Multi Objective Optimization of Medium Voltage Reclosers
A global leader in power and automation technologies
Leading market positions in main businesses

- 145,000 employees in about 100 countries
- $39 billion in revenue (2012)
- Formed in 1988 merger of Swiss and Swedish engineering companies
- Predecessors founded in 1883 and 1891
- Publicly owned company with head office in Switzerland
How ABB is organized
Five global divisions

- **Power Products**
  - $10.7 billion
  - 36,000 employees

- **Power Systems**
  - $7.9 billion
  - 20,000 employees

- **Discrete Automation and Motion**
  - $9.4 billion
  - 29,000 employees

- **Low Voltage Products**
  - $6.6 billion
  - 31,000 employees

- **Process Automation**
  - $8.2 billion
  - 27,000 employees

(2012 revenues)

- **ABB’s portfolio covers:**
  - Electricals, automation, controls and instrumentation for power generation and industrial processes
  - Power transmission
  - Distribution solutions
  - Low-voltage products
  - Motors and drives
  - Intelligent building systems
  - Robots and robot systems
  - Services to improve customers productivity and reliability
Innovation is key to ABB’s competitive advantage.
Leadership built on consistent R&D investment.

- More than $1.4 billion invested annually in R&D
- 8,000 scientists and engineers
- Collaboration with 70 universities
  - MIT (US), Tsinghua (China), KTH Royal Institute of Technology (Sweden), Indian Institute of Technology (New Delhi), ETH (Switzerland), Karlsruhe (Germany), AGH University of Science and Technology (Poland)
GridShield
Three-Phase Vacuum Recloser
Multi-Objective Optimization of MV Reclosers
GridShield Recloser

- The ABB 3-phase GridShield® recloser is a well know medium voltage protection device in which single coil actuators are used main component driving the opening and closing the device.
- It has the ability to perform as a recloser, sectionalizer or automated load break switch.
- The proven design is rated for 10,000 full load operations.
Multi-Objective Optimization of MV Reclosers
GridShield Recloser

- The Electromagnetic actuators of ABB 3-phase GridShield® recloser are powered by suitable Electronic Control Units enabling safe COC cycles all over the temperature ranges.
Multi-Objective Optimization of MV Reclosers

Operating Principle
Multi-Objective Optimization of MV Reclosers

Operating Principle

[Diagram showing a power distribution system with CB (Circuit Breaker), Sect. (Sectionalizer), and R (Recloser). The diagram indicates a fault scenario with 4 operations to lockout and 3 count sectionalizer.]
Medium Voltage Reclosers
Actuators Optimization
Cost efficiency & Robustness!

Excellent switching properties

We have to be fast… but not too fast..

We have to be efficient…

We have to enable high life time…

…
Multi-Objective Optimization of MV Reclosers
Actuators Optimization

- Optimization based on Numerical Simulation
- Design A
- Optimization based on Hardware in the Loop Simulation
- Design B
Multi-Objective Optimization of MV Reclosers
Numerical Simulation Optimization
Multi-Objective Optimization of MV Reclosers

Numerical Simulation Optimization

- Example of optimization results using LiveLink for Matlab and modeFrontier MOGAII optimization algorithm
  - Permanent Magnet volume
  - Geometry optimization as a function of different design parameters and constraints

![Graphs showing optimization results](attachment:graphs.png)
Multi-Objective Optimization of MV Reclosers

HIL Optimization

Hardware in the Loop
Multi-Objective Optimization

Real Time Target

Real Time Interface

FPGA Control Loop

Power Amplifier

GriedShield Recloser

TCP/IP

PWM

Va

la

Xa

Ca

Host PC
Measurement, Control and Postprocessing

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Multi-Objective Optimization of MV Reclosers
HIL Optimization

1 – Start LabView
2 – Deployment process
3 – Closing operation
4 – Dead time close/open
5 – Opening operation
6 – Stop LabView
7 – Postprocessing Matlab
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HIL Optimization

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Conclusion
Multi-Objective Optimization of MV Reclosers

Conclusion

- Multi-objective optimization platform (based on numerical modelling and real prototype) for medium voltage reclosers.

- The influence of different design parameters is analyzed in order to enable robust and cost efficient design of switching devices.

- modeFRONTIER represents the main integration platform for multi-objective optimization of ABB mechatronic products.
Power and productivity for a better world™

ABB