Annie-Qingwen Guo, Chief Engineer, ABB Xi’an Power Capacitor Co., Ltd., November, 2016

New UHV Capacitor with Low Noise, Small Footprint, Anti-seismic
ABB capacitors & filters
Focus on technology knowhow & customer needs

1910S
Acquired Liljeholmens

1920S
Entered Capacitor Field

1930S
to produce series capacitor s, and promote to the world

1950S
Innovate internal fuse tech

1960S
Design & produce HVDC capacitors

1970S
World 1st of commercial thyristor-switched capacitor installation

2000S
to serve global needs
ABB capacitors & filters
Worldwide footprint to close to customer needs
ABB Xi’an Power Capacitor
Global feeder factory
ABB Xi’an Power Capacitor
Products and service

Capacitor unit
Design for heavy load operation, three configuration of fuse. Single/three-phase. Maximum output: 1200 kvar

Shunt capacitor installation
Improve power factor, reduce the network losses. Compact design, full protection and easy maintenance

Filter capacitor installation
Reduce the harmonic content in the network and improve the power quality

Series capacitor installation
Improve transmission capability, reduce loss, improve the stability of power grid

Capacitor installation for HVAV & HVDC
Reduce harmonics, supply reactive power, improve transmission capacity.

Low voltage power quality
Low voltage power factor correction components and solution; low voltage power active filter.

Accessories
The range of high quality accessories for capacitor applications

Services
Installation and test, spare part, maintenance and on-site service, training, etc.
HVDC capacitors
HVDC capacitors
Improve system capacity and power quality
ABB DC filter capacitors for HVDC project
Design feature

- For 1100kV DC filter capacitor, C1 capacitance is 0.6uF, and adopts single stack design, which is similar to one capacitor stack of 800kV project, with 29 layers and 24.5m in height. The unit storage energy capacity is 3.88kJ.

- 800kV DC filter capacitor banks are usually 30 layers, and 3 stacks facing each other. Rigid connections between the layers to achieve best mechanical properties and seismic performance.

- In 500kV Huaxin/Yidu convert station, ABB DC filters adopt unit of DAM14.442-41.6W with the storage energy capacity of 4.34kJ.

- Yulong convert station adopts ABB DC capacitors of DAM24.34-11.6W, with the storage energy capacity of 3.44kJ, which gives reliable operation with no failure.

- Able to offer bigger internally fused capacitor unit, with small footprint, and less maintenance workload.
- Tailor made design
  To meet different customer requirements, on different structures like standing type, hanging type, three stacks, twin stacks or single stack structures, as well as different voltages including 500kV, 800kV, 1100kV and different capacitance requirements.

- High precision of equalizing resistance
  DC capacitor bank requires high precision of equalizing resistance to ensure reliable operation. ABB strictly guarantees the equalizing resistor deviation does not exceed $\pm 1\%$, while for other competitors, this configurator is bigger. The deviation of Vishay capacitors operating in CSG 800kV Yunguang project is about 15%, with high failure rate.

- Capacitor unit is with large energy storage capacity, up to 5kJ/unit, while domestic product is up to about 3.4kJ/unit

- special DC film
  Special material to ensure product reliability. ABB DC capacitors has been operating in many projects worldwide.

- Advance noise reduction technology
ABB AC filter capacitor for HVDC system
Design feature

- Single bank with bigger capacity. Operation installed capacity is up to 480Mvar.

- Larger capacitor unit, less maintenance workload.
  - Actual operated largest unit capacity is 890kvar.

- More units for one phase, maximum 180 units for one phase in actual operated projects.

- Advanced noise reduction technology (optional according to customer requirements)
  - Apply ABB noise reduction technology inside capacitors, i.e. add advanced damping noise reduction element;
  - Externally add rubber pad in the position of lifting lugs, and damping noise reduction gasket between capacitors and racks;

- After seismic analysis by Xi’an Jiao Tong University, the installation meet the seismic requirements;

- The installation adopts double tower structure, and new type of electrical connection.
ABB AC capacitors feature

- Patent internal fuse technology
  AC filter capacitor C1 adopt internal fuse capacitors, which ABB has more than 80 years of history, and has first patented technology.

- High reliability
  Using high quality imported raw materials including fuse, good product structure and advance process, to ensure product quality and reliability.

- Zero failure rate
  Since Y2002, ABB Xi’an started offering AC filter capacitors to Three Gorges HVDC projects. Many of them has been operating more than 10 years with zero failure rate among tens of thousands of capacitor units.

- ABB fuseless patented technology applied for C2 and C3.
  Compared with conventional fuseless technology, it is more reliable and ensures longer lifetime.

- Bigger unit, less footprint. ABB biggest unit is 1000kvar, while domestic unit is about 500kvar~600kvar

- Advance noise reduction technology.
Design feature
Bigger capacitor help customer save costs

- 2 x 350 kvar
- 1 x 700 kvar

- Same field strength
- Same raw material
- Saving installation workload
- Saving insulation materials (e.g., Bushings, Dielectric medium etc.)
- Less footprint
±800kV Jinping - Sunan HVDC project
Yulong convert station DC filter capacitors

<table>
<thead>
<tr>
<th>Customer</th>
<th>SGCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>800kV UHV DC system</td>
</tr>
<tr>
<td>Substation</td>
<td>Yulong convert station</td>
</tr>
<tr>
<td>Delivery time</td>
<td>Y2012</td>
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</table>

<table>
<thead>
<tr>
<th>Capacitor specification</th>
<th>unit</th>
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<tbody>
<tr>
<td>HP12-24</td>
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<tr>
<td>C1 DAM23.88-10.15W</td>
<td>244</td>
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<tr>
<td>C2 AAM17.67-477</td>
<td>15</td>
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<tr>
<td>HP2-39</td>
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<tr>
<td>C1 DAM24.34-11.6</td>
<td>487</td>
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<tr>
<td>C2 AAM20.4-597</td>
<td>83</td>
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<tr>
<td>Neutral bus capacitor</td>
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<td>DAM14.2-34</td>
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<td>Blocking capacitor</td>
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<td>ZAM20-0.52</td>
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</table>

Altitude of Yulong convert station is 1,850M, which is the functioning ±800kV convert station with the highest altitude in the world.
±800kV Xiluodu - Zhexi HVDC project
Jinhua convert station DC filter capacitors

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<tbody>
<tr>
<td>System</td>
<td>800kV UHV DC system</td>
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<tr>
<td>Station</td>
<td>Jinhua convert station</td>
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<td>Delivery time</td>
<td>Y2013</td>
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<th>Capacitor specification</th>
<th>Unit</th>
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<tr>
<td>HP12-24</td>
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<tr>
<td>C1</td>
<td>DAM11.94-20.3W</td>
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<td>C2</td>
<td>AAM16.799-288</td>
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<td>DAM14.424-15W</td>
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<td>DAM16-0.52W</td>
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### HVDC DC capacitors sales reference

<table>
<thead>
<tr>
<th>Project</th>
<th>Year</th>
<th>Convert station</th>
<th>Customer</th>
<th>Highlight</th>
</tr>
</thead>
<tbody>
<tr>
<td>±800kV Jinbei – Nanjing HVDC</td>
<td>2015</td>
<td>Nanjing</td>
<td>SGCC</td>
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<tr>
<td>±800kV Ximeng – Taizhou HVDC</td>
<td>2016</td>
<td>Ximeng</td>
<td>SGCC</td>
<td>Low temperature requirement: minus 42°C</td>
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<tr>
<td>±800kV Dianxibei – Shenzhen UHVDC</td>
<td>2016</td>
<td>Dongfang</td>
<td>CSG</td>
<td>Hanging type design, big capacitor unit and noise reduction solution</td>
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<tr>
<td>±1100kV Changji – Guquan UHVDC</td>
<td>2016</td>
<td>Changji</td>
<td>SGCC</td>
<td>Current highest voltage in the world</td>
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±500kV Three gorges - Guangdong HVDC project
Huizhou convert station AC filter capacitors

Customer | SGCC
System | 500kV UHV AC system
Delivery time | Y2003

<table>
<thead>
<tr>
<th>Filter bank</th>
<th>Unit specification</th>
<th>Unit</th>
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<tbody>
<tr>
<td>C1</td>
<td>AAM6.618-823-1W</td>
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<tr>
<td>C2</td>
<td>AAM12.285-609-1W</td>
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</tbody>
</table>

Reliable operation, fulfill system requirement
single tower structure, with height of 13m.
HVDC AC capacitors sales reference

±400kV HVDC
- 1. Qinghai – Tibet
  - Current highest altitude HVDC line, above 4000M, and cold area

±500kV HVDC
- 2. Guizhou – Guangdong
- 3. Three Gorges – Shanghai
- 4. Guizhou – Guangdong (II)
- 5. Northwest-Central China
- 6. Yunnan – Guangxi
- 7. Yongren – Funing

±800kV UHVDC
- 8. Yunnan – Guangdong
- 9. Nuozhadu – Guangdong
- 10. Hami – Zhengzhou
- 11. Ximeng – Taizhou
- 12. Shanghai – Shanghai

±1100kV UHVDC
- 13. Zhalute – Qingzhou
- 14. Changji – Guquan
Q & A

Thank you!
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