22nd Sep 2016

ABB Capacitors and Filters
ABB-PLN Workshop
Vision: Being recognized as the leading and best supplier of power quality solutions focusing on filtering, reactive and active power compensation

Mission: Provide value to customers by presenting them the right power quality solutions and products for their applications
Power Quality-UT

Electric energy is the commodity. Focus is on:
- Network losses
- Voltage stability
- Transmission capacity

Reduced cost
- Higher capacity \(\Rightarrow\) No need for new lines and substations
- Low losses \(\Rightarrow\) Low maintenance

Higher revenues
- Voltage stability \(\Rightarrow\) Load flow control
- Power quality \(\Rightarrow\) Higher efficiency
- Load increase \(\Rightarrow\) Higher capacity

Environmental Aspects
- Less power lines
- Less generation of electricity

Power compensation increases capacity and gives lower costs
Electric energy is a production cost. Focus is on:
- Power factor
- Voltage stability
- Power quality

Reduced cost
- Higher power factor $\cos \phi \Rightarrow$ No penalty tariff
- Voltage stability $\Rightarrow$ No unplanned production stops
- Lower losses $\Rightarrow$ Low maintenance
- Power quality $\Rightarrow$ No disturbance

Higher revenues
- No stops $\Rightarrow$ Higher output

Power compensation decreases costs and gives higher revenues
Reasons for investing in Power Quality

Poor Power Quality costs

Poor Power Quality:
- Reactive power
- Harmonics
- Load imbalance
That ultimately results in
down-time and high
running costs

<table>
<thead>
<tr>
<th>Sector</th>
<th>Financial loss per incident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-conductors production(*)</td>
<td>3 800 000 €</td>
</tr>
<tr>
<td>Financial trade(*)</td>
<td>6 000 000 € per hour</td>
</tr>
<tr>
<td>Computer center(*)</td>
<td>750 000 €</td>
</tr>
<tr>
<td>Telecommunication(*)</td>
<td>30 000 € per minute</td>
</tr>
<tr>
<td>Steel industry(*)</td>
<td>350 000 €</td>
</tr>
<tr>
<td>Glass industry(*)</td>
<td>250 000 €</td>
</tr>
<tr>
<td>Offshore platforms</td>
<td>250 000 € per day</td>
</tr>
<tr>
<td>Dredging/land reclamation</td>
<td>50 000 – 250 000 € per day</td>
</tr>
</tbody>
</table>

(*) European Copper Institute 2002
### Reasons for investing in Power Quality

#### Examples of impact of harmonics

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Losses/year</th>
<th>CO₂ emissions/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small/medium transformers</td>
<td>3000 €</td>
<td>30 T</td>
</tr>
<tr>
<td>Large transformers</td>
<td>10 000 €</td>
<td>100 T</td>
</tr>
<tr>
<td>LV cables (per 100 m)</td>
<td>1500 €</td>
<td>15 T</td>
</tr>
<tr>
<td>Motors</td>
<td>10% additional losses</td>
<td>10% additional emissions</td>
</tr>
</tbody>
</table>

Note: Actual results may be different from examples. Values given do not constitute a performance guarantee and depend on local conditions.
Reasons for investing in Power Quality

Your benefits of having good Power Quality
- Reduction of technical problems
- Compliance with (utility) regulations
- Increasing the production efficiency
- Rendering your installation more environmental friendly

Poor Power Quality:
- Reactive power
- Harmonics
- Load imbalance
- That ultimately results in down-time and high running costs
Power Quality
Effects All Voltage across the Network
Power Quality

Main load in the system

Active Power ($kW$)  
\[ \frac{\text{Active Power (kW)}}{\text{Apparent Power (kVA)}} \]

Drinkable beer  
\[ \frac{\text{Drinkable beer}}{\text{Full glass of beer}} \]

\[ PF = \frac{kW}{kVA} \]

1,500 kVA Transformer

1428 kVA  
1250 kVA  
1111 kVA

Power Factor  
1000 kVAR  
750 kVAR  
482 kVAR

= 0.8  
= 0.7
Power Quality
Power Factor Compensation

Low cos $\phi$ - Transformer is fully loaded

High cos $\phi$ - Transformer has 22% more capacity

Pay-back time 0.5-1 year
The lower the power factor, the more reactive power the Network needs to provide. This can result in:

- **Larger equipment** (i.e. poles and wires) required to supply power

- System capacity problems due to inefficient loading of incoming transformers

- **Higher operating costs** due to maximum demand charges – kvar (kVA) tariff, local generation costs and energy loss

- **Consideration when renewable applications exist** - Wind, Solar, and Battery

- **Increasing Harmonic issues**
Power Quality
Harmonics
Power Quality

Harmonics

HARMONICS

INSTANTANEOUS VALUE

TIME IN MS

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### Power Quality

**Harmonics**

<table>
<thead>
<tr>
<th>Order</th>
<th>Group</th>
<th>Effects</th>
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</thead>
<tbody>
<tr>
<td>$n = 1$</td>
<td>Fundamental</td>
<td>Active power</td>
</tr>
<tr>
<td>$n = 3k + 1$</td>
<td>+ sequence</td>
<td>Heating</td>
</tr>
<tr>
<td>$n = 3k - 1$</td>
<td>- Sequence</td>
<td>Heating &amp; motor problems</td>
</tr>
<tr>
<td>$n = 3n$</td>
<td>0 sequence</td>
<td>Heating &amp; neutral problems</td>
</tr>
</tbody>
</table>
Power Quality
Harmonics

100% $H_1$  +33% $H_3$  +20% $H_5$  ...+4% $H_{25}$

<table>
<thead>
<tr>
<th>Peak</th>
<th>100%</th>
<th>133%</th>
<th>168%</th>
<th>204%</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS</td>
<td>100%</td>
<td>105%</td>
<td>108%</td>
<td>110%</td>
</tr>
<tr>
<td>THD</td>
<td>0%</td>
<td>33%</td>
<td>38.6%</td>
<td>44%</td>
</tr>
</tbody>
</table>

- RMS: Thermal effect
- Peak: Dynamic effect
Power Quality
Harmonics-Voltage Problems

generator
$V_{\text{harmonic}} = 0$

$R + jX$  $R + jX$  $R + jX$

Voltage

Load current

$R + jX$  $R + jX$  $R + jX$
Power Quality
Harmonics - Current Problems

Excessive heating of devices
- Distortion → Increase of RMS

\[ \text{Losses} = R \cdot I_{\text{RMS}}^2 = R \cdot I_1^2 + R \cdot \sum I_h^2 \]

Transformer
- small Z

Harmonic
- I5, I7, I11...

Other User
- Big Z

Rectifier
Power Quality
Harmonics-Other Problems

- Excessive harmonic current may lead to overheating (or even burning) of network components
- Motor problems
  - Additional losses in windings & iron (RMS increase & skin effect)
  - Perturbing torques on shaft (negative sequence harmonics)
Power Quality
Harmonics-Skin Effect

Cross-sectional area of a round conductor available for conducting DC current

"DC resistance"

Cross-sectional area of the same conductor available for conducting low-frequency AC

"AC resistance"

Cross-sectional area of the same conductor available for conducting high-frequency AC

"AC resistance"
Power Quality
Harmonics-Other problem

- Damage to electronic sensitive equipment
- Electronic communications interferences

Electrocardiography (ECG) at a hospital:

without PQF  with PQF
Power Quality
Harmonics - Influence on the power factor

$$COS\phi = \frac{P_1}{S_1}$$

$$PF = \frac{P}{S} = \frac{\sum_{n=1}^{n} V_n I_n \cos \phi_n}{\sqrt{\sum_{n=1}^{n} V_n^2 \times \sum_{n=1}^{n} I_n^2}}$$
Power Quality
Harmonics-Summary

Heat effect (RMS current)
- Overloading of neutrals
- Overheating of cables, motors and transformers
- Interference to sensitive instrument/devices (neutral point shift)

Waveform distortion effect (form, crest factor)
- Nuisance tripping of circuit breakers (peak current)
- Zero crossing problems

Frequency effect (high frequency)
- Capacitor resonance
- Skin effect

Power factor
- Reduction of the TOTAL power factor
- Difference between $\cos \phi$ and TPF (true power factor)
Power Quality
Products and Solution

- System study/ PQ Analysis & Detection
  / Fault Analysis / Solution, Revenue & Payback Analysis
  / Commissioning work
  / Distribution Power System Power Quality Solution
  / All Industry Power Quality Solution

- Shunt bank
  HV: Open Rack/MECB/Qpole/SVG/SVC/TSC
  LV: SVG(statcon)/PQF/Dynacomp/
  Series Bank(10kV SC bank/DVR)

- Capacitor Unit
  HV: HIQ, Dry type(DC)
  LV: CLMD/Smart-Module

- Series Compensation Installation
- Thyristor Switched Capacitor bank
- Dynamic Voltage Restorers
- Static Var Generator

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Power Quality
Products and Solution

Transmission

Distribution

Industry

SC

SVC

QBANK

SVC

Load

SVC

CHARM
ABB capacitors and filters
Worldwide organization close to the customer
Power Quality
Work Scope of Power Quality Center

- Distribution Power System Power Quality Solution
- High energy consumption Industry Power Quality Solution
  - PQ Measurement
  - PQ Analysis (Study/Simulation Report)
- Solution Design
- Commissioning Work
- Business Development & Promotion
LV portfolio/applications
Overview

Voltage drop/variation
dynamic compensation

Harmonic mitigation

Reactive power compensation
LV reactive power compensation components
Capacitor units

- Best solution for:
  - Low power factor
  - Power quality problems

- Benefits
  - Dry type design
  - Unique sequential protection system
  - ABB in-house metalized film

- Applications
  - Industrial and commercial networks
LV reactive power compensation components
Power factor controllers type RVC and RVT

- A key role player in the control and monitoring of power quality

- Benefits
  - Measurement and display of key parameters
  - Easy to use thanks to user-friendly interface
  - Easy commissioning
  - Usable in LV and MV networks

- Applications
  - Industrial and commercial networks
LV reactive power compensation solutions
Standard capacitor banks – contactor switched

- The ideal automatic power factor correction solution for steady state or slowly varying loads requiring power factor compensation

- Benefits
  - Powerful and compact
  - Easy to install and use thanks to the RVC controller
  - ABB CLMD capacitors technology
  - Detuning reactors
  - Wall-mounted and free-standing floor mounted cubicles

- Applications
  - Industrial and commercial networks
LV reactive power/voltage drop compensation
Thyristor switched reactive power compensators

- Ultra-rapid transient free power factor compensation and voltage fluctuation mitigation

- Benefits
  - No transient thanks to thyristor switched technology
  - ABB CLMD capacitors technology
  - Can be connected up to 690V
  - Modular and compact standardized design
  - Easy to install and extend
  - Advanced communication features with Modbus

- Typical application: lifting devices
LV reactive power/voltage drop compensation
Stepless reactive power compensators – PQC-STATCON

- Instantaneous stepless power electronics based dynamic compensator for reactive power and unbalanced loads

- Benefits
  - Improves the reliability of existing capacitor banks under dynamic conditions
  - Reduces system losses and carbon footprint
  - Reduces maintenance need and enhances life of electrical installations

- Applications:
  - Inductive and capacitive loads
  - Highly fluctuating loads …
LV harmonic filtering solutions
Active harmonic filters PQF

- Ultimate answer to tough Power Quality problems caused by harmonics, load unbalance and reactive power demand

- Benefits
  - Unprecedented filtering efficiency thanks to closed loop control system
  - Individual harmonic selection
  - Stepless reactive power compensation
  - Load balancing in 3 and 4-wire systems
  - Full redundancy

- Applications
  - Small, medium or large applications
  - Industrial and commercial installations
MV/HV portfolio/applications
Overview

- Reactive power compensation banks
- Harmonic filtering
- Reactive power compensation
MV/HV reactive power compensation components

Capacitor units

- Very beneficial in power grids thanks to reactive power compensation

- Benefits
  - All types of fuses technologies
  - Low dielectric losses and long life time
  - High reliability thanks to folded edges of the electrode
  - Low installation and maintenance costs

- Applications
  - All types of power grids and industrial installations
Accessories
Capacitor controller type CQ900

- Low cost and reliable method to switch pole-mounted capacitors

- Benefits
  - Accurate sampling, measurement & decision making thanks to fast onboard micro-processor
  - Advance automatic switching
  - Flexible mounting options
  - Fully user programmable
  - Real-time monitoring

- Applications
  - Switching of pole-mounted capacitors
Accessories
Capacitor meter type CB2000

- Portable capacitance meter
- Benefits
  - No disconnection of the capacitor banks
  - Ergonomic and compact design
  - Low weight
  - Own battery system
  - LDC display
  - Easy transfer of values to a PC via USB
  - Short-circuit proof
- Applications
  - High power capacitor banks
MV reactive power compensation solutions
Metal enclosed capacitor banks – contactor/vacuum switched

- Fully integrated solution for reactive compensation

- Benefits
  - Range of enclosure types to suit a variety of applications
  - Reduced life cycle costs thanks to ABB design
  - Protected life parts
  - Modular design fully expandable
  - Can be moved as plant demands change

- Applications
  - Electrical distribution and large industrial power users

Optimized models for local markets
Power Quality
Series Compensation Installation for Distribution Grid/Railway
MV/HV reactive power compensation solutions
Pole-mounted capacitor banks - Qpole

- Economical solutions for shunt reactive compensation on overhead distribution networks
- Benefits
  - Fixed or switched system
  - Galvanized steel or aluminium frame suitable for pole mounting
  - Increased safety and reliability thanks to bird guards
- Applications
  - Voltage stability
  - Reactive compensation
  - Volt-var management
HV reactive power compensation solutions
Open-rack capacitor banks - QBANK

- Reactive compensation in all types of power grids

- Benefits
  - Reliable operation in all climates
  - Tailor cost effective
  - Environmentally friendly
  - Compact design
  - Easy to install and maintain
  - Optimal solution for each unique installation

- Applications
  - Small and large installations all over the world
MV/HV harmonic filtering solutions
Ultimate answer to tough MV/HV power quality problems

- Passive solution for addressing harmonic problems

- Benefits
  - ABB expertise to measure and analyse the harmonic content
  - Suggestion of the most efficient solution to reduce harmonics
  - Complete package
  - Reliable operation in all climates

- Applications
  - Small and large MV and HV applications
Success stories
Project Case-Guiyang Aluminum

Power System

- Sd(min) 12660.25MVAR
- DC load:
  - Active 272MW
  - Reactive 89Mvar
- AC load
  - Active 23MW
  - Reactive 12Mvar
- 5 Rectifiers, 12 pulse per rectifier, totally 60 pulses
- Power factor 0.87, target: 0.92～0.984 (5 rectifiers) 0.91～0.96 (4 rectifiers).

<table>
<thead>
<tr>
<th>Customer</th>
<th>Guiyang Aluminum</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>220kV network</td>
</tr>
<tr>
<td>Operating date</td>
<td>2005-2011</td>
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</tbody>
</table>
### Success stories

#### Project Case - Guiyang Aluminum

<table>
<thead>
<tr>
<th>Branch</th>
<th>5\textsuperscript{th}</th>
<th>7\textsuperscript{th}</th>
<th>11\textsuperscript{th}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>TALA22-5400/450BLW</td>
<td>TALA22-3600/300BLW</td>
<td>TALA22-5400/450BLW</td>
</tr>
<tr>
<td>Capacity kvar</td>
<td>5400</td>
<td>3600</td>
<td>5400</td>
</tr>
<tr>
<td>Capacitance $\mu$F</td>
<td>20.7</td>
<td>13.8</td>
<td>20.7</td>
</tr>
<tr>
<td>Capacity /unit kvar</td>
<td>450</td>
<td>300</td>
<td>450</td>
</tr>
<tr>
<td>Rated voltage kV</td>
<td></td>
<td>8.32</td>
<td></td>
</tr>
<tr>
<td>Series &amp; parallel</td>
<td></td>
<td>2 S 2 P</td>
<td></td>
</tr>
<tr>
<td>Protect Type</td>
<td></td>
<td>Double-star unbalance current protection</td>
<td></td>
</tr>
<tr>
<td>Inductance mH</td>
<td>19.68</td>
<td>15.14</td>
<td>4.21</td>
</tr>
</tbody>
</table>
Success stories
Project Case-Guiyang Aluminum

Benefit to Customer

**Power factor increases** from 0.87 to above 0.93 (meet power department requirement)

**Reduce harmonic**: decrease the electrolytic aluminum time, electrolyzer overhaul cycle lengthened. Electrolytic aluminum productivity increased.

Running in later stage

- As for electrolytic aluminum electrolytic copper factory, adopt strong direct current electrolysis. So, the magnetic inductance of electromagnetic to nearby metal objects have to be taken into consideration. Magnetic metal as racks, accessories are not allowed.
Harmonics current comparison before and after filter

<table>
<thead>
<tr>
<th>Harmonics</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>27.6</td>
<td>1.6</td>
</tr>
<tr>
<td>7</td>
<td>12.1</td>
<td>0.6</td>
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<tr>
<td>11</td>
<td>85.5</td>
<td>2.3</td>
</tr>
<tr>
<td>13</td>
<td>55.9</td>
<td>8</td>
</tr>
<tr>
<td>17</td>
<td>4.8</td>
<td>1.1</td>
</tr>
<tr>
<td>19</td>
<td>3.2</td>
<td>0.8</td>
</tr>
<tr>
<td>23</td>
<td>30.4</td>
<td>8.3</td>
</tr>
<tr>
<td>25</td>
<td>23.8</td>
<td>6.7</td>
</tr>
</tbody>
</table>
## Success stories

### Project Case - Guiyang Aluminum

<table>
<thead>
<tr>
<th>Solution</th>
<th>H3 filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TAL10-6600/550-AKW</td>
</tr>
<tr>
<td>Number</td>
<td>3</td>
</tr>
<tr>
<td>Protection</td>
<td>Open Delta</td>
</tr>
<tr>
<td>Output power</td>
<td>5 Mvar/set (At 10kV)</td>
</tr>
</tbody>
</table>

| H5 filter         |                                                                           |
| Number            | TAL10-3000/500-AKW                                                       |
| Protection        | 3                                                                         |
| Output power      | Open Delta                                                               |
| Number            | 2 Mvar/set (At 10kV)                                                     |
Success stories
Project Case-Guiyang Aluminum

After Compensation PF: 0.975
Filtering effect THDu: 0.122%
Success stories

Project Case-Chiba
### Success stories

#### Project Case - Chiba

<table>
<thead>
<tr>
<th>System</th>
<th>Mode 1 (3-635V-19.04kA)</th>
<th>Mode 2 (4-615V-15.23kA)</th>
<th>Mode 3 (3-520V-19.04kA)</th>
<th>Mode 4 (4-498V-15.23kA)</th>
<th>Mode 5 (3-505V-4.08kA)</th>
<th>Mode 6 (4-505V-4.08kA)</th>
<th>Mode 7 (3-435V-4.08kA)</th>
<th>Mode 8 (4-435V-4.08kA)</th>
<th>Mode 9 (2-635V-19.04kA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11kV voltage factor</td>
<td>1.05, 1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
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</tr>
<tr>
<td>Running branch</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
<td>5.7, 11</td>
</tr>
<tr>
<td>Stopped branch</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
<td>13, 13</td>
</tr>
<tr>
<td>PF</td>
<td>0.971, 0.986</td>
<td>0.998</td>
<td>0.947, 0.967</td>
<td>0.967, 0.996</td>
<td>0.953, 0.968</td>
<td>0.955, 0.967</td>
<td>0.924, 0.935</td>
<td>0.935, 0.948</td>
<td>0.852, 0.864</td>
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<tr>
<td>System voltage distortion (kV)</td>
<td>0.31, 0.27</td>
<td>0.23</td>
<td>0.31</td>
<td>0.27</td>
<td>0.37</td>
<td>0.48</td>
<td>0.37</td>
<td>0.48</td>
<td>0.41</td>
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<tr>
<td>11kV voltage factor</td>
<td>1.05, 1.05</td>
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<td>1.05</td>
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<td>1.05</td>
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<tr>
<td>Running branch</td>
<td>5.7, 13</td>
<td>5.7, 13</td>
<td>5.7, 13</td>
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<tr>
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<td>/</td>
<td>/</td>
<td>/</td>
<td>/</td>
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<tr>
<td>PF</td>
<td>0.98, 0.984</td>
<td>0.989</td>
<td>0.953, 0.968</td>
<td>0.968</td>
<td>1.64, 1.684</td>
<td>1.729</td>
<td>1.642, 1.678</td>
<td>1.722</td>
<td></td>
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<tr>
<td>THDu%</td>
<td>1.646, 1.684</td>
<td>1.729</td>
<td>1.642, 1.678</td>
<td>1.722</td>
<td>0.55, 0.48</td>
<td>0.37</td>
<td>0.55, 0.48</td>
<td>0.48</td>
<td>0.41</td>
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<tr>
<td>System voltage distortion (kV)</td>
<td>0.14, 0.12</td>
<td>0.1</td>
<td>0.14</td>
<td>0.12</td>
<td>0.14</td>
<td>0.12</td>
<td>0.14</td>
<td>0.12</td>
<td>0.1</td>
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<tr>
<td>11kV voltage factor</td>
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<td>1.05</td>
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<tr>
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<td>5.7</td>
<td>5.7</td>
<td>5.7</td>
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### Success stories

#### Project Case - Chiba

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**メモ:**
- P1: 5.970MW, Q: 12.639Mvar
- P2: 6.158MW, S: 22.153MVA
- P3: 6.068MW, PF: 0.8213
- P: 18.195MW, f: 49.926 Hz
- WP: 0.000MW, 0:00:00

**注:**
- PLL: 50Hz
- インターバル: 10m
- タイムスタンプ: 2013/04/14 11:20:56
Success stories
Project Case-Malaysia Samalajue 275kV Filter bank
Success stories
Project Case-Malaysia Samalajue 275kV Filter bank
1.1. For capacitor bank analysis
1.1.1. Parameters design of the components:
   · Capacitor bank
   · Reactor
   · Arrester
   · Magnetic Voltage Transformer
   · Current transformer
   · Earthing switch
1.1.2. Characteristic curve of MFC Frequency – Impedance
1.1.3. Modeling the capacitor bank by PSCAD
1.1.4. Inrush current analysis
1.1.5. Transient voltage analysis
1.1.6. Insulation coordination calculation

1.2. For power system
1.2.1. Power factor & Voltage rise analysis
1.2.2. Resonance analysis
   · Harmonic resonance frequency calculation
   · Frequency scan by PSCAD model with 4*100Mvar bank operating
1.2.3. Harmonic analysis

Success stories
Project Case-Malaysia Samalajue 275kV Filter bank
Success stories
Project Case-Malaysia Samalajue 275kV Filter bank

Fig 4.2 Frequency scan result of 2018Light A1B1C1 case

Fig 6.2 Inrush current of 2017Peak A2B2C3 with 1'H3 filter

Fig 6.9 Restrike voltage in case 2016Light A1B1C1 with 1'H3 filter

Fig 6.13 Simulation result of TRV on 3-phase fault
Success stories
Project Case - Malaysia Samalajue 275kV Filter bank

Fig 6.20 Power factor simulation result of 2016_light A1B1C1

Fig 6.19 Steady state voltage rise calculation result of 2017_A2B2C4

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<tr>
<th>Operation Case</th>
<th>ABB Xian Result</th>
<th>ABB PSC Result (R2)</th>
<th>ABB PSC Result (R3)</th>
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<td>3.23%</td>
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<td>1*H5 filter</td>
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Success stories

Project Case - Malaysia Sakura

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<td>Rated capacity(Mvar)</td>
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<td>H4 Filter</td>
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Success stories
Project Case-China Baiyin

- 2015.09: Big Noise With 7th filter Operating
- 2015.09: ABB Engineer check and exclude the product quality reason
- 2015.10: ABB PQC engineer do the PQ test
- 2015.11: ABB PQC provide simulation & Solution
- 2015.12: Installed the protection equipment, Noise disappear
- 2015.12: ABB PQC provide the PQ test and simulation again and operating suggestion
- 2016.01: Customer follow ABB’s suggestion, Succeed.
Power and productivity for a better world™