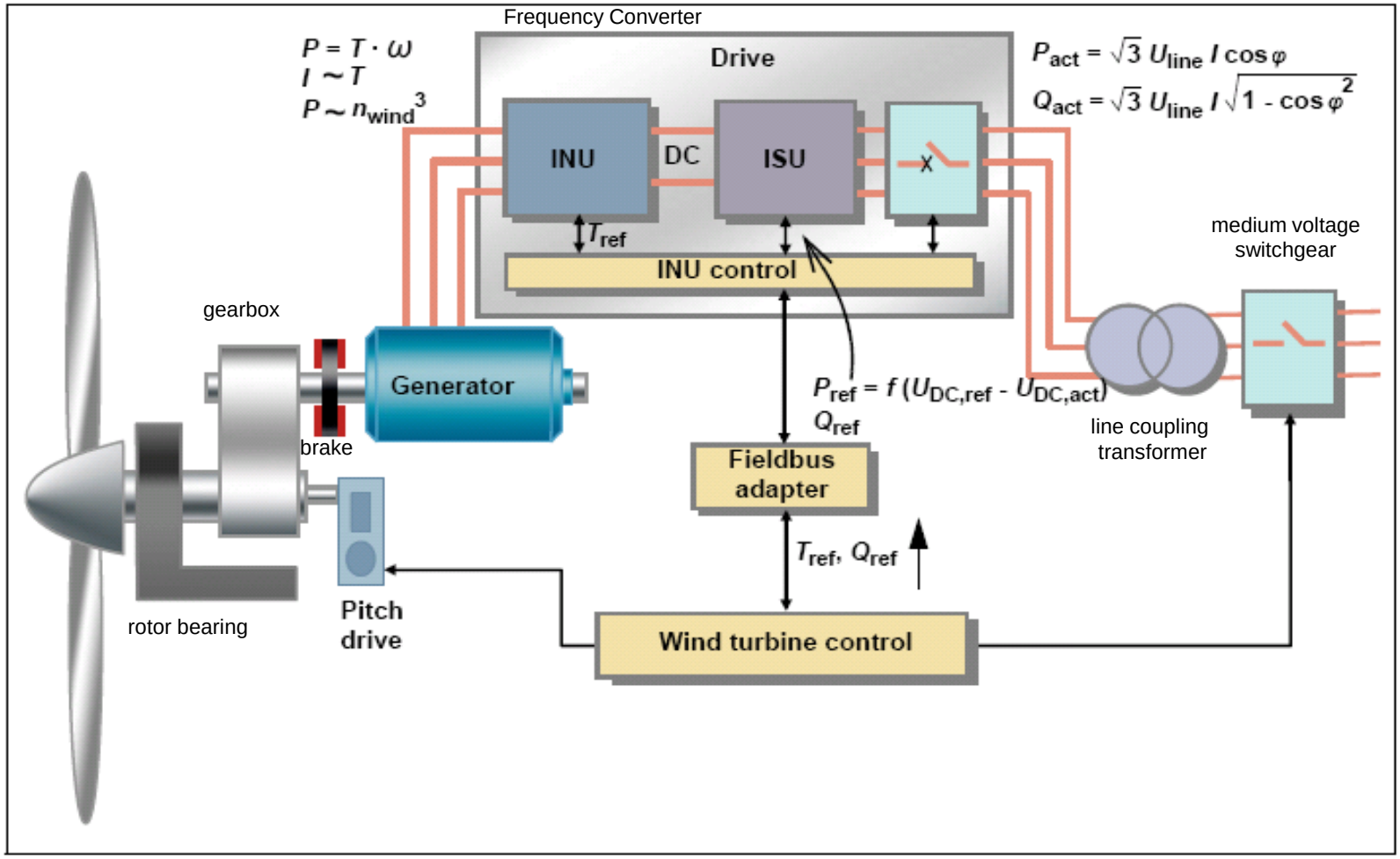
Extend Life of Turbine

- Refurbish and upgrade existing electrical and mechanical components
- Add full power converter that reduces mechanical stress on drivetrain

Delivery

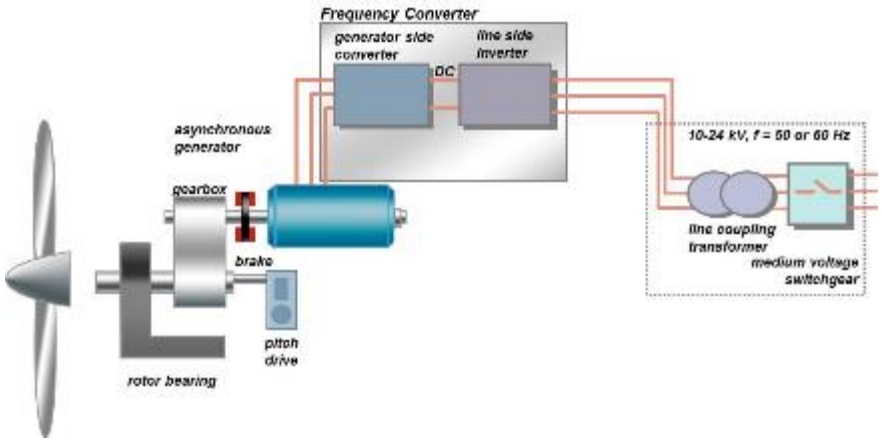
- Flexible packages for older generation turbines
- Improve efficiency and reliability
- Meet grid code compliance

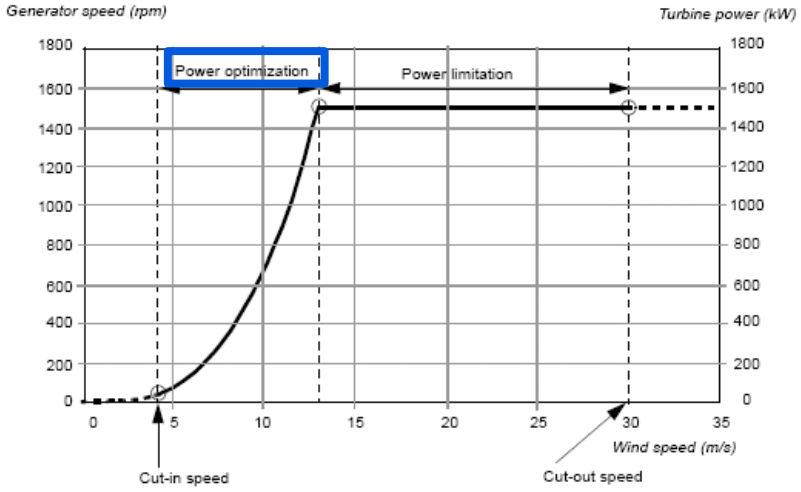
ABB Wind Retrofit
Full Power Converter System



U_{line} denotes line-to-line voltage, I phase current

ABB Wind Retrofit
Full power converter concept (FPC) – Overview





Full power converter concept

- Decouples the generator from the grid
- All generated power flows through converter to the grid
- Enables full reactive power production @ desired PF
- Improved output power quality
- Converter provides generator's torque and speed control
- Noise reduction by avoiding harmful resonance frequencies to the mechanical structure

Advantages compared to fixed speed turbines

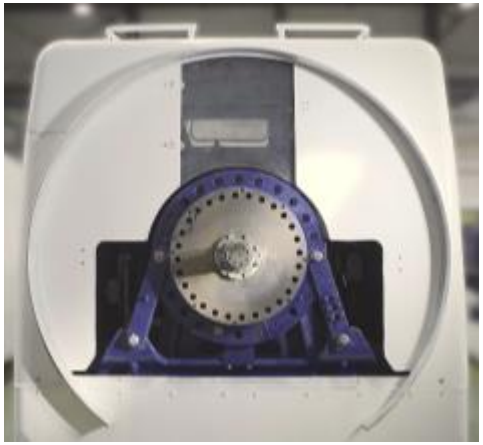
- Satisfies grid code compliance
- Increased production (kWh) in terms of efficiency by taking advantage of low and medium speed winds
- Reduction in mechanical shocks and stresses on turbine

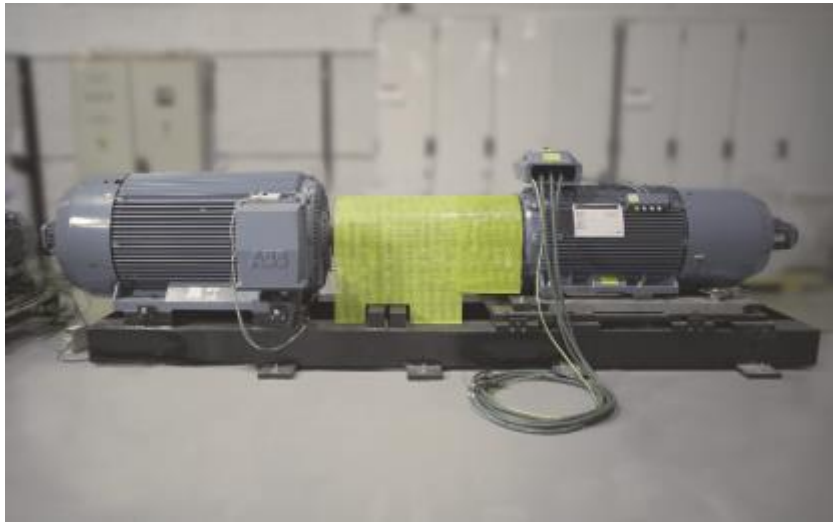
ABB Wind Retrofit
Reference – Before Retrofit






ABB Wind Retrofit
Reference – After Retrofit




Reference

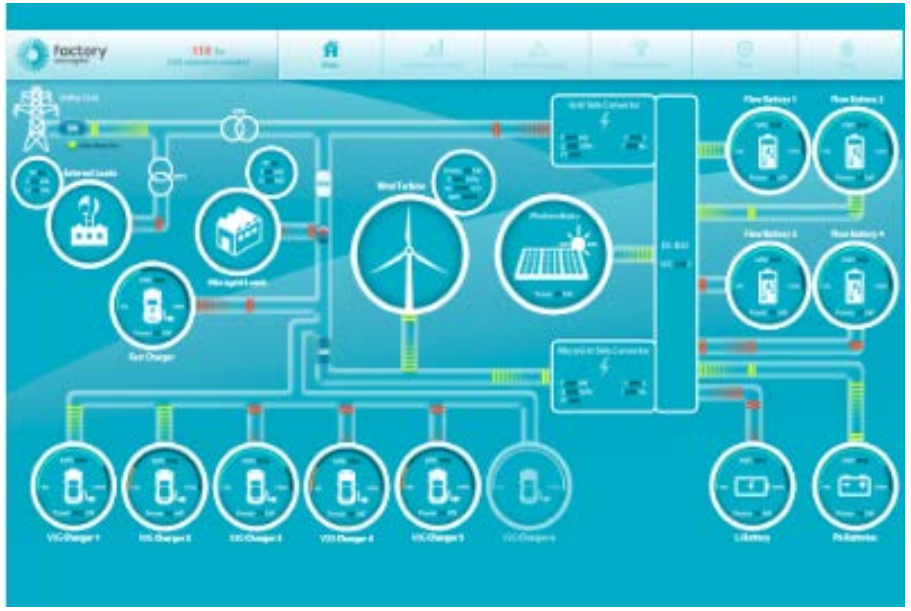
NTR, Northern Ireland: 1 x V29 225 kW Retrofit

- Electrical Retrofit and Full power converter installation
- Superior control system from DEIF
- Generator refurbishment

Reference

Jofemar, Spain: 1 x V25 (150 kW) retrofit for micro grid application http://www.factorymicrogrid.com/en/

- Electrical Retrofit and Full power converter installation
- Superior control system from ABB
- Generator refurbishment
- Integration in micro grid (solar, EV charging, etc.) done by others



Reference

Chile Chico, Chile: 3 x V44 turbines (600 kW)

- Electrical Retrofit and Full power converter installation
- Mechanical Retrofit
- Superior control system from DEIF
- 3x switch-rooms containing the MV switchgear and transformer (13.3 kV/690V) from ABB (pull-through)

ABB Wind Retrofit
Conclusions

- Extend the life of your orphan turbines (NegMicon, Bonus, Vestas)
- Bring older turbines in to compliance with local grid codes
- Remove/minimize maintenance on ancillary grid support equipment
- Additional side benefit of potential power production by maximizing power curve

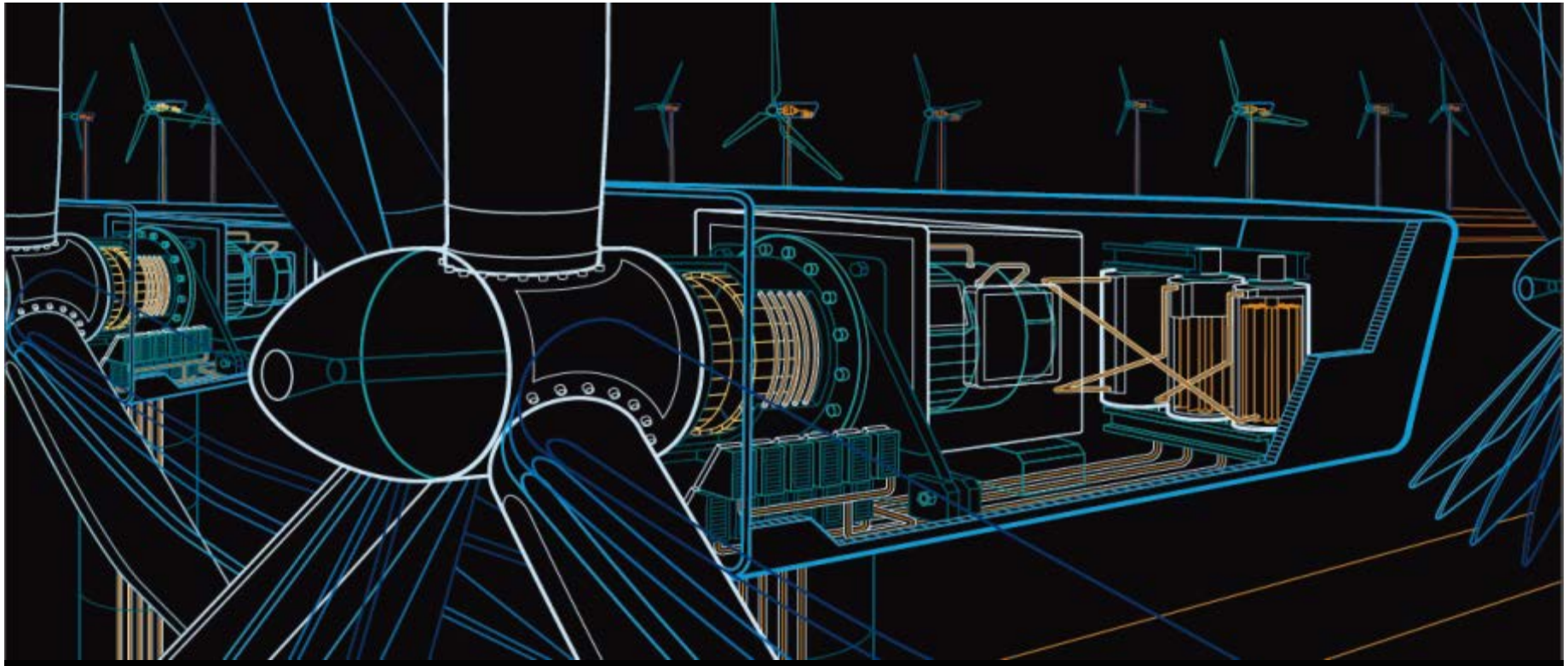


ABB Wind Drive Upgrade
Optimize your ACS800-67 performance

ABB Wind Drive Upgrade
Service offering

- Increase the availability of your ACS800-67 by adding new components reducing its maintenance costs and improving its efficiency

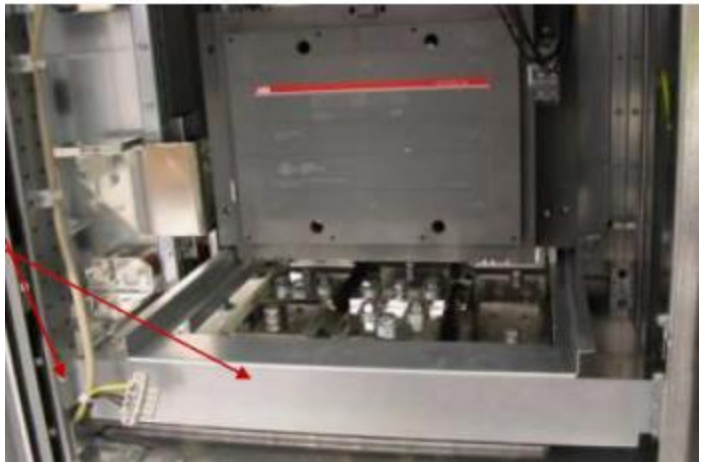
ABB Wind Drive Upgrade
Service offering

- Brake Chopper upgrade
- Contactor upgrade
- NDCU Upgrade
- NETA-01 to -21
- Carbon Dust Exhaust
- Future Upgrades

ABB Wind HW Upgrade
Contactor kit

Reduce maintenance costs and increase reliability of the grid coupling

Benefits
Increased operational lifetime: With contactor kid you increase the circuit breaker lifetime beyond the turbine lifetime.
Optimized maintenance costs: Avoid extra costs of the circuit breaker replacement.
Increased operational reliability: Contactor and circuit breaker will perform for what they have been designed.



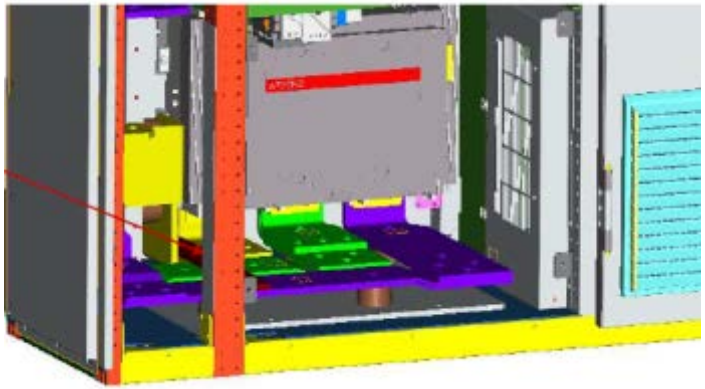


ABB Wind HW Upgrade
Brake chopper kit

Improve LVRT performance of your ACS800-67

Benefits
Improved performance: better ride-through capabilities
Increased operational reliability: Reduces the quantity of overvoltage converter shut off
Optimized maintenance costs: Avoid the component aging and damaging caused by converter trips.

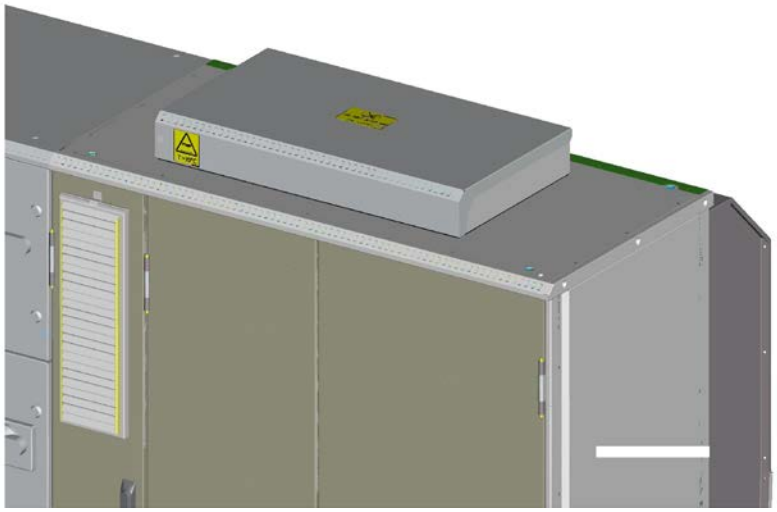
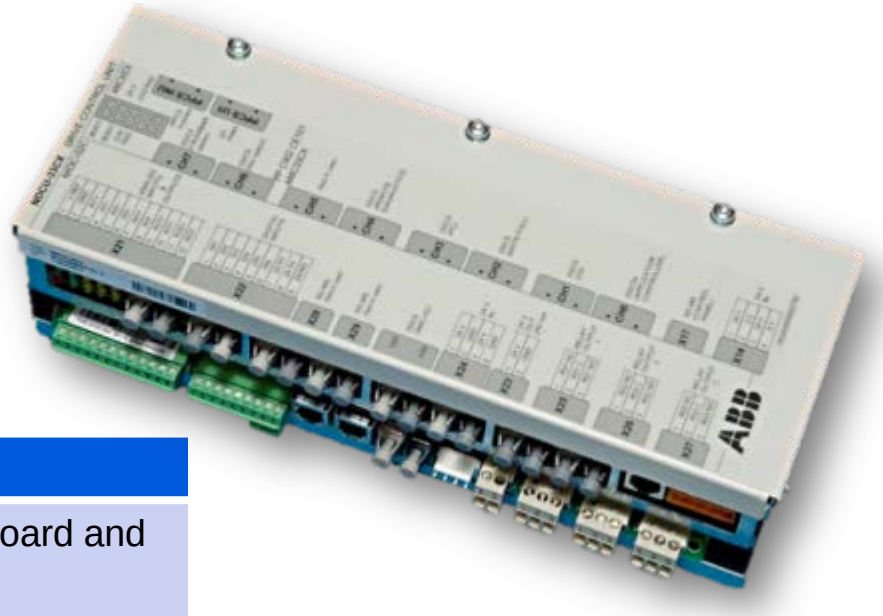


ABB Wind HW Upgrade
NDCU 33-CX

NDCU 33-CX replaces the NDCU 32/33 solution that was originally shipped with converter.



Benefits
Increased operational reliability with the latest control board and the new software.
Increased operational lifetime. The new control board increases the NDCU lifetime beyond the operational lifetime of the wind turbine.
Improved performance: The new processor, real time clock and optimized software, allows the NDCU-33CX to perform better and faster than its predecessor.
Better converter capabilities with lots of new parameters such us AC & LVRT signals, system control inputs, crowbar stats…

ABB Wind HW Upgrade
NETA 21

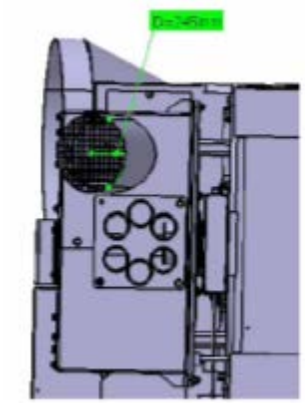
NETA 21 replaces the NETA 01 solution and enables the real-rime Condition Monitoring.

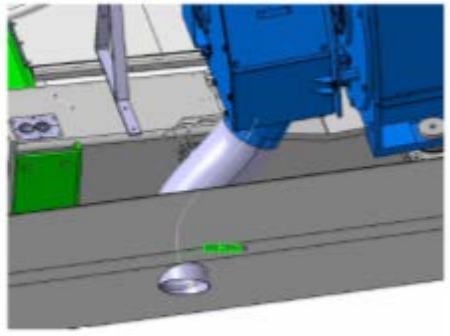
Benefits
Real-time Condition Monitoring: Prevent failures and their consequences.
Improved performance: Easier and faster communication.
Increased customizing: Create custom events and reports

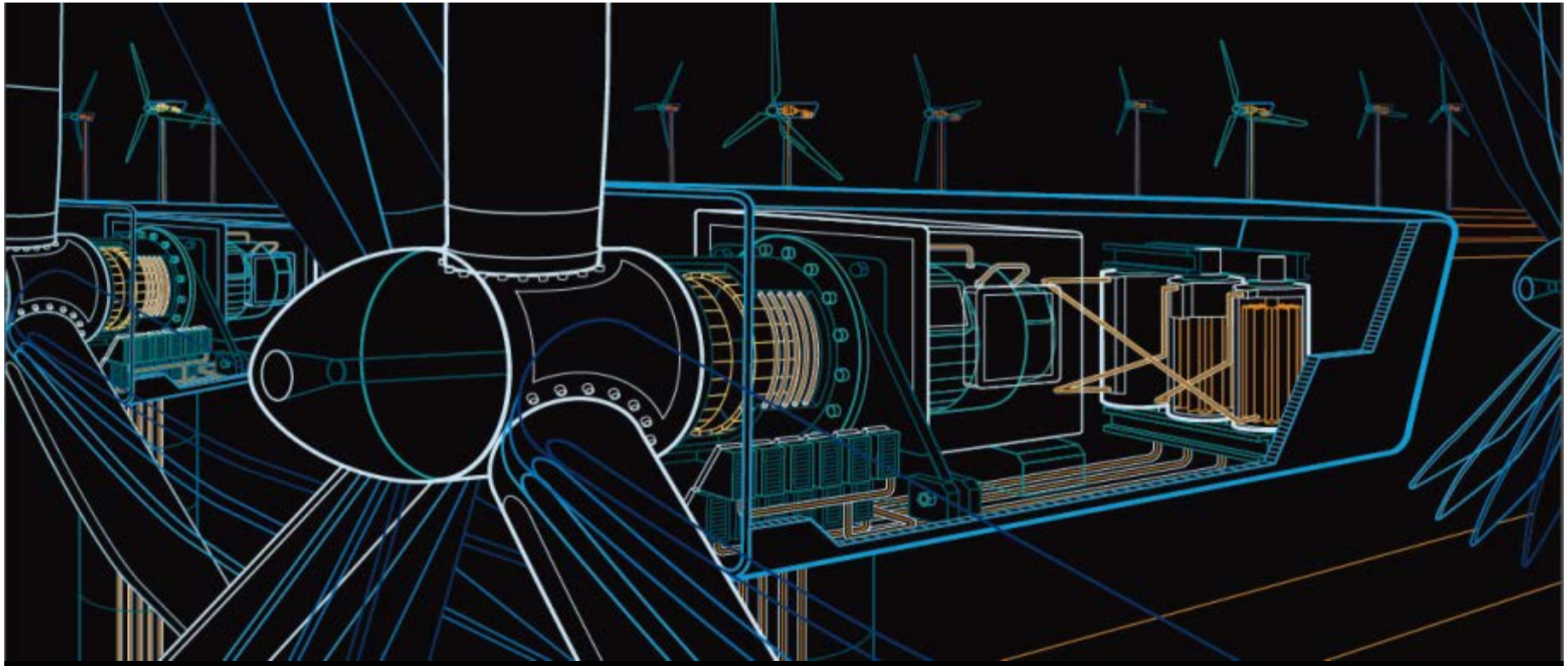
ABB Wind HW Upgrade
Carbon dust exhaust pipe

Keep your nacelle clean by installing the exhaust pipe

Benefits
Increased Reliability: Keeping the nacelle clean means that there is no dust that can damage the mechanical or electrical components in the long term.
Better safety and healthy conditions







Generator Replace and recycle
ABB Wind Care – Generators : Replace & Recycle Concept

ABB Wind Care
Wind power generator: Replace and recycle concept

- When a wind power generator faces a damage, it causes downtime up to 20 weeks and production losses
- To help our customers to overcome this problem, we have created two storages for rapid replacement, one in Denmark for 50 Hz, and one in USA for 60 Hz generators. We store few different generator types of the largest fleets.

- The “recycle” means that we require the damaged ABB generator for exchange, we repair and refurbish it, if possible and feasible, and return it to the storage. If they are not feasible to be repaired, we shall manufacture a new one for the storage.
- If you want to guarantee the availability of the replacement generator, you can buy them and make a hosting agreement with ABB

Marzio Zambetti - USA

Wind service

Electrification Products & Service

EP – Service
Main Pillar

Product Portfolio

Replacement
- ABB to ABB
- ABB to Competitors

Spara parts
- Consumable
- Components

LCM
- Retrofitting

Documentation

Value Proposition

Go to Market

OEM
- Vestas
- Gamesa
- SWP

System Integrator
- DMDR
- Ingeteam

ISP

Utilities

Distributors

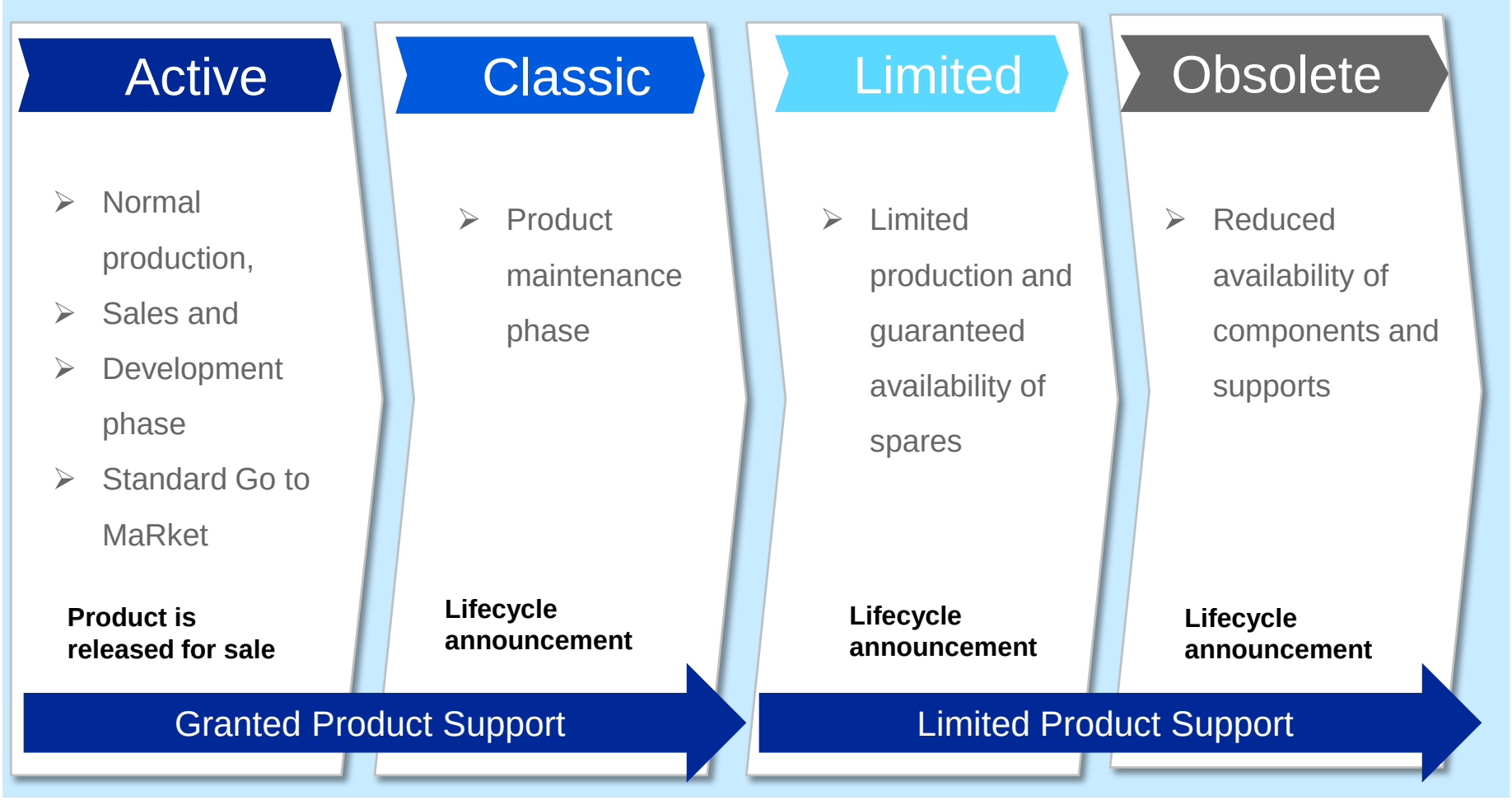
Connection among Distributors and Utilities

Circuit Breakers & Switches - Service
Maintenance: Why Maintenance? Why Service?

Maintenance: Personnel, Materials

- Health & Safety Risks
- Production Loss
- Reduced Life Time of Equipment
- Management of Urgency
- Energy Consumption

Circuit Breakers & Switches – Service
Life Cycle Management



Circuit Breakers & Switches – Service
Life Cycle Management

Active

Emax 2

AF Contactor

Classic

New Emax

PR122/P

- New Emax: Active until end of June 2017
- Classic from 1st July 2017
- EK 370 -1000

Limited

- EH 370 – EH 1200
- EHDB 520-960
- MEGAMAX
- ISOMAX up 800 A

Obsolete

Emax

Granted Product Support

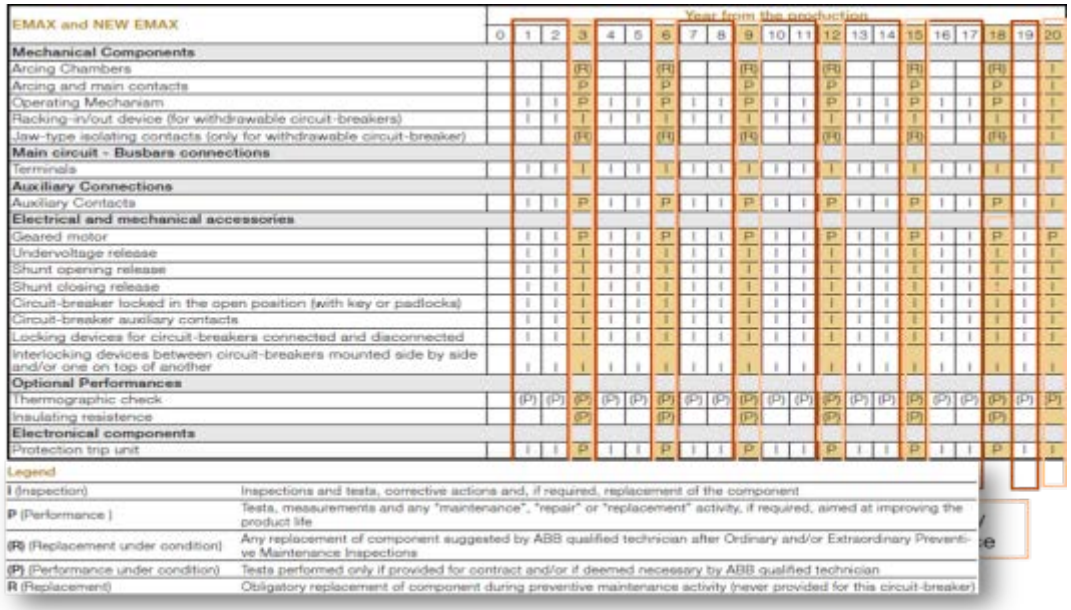
Limited Product Support

Electrification Products – Service Maintenance

Corrective Maintenance

- Component failure due to lack of maintenance
- Miss-used

Preventive Maintenence



EMAX and NEW EMAX	Year from the production																			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Mechanical Components																					
Arcing Chambers				(R)			(R)			(R)			(R)			(R)			(R)		I
Arcing and main contacts				P			P			P			P			P			P		I
Operating Mechanism		I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I
Racking-in/out device (for withdrawable circuit-breakers)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Jaw-type isolating contacts (only for withdrawable circuit-breaker)				(R)			(R)			(R)			(R)			(R)			(R)		I
Main circuit - Busbars connections																					
Terminals		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Auxiliary Connections																					
Auxiliary Contacts		I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I
Electrical and mechanical accessories																					
Geared motor		I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	P
Undervoltage release		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Shunt opening release		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Shunt closing release		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Circuit-breaker locked in the open position (with key or padlocks)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Circuit-breaker auxiliary contacts		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Locking devices for circuit-breakers connected and disconnected		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Interlocking devices between circuit-breakers mounted side by side and/or one on top of another		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Optional Performances																					
Thermographic check		(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)	(P)
Insulating resistence				(P)			(P)			(P)			(P)			(P)			(P)		
Electronical components																					
Protection trip unit		I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I	P	I	I

Legend

I (Inspection)	Inspections and tests, corrective actions and, if required, replacement of the component
P (Performance)	Tests, measurements and any "maintenance", "repair" or "replacement" activity, if required, aimed at improving the product life
(R) (Replacement under condition)	Any replacement of component suggested by ABB qualified technician after Ordinary and/or Extraordinary Preventive Maintenance Inspections
(P) (Performance under condition)	Tests performed only if provided for contract and/or if deemed necessary by ABB qualified technician
R (Replacement)	Obligatory replacement of component during preventive maintenance activity (never provided for this circuit-breaker)

Eletrification Products– Service
Maintenance - Check List Emax / Contactor

Old Emax / New Emax

- Ordinary Maintenance (cleaning & greasing)
  - Visual Inspection
  - Trip Test
    - Ekip T&P (new Emax)
    - PR010/T (old Emax)
  - Check the contact wear and arc chambers
  - Electrical test of the accessories (YO, YU, AUX, gear motor, etc..)
  - Device locking, open-close the key locks
  - Manual opening-closing of Emax (10 operations)

Contactor AF range

Ordinary Maintenance (cleaning & greasing)

- ✓ Visual Inspection
- ✓ Check the contact wear and arc chambers

- Manual 1SDH000460R0002

Eletrification Products– Service
Maintenance: Check List MCCBs < 630A- ISOMAX S7

TMAX < 630 A

- Visual Inspection
- Manual opening-closing operation (5 times)
- Trip Test:
  - TMD: trip test by push button
  - ELT: trip test by ekip T&P (or PR010/T for Isomax)
- Electrical testing of accessories (YO, YU, AUX, Motor, etc..)
- Tightening of the screws and cables

ISOMAX S7

- Ordinary maintenance (cleaning & greasing)
  - Visual Inspection
  - Trip Test by PR010/T
  - Electrical testing of accessories (YO, YU, AUX, gear-motor, etc..)
  - Device locking, open-close the key locks
  - Opening-closing operation (10 times)

- Manual

Circuit Breakers & Switches – Service Trainings

Online trainings

- Products and Features
- Where to find material/documents

Ordinary maintenance

- Getting into Service
- General Inspections
- Preventive Maintenance

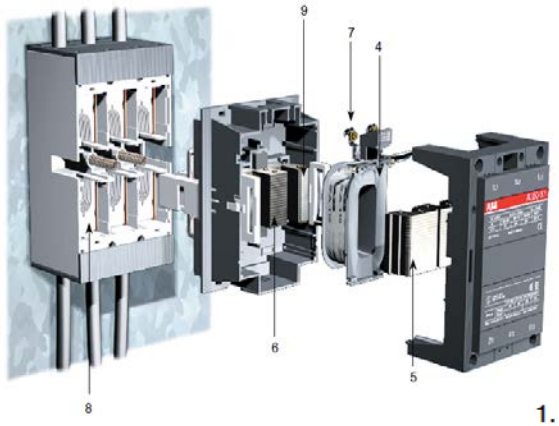
Extraordinary maintenance

- Replacement of critical components (mechanism, poles,..)
- ABB Technicians Only

Breakers and Contactors

Breakers

Contactors



1. Terminal bar
2. Moving contact
3. Fixed contact
4. Operating coil
5. Armature
6. Core
7. Coil terminals
8. Arc chutes
9. Shading coil

Kits and testing equipment

Maintenance Kit & Greasing Kit

Test Equipment

- ✓ **Ekip T&P** (New Emax – Tmax)

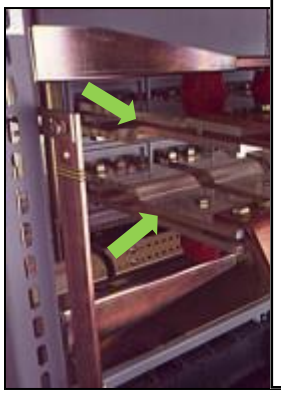
- ✓ **PR010T** (Old Emax - Isomax)

Circuit Breakers & Switches – Service

Retrofitt

Original Bu

Existing Busbar



Circuit Breakers & Switches – Service
Available Documents

Wind Service Brochure

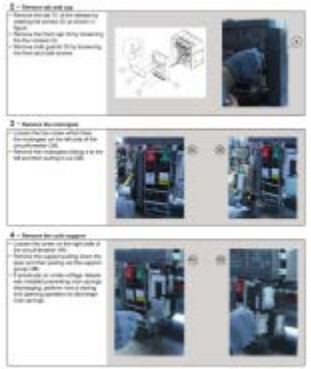
Adobe Acrobat Document

Service Manual

Check List

WARNING! SAFETY DIRECTIVES
Before carrying out any maintenance work, it is necessary to complete the following procedures:
– Ensure that incoming and out coming section are no longer energized
– Switch off the circuit breaker
– Rack the circuit breaker in "DISCONNECTED" position
– For extraordinary maintenance move the circuit breaker down of the nacelle to ensure safe and easy access to it
– Put into safety conditions in compliance with the standards and laws in force
ABB accepts no liability for damage to property or personal injury due to failure to comply with the instructions contained in this document.
These servicing procedures shall be handled only by qualified personnel with a thorough understanding of the equipment.
MOVING PART SERVICING PROCEDURES
General inspection and cleaning of the exterior
Check that there is not dust, dirt or carbon traces on the circuit-breaker. If present, remove dirt, oil traces or exceeding grease, with a clean dry cloth.
Remove grease or dust from plastic components with a clean dry cloth, alcohol and not aggressive products suitable for plastic components.
Check that the labels showing the technical characteristics of the circuit-breaker are present.
Clean circuit-breaker labels with a clean dry cloth.
Check that there are not overheating traces on the circuit-breaker isolation parts. These parts should be light grey in color.
Check that the circuit breaker contacts are intact. These contacts should be silver in color, with no traces of erosion or smoke.
Check the number of operations carried out
Operating Mechanism
Remove circuit breaker front cover
Remove coils holder
Discharge closing springs by closing and opening the circuit breaker
Dismantle Operating Mechanism and coupling pin
Remove grease or dust, and, if present, oil traces or exceeding grease from internal components with clean dry cloth and laminated diluting
Clean and lubricate the opening and closing shafts, the hooks and other moving parts with grease type Exxon Mobil Mobilgrease 28
Check that all safety rings are in their place and that they are correctly installed
In case of excessive wear of any part replace the operating mechanism with a new one
Install operating mechanism lubricating coupling pin with grease type Exxon Mobil Mobilgrease 28
Check that screws of Operating Mechanism are tightened.
Check that the pin between operating mechanism and contacts rod is in place with its safety washer in place
Measure release close effort on closing button board
Measure release open effort on opening button board
Check that antipumping device works properly
Check the correct opening hook stroke
Check the correct charge springs pawl stroke
Check the correct knee-pad hook stroke
Check lubrication of the moving parts. Lubricate the bearings of the drive shaft with Exxon Mobil Mobilgrease 28 grease, including those on the circuit-breaker sides

Spare part Catalogue



Adobe Acrobat Document

EP Service
Extended Warranty

Products

- Emax 2
- New Emax
- Tmax (from T4 to T8)
- Tmax XT

Whom

Anyone can access to the Extended Warranty dedicated tool :

1) ABB Local sales Units

2) ABB Sales Partners: Panel Builder, Original Equipment Manufacturer (OEM), Wholesaler, Utility, System Integrator, EPC, Service Provides, etc…

3) End users

Extend Warranty

- +1 year free of charge if end user and site details are indicated in the WEB based tool à total number of warranty years = 2 years
- +3 years with a fee à total number of warranty = 4 years
- +4 years (at the same +3years) price if end user and site details are indicated à total number of warranty years = 5 years

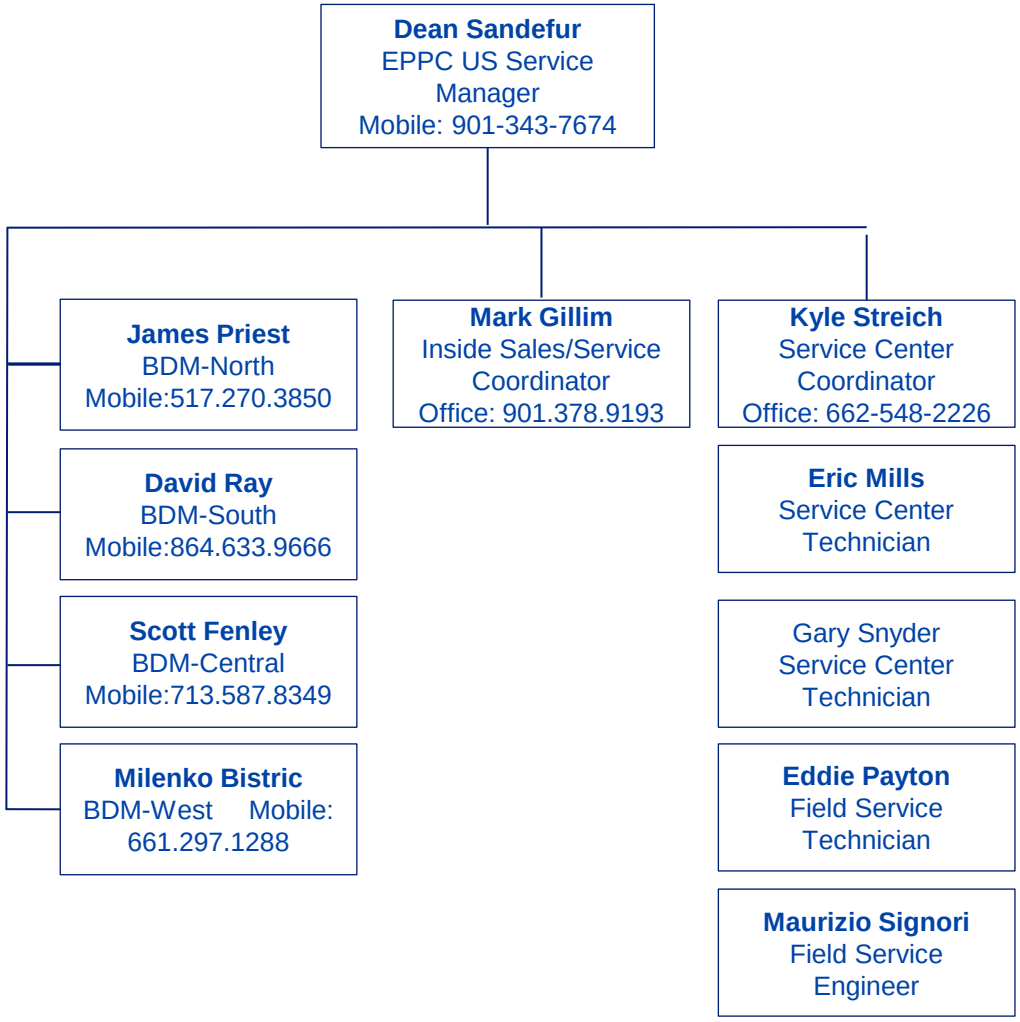
Condition

The extended warranty covers the circuit breaker and the accessories ordered already mounted on the circuit breaker from ABB factory.

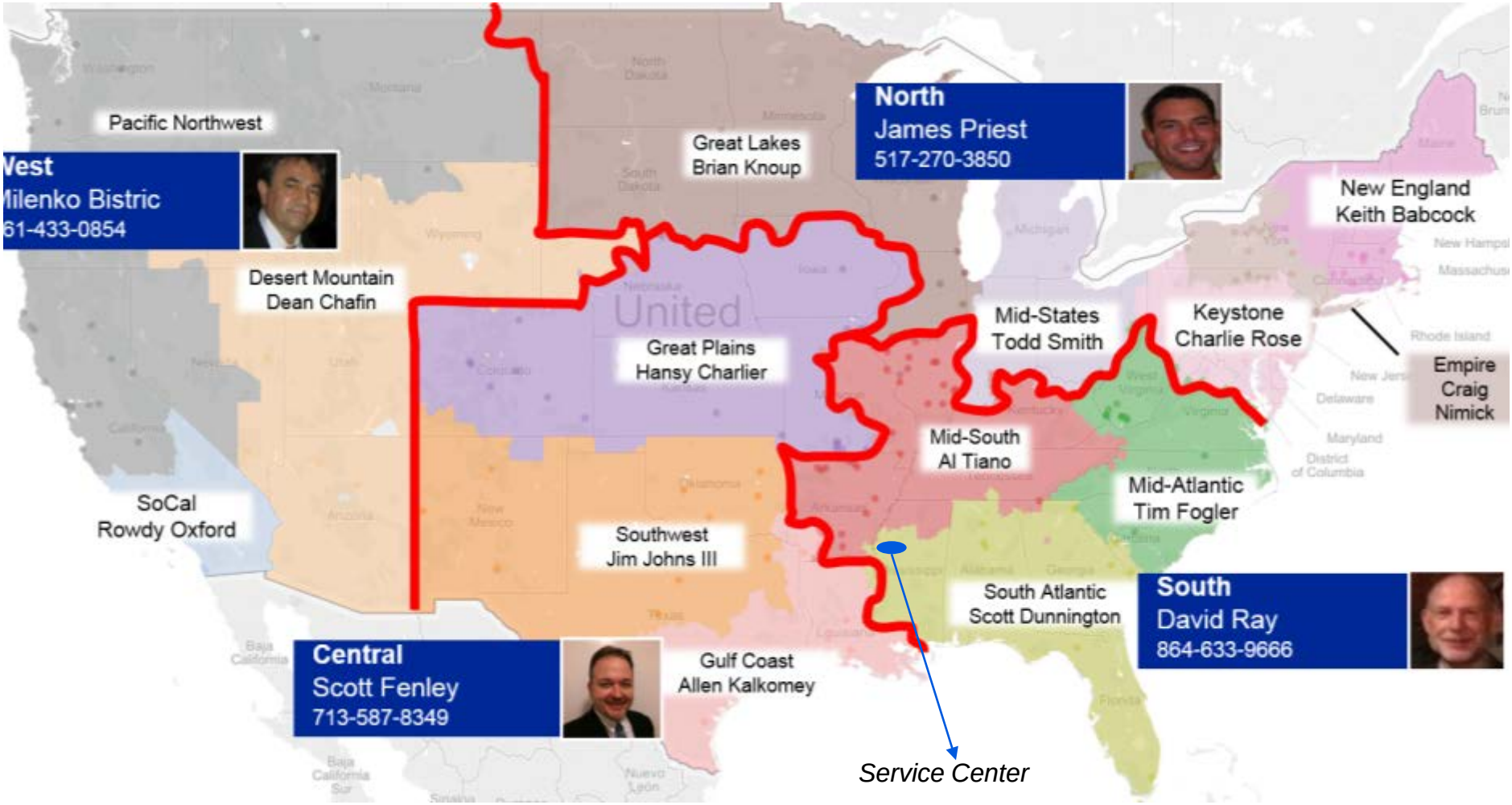
To activate the extension of warranty is mandatory to register the product in the WEB based Extended warranty tool .

Power and productivity
for a better world™

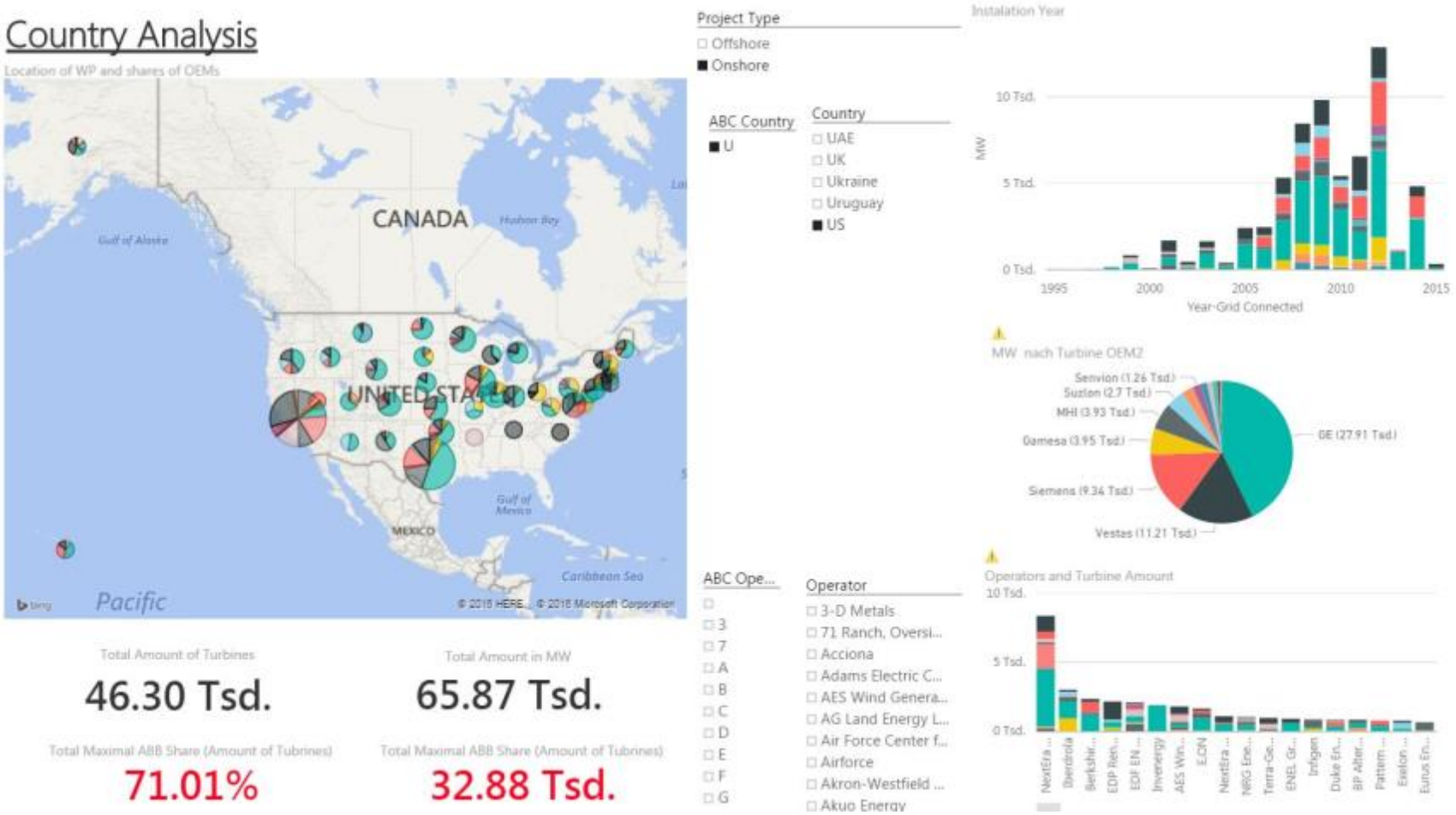
Electrification Products– Service
US Service Team



Electrification Products– Service
US Business Development Managers



Electrification Products– Service
US Wind Installed Base



Electrification Products– Service
US Distribution of ABB products