ABB High Voltage Products
Live Tank Circuit Breakers
# Outline

## Circuit Breakers

<table>
<thead>
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<th>Outline</th>
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<tr>
<td>- Product Portfolio</td>
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<td>- New spring drive type MSD</td>
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<td>- New design for LTB245E1 breakers</td>
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<td>- New high voltage circuit breakers with CO2</td>
</tr>
<tr>
<td>- Summary</td>
</tr>
</tbody>
</table>
Live tank circuit breakers
Portfolio
Product Portfolio
Circuit breakers for all applications

Standard applications
- Overhead lines
- Transformer
- Capacitor banks
- Harmonic filters
- Shunt reactors

Special applications
- “Tailor made” solutions

We can meet all customer needs
**LTB family**

For high performance

Low operating energy

<table>
<thead>
<tr>
<th>Type</th>
<th>LTB 72.5-170D1/B</th>
<th>LTB 72.5-245E1</th>
<th>LTB 362-550E2</th>
<th>LTB 800E4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5-170 kV</td>
<td>72.5-245 kV</td>
<td>362-550 kV</td>
<td>800 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>Up to 3150 A</td>
<td>Up to 4000 A</td>
<td>Up to 4000 A</td>
<td>Up to 4000 A</td>
</tr>
<tr>
<td>Breaking capacity</td>
<td>Up to 40 kA</td>
<td>Up to 50 kA</td>
<td>Up to 50 kA</td>
<td>Up to 50 kA</td>
</tr>
</tbody>
</table>
The HPL family
For extra high performance

High current capability

<table>
<thead>
<tr>
<th>Type</th>
<th>HPL 72.5-300B1</th>
<th>HPL 362-550B2</th>
<th>HPL 800B4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5-300 kV</td>
<td>362-550 kV</td>
<td>800 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>Up to 5000 A</td>
<td>Up to 5000 A</td>
<td>Up to 5000 A</td>
</tr>
<tr>
<td>Breaking capacity</td>
<td>Up to 80 kA</td>
<td>Up to 80 kA</td>
<td>Up to 80 kA</td>
</tr>
</tbody>
</table>
The DCB family
For a simplified substation

Increased availability
Reduced space
Lower costs

<table>
<thead>
<tr>
<th>Type</th>
<th>DCB LTB 72.5D1/B</th>
<th>DCB LTB 145D1/B</th>
<th>DCB HPL 170-245B1</th>
<th>DCB HPL 362-550B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5 kV</td>
<td>145 kV</td>
<td>170 - 245 kV</td>
<td>362 -550 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>3150 A</td>
<td>3150 A</td>
<td>4000 A</td>
<td>4000 A</td>
</tr>
<tr>
<td>Breaking capacity</td>
<td>40 kA</td>
<td>40 kA</td>
<td>50 kA</td>
<td>63 kA</td>
</tr>
</tbody>
</table>
Withdrawable Circuit Breaker

WCB

- Disconnecting function
- Fulfills all requirements for a circuit breaker as well as for a disconnector.
## The WCB family

<table>
<thead>
<tr>
<th>Type</th>
<th>WCB LTB 72.5 - 145</th>
<th>WCB LTB or HPL 245</th>
<th>WCB HPL 300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5 – 145 kV</td>
<td>245 kV</td>
<td>300 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>3150 A</td>
<td>3150</td>
<td>3150</td>
</tr>
<tr>
<td>Circuit-breaking capacity</td>
<td>40 kA</td>
<td>50 kA</td>
<td>50 kA</td>
</tr>
</tbody>
</table>
Controlled Switching
How does it work?

U_ref

Switchsync™

Substation control system
Switchsync™ product program

<table>
<thead>
<tr>
<th>Switchsync™ controller</th>
<th>Controls CB operation</th>
<th>Type of CB mechanism</th>
<th>Main application</th>
</tr>
</thead>
<tbody>
<tr>
<td>E113</td>
<td>Open or close</td>
<td>Three-pole operation</td>
<td>Capacitor banks, shunt reactors</td>
</tr>
<tr>
<td>E213</td>
<td>Open and close</td>
<td>Three-pole operation</td>
<td>Capacitor banks</td>
</tr>
<tr>
<td>F236</td>
<td>Open and close</td>
<td>Single-pole operation</td>
<td>Capacitor banks, shunt reactors, transformers</td>
</tr>
<tr>
<td>T183</td>
<td>Close</td>
<td>Single-pole operation</td>
<td>Transformers</td>
</tr>
<tr>
<td>L183</td>
<td>Close</td>
<td>Single-pole operation</td>
<td>Transmission lines (uncompensated)</td>
</tr>
</tbody>
</table>

![Switchsync™ controller images](E213, F236, T183, L183)
New spring drive type MSD1
MSD Function

“...Within a few milliseconds an operating mechanism must supply the energy needed to transform the circuit breakers from a perfect conductor to a perfect insulator”
Both opening and closing springs are contained inside the drive

- Improved robustness
- Adjustment free installation

Used for the lower voltage range:

- LTB D, 72.5 – 170 kV  Single- and three-pole operation
- LTB 245 E1  Single-pole operation
MSD
Improved robustness

- Designed with a minimum of components
- No risk of overchanging
- Energy efficient solution
- Based on the well-proven technology for ABB spring drives
Spring operating mechanism
MSD1
MSD
No risk of overcharging

- Fool proof design
- Not possible to overcharge the springs due to a mechanical stop and torque limiter
MSD
Harmonization of installation and service

- 15NO + 15NC available auxiliary contacts
- 2 opening coils + 1 closing coil (2 closing coils also possible)
- Protection degree IP55
- Extra painting thickness also possible (120um)
- O-0,3s-CO-3min-CO (t’=15sec is also possible)
New design circuit breaker type LTB245E1 – single pole operation
A new generation of HV circuit breakers

LTB 245E1
What’s the news?

- Breaking chamber with “full” double motion
- (New effective auto-puffer™ breaking chamber)
  - Low opening speed
- Makes it possible to use the new spring operating mechanism MSD1
- Optimized linkage
Breaking chamber
Auto-Puffer™ Design

- Full double motion gear
- New puffer design
Breaking chamber
Auto-Puffer™ Design

Open position

Close position
Breaking Chamber
Auto-Puffer™ Design

Auto-Puffer volume

Puffer volume
Optimized Linkage
Optimized Linkage

Close position

Open position
MSD
Adjustment free installation

- Plug and play solution
- The drive is attached directly to the mechanism housing
LTB245E1
Easier access to the drive

CCC solution

ICC solution
LTB245E1
Ratings

Rated voltage: 245kV
Rated Current: 4000A
Rated Icc: 50kA
LIWL: 1050kVp
PFWL: 460kV
Extend LIWL: 1200kVp
Extend PFWL: 530kV
Rated seq: O-0,3s-CO-3’-CO
Mech. Class: M2
Cap. Class: C2
Insulator: Porcelain or Polymeric
Live tank circuit breakers
Low environmental impact – CO2
Circuit Breakers
Low environmental impact over lifecycle
Design, purchase and manufacturing

- Light weight designs and materials – low kg/kV and kA rating
- Reduced volume of SF$_6$ gas – low kg/kV and kA rating
- Environment audits of suppliers
- Factories certified for environment systems – ISO 14001
Low environmental impact over lifecycle
Field operation

Best practices

- Low resistive losses due to special designs and material choices
- Low drive energy - replacement of large hydraulic drives by compact mechanical drives
- Minimized $\text{SF}_6$ gas leakage rates with special sealing systems
Low environmental impact over lifecycle
Evolution of single line configuration with DCB (72 kV)

- **SF₆ gas**
- **LTB + Disconnectors**
  - 255 300 kg
  - CO₂ equiv.

- **SF₆ DCB**
  - 120 000 kg
  - CO₂ equiv.

- **CO₂ DCB**
  - 100 000 kg
  - CO₂ equiv.
ABB developing alternative gas platform
- LTB & DCB using CO$_2$
- Developed from ABB’s highly efficient SF$_6$ interrupter technology with low loss copper contacts
- Common components with SF$_6$ platform
  - MSD1 mechanical spring drive
  - Insulators, linkages, structure, castings

Continued focus on low environmental impact solutions with high ratings and compact design
Each new 72.5 kV LTA breaker has the potential to reduce CO\textsubscript{2} emissions by 10 tons through the product life cycle – which is 18 percent less than its predecessor.
Comparisson between SF6 and CO2

<table>
<thead>
<tr>
<th>Gas</th>
<th>SF$_6$</th>
<th>CO$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular Weight</td>
<td>146.06</td>
<td>44.01</td>
</tr>
<tr>
<td>Density</td>
<td>kg/m$^3$</td>
<td>5.9</td>
</tr>
<tr>
<td>GWP 1)</td>
<td>kg</td>
<td>23900</td>
</tr>
<tr>
<td>Chemical Stability</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Dielectric Strength</td>
<td>%</td>
<td>100</td>
</tr>
</tbody>
</table>

1) Global Warming Potential
Polymeric Insulators

- Explosion proof
- Non-brittle
- Excellent insulation
- Low weight
- Maintenance free
- Outstanding seismic performance

Excellent insulation performance
LTA 72 kV
Technical data based on our latest interrupter technology

Main characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5/84 kV</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Breaking current</td>
<td>31.5 kA</td>
</tr>
<tr>
<td>Continuous current</td>
<td>2750 A</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-50/+40 °C</td>
</tr>
<tr>
<td>Operation</td>
<td>Three-pole</td>
</tr>
</tbody>
</table>

Similar ratings as a conventional SF₆ circuit breaker!
LTA 72 Disconnecting Circuit Breaker

Technical data

- Similar ratings as a conventional SF$_6$ disconnecting circuit breaker!

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<tr>
<th>Main characteristics</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5 kV</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Breaking current</td>
<td>31.5 kA</td>
</tr>
<tr>
<td>Continuous current</td>
<td>2750 A</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-50 /+40 °C</td>
</tr>
<tr>
<td>Operation</td>
<td>Three-pole</td>
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</tbody>
</table>
LTA next step for development

<table>
<thead>
<tr>
<th>Main characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>145 kV</td>
</tr>
<tr>
<td>Frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Breaking current</td>
<td>31,5 kA</td>
</tr>
<tr>
<td>Continuous current</td>
<td>2750 A</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-50/+40°C</td>
</tr>
<tr>
<td>Operation</td>
<td>Three-pole</td>
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</tbody>
</table>
145 kV Pilot project C0₂
Installed in 2010

Installed for Vattenfall Utility
March 2010
Capacitor bank application

Main characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>145 kV</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>Rated short-circuit current</td>
<td>31.5 kA</td>
</tr>
<tr>
<td>Capacitive switching factor</td>
<td>1.4</td>
</tr>
<tr>
<td>Rated current</td>
<td>3150 A</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-50 °C</td>
</tr>
<tr>
<td>Tested according to IEC 62271-100</td>
<td></td>
</tr>
<tr>
<td>Composite insulators</td>
<td></td>
</tr>
</tbody>
</table>
Summary
Summary

- Spring drive – low operating energy, long endurance
- Simplified installation for new LTB245E1 design
- Proven interrupter – capacity in rating, nominal current etc
- Alternative gas platform
- Gas handling – no special measures required
- Low resistive losses for CO2 breakers, same as SF$_6$ breaker losses
- Service concept – simple gas control, no special commissioning training
Power and productivity for a better world™