Olof Heyman, Vice President, Power Systems, HVDC

HVDC Presentation
What is an HVDC transmission system?

Why HVDC?
- Long cables
- Stabilize networks
- Low losses for long power transport
- Connecting countries or regions
ABB pioneered HVDC technology 60 years ago
World’s first history in short

- **1929**: Start HVDC R&D Dr. Uno Lamm
- **1954**: Commercial HVDC 150 kV, Gotland, Sweden
- **1970**: Pacific Intertie, USA, 400 kV
- **1980**: Itaipu, Brazil, 600 kV
- **1990**: HVDC Light 150 kV, Cross Sound Cable, USA
- **2000**: HVDC Light 3 kV, Hällsjön, Sweden
- **2010**: EWIC, 500 MW, Ireland-UK
- **2020**: Multiterminal NEA ±800 kV, 8,000 MW

Key Projects:
- **1929-1954**: Dr. Uno Lamm's research led to commercialization.
- **1990-2000**: Significant milestones including HVDC Light projects and grid extensions.
- **2010-2020**: Advanced technologies like UHVDC and hybrid DC breakers.

ABB continues to innovate with projects like DolWin1 and Multiterminal NEA.
ABB has supplied to more than half of the 190 HVDC projects
The track record of a global leader

60 HVDC Classic Projects since 1954 | 24 HVDC Upgrades since 1990 | 25 HVDC Light Projects since 1997
HVDC Applications

- Interconnecting grids
- DC links in AC grids
- Power from shore
- Connecting remote generation
- Offshore wind connections
Why HVDC interconnections
Skagerrak 4 HVDC Light® link at world-record 500-kV Norway – Denmark

**Customer’s need**
- Boost transmission capacity with 700 MW
- Use electricity more efficiently
- Enable networks to add more renewable energy

**ABB’s response**
- Two 700 MW HVDC Light stations
- 500 kV – new voltage record for the HVDC Light technology

**Customer’s benefits**
- Network stability and high reliability
- Balance power for CO2 reduction
- Quick grid restoration with black-start capability
HVDC – a lifetime commitment
Norway – Denmark

Skagerrak 1&2  Skagerrak 3  Upgrade 1&2  Upgrade 3

NordLink – facilitating efficient use of renewables
Norway – Germany

Customers’ need
- Meet EU’s target for CO₂ reduction
- Security of supply

ABB’s response
- Two 1,400 MW, ±525 kV HVDC Light® converter stations
- 525 kV DC subsea and land MI cables for over 200 km of the route

Customer’s benefits
- Daily and seasonal fluctuations in power demand can be met by using the other country’s renewable surplus power
- Higher availability
Global HVDC market prospect
Competitor landscape

HVDC know how

Partnership for access to market

Strategic partnership

Trend
Ambition
Transmission
Civil construction

ABB
Siemens
Alstom

SGCC
GE

Cobra
Bechtel

Kiewit
KBR

CET
Hitachi
XD

Toshiba
Hysong
LS IS
Major HVDC hubs around the world

- HVDC, Ludvika, Sweden
- INOPC, Chennai, India
- HVC, Karlskrona, Sweden
- CNDCB, Beijing, China
- CHSEM, Lenzburg, Switzerland
Multicultural Ludvika
48 nationalities, 25 percent non-Swedish

HVDC Ludvika

Employees 800
Consultants 300

Educational level:
Ph.D or M.Sc 50%
B.Sc. 25%
Other 25%
Technology on the edge

Hybrid DC breaker

MIT Technology Review recognizes ABB innovation among top 10 technologies

Development of hybrid HVDC breaker will help shape the power grid of the future.

Zurich, Switzerland, April 23, 2013 - ABB, the leading power and automation technology group, has been recognized by MIT Technology Review for its hybrid high-voltage direct current (HVDC) breaker, placing it among the ten most important technology milestones of the past year. This is an annual list highlighting the top ten breakthrough technologies the editors believe will have the greatest impact on the shape of innovation in the years to come.

"Since 2001, our editors have carefully selected the technologies poised to make the greatest impact on the shape of innovation in the years to come and the organizations leading the charge in those fields," said MIT Technology Review's Editor in Chief and Publisher, Jason Pontin. "ABB is helping to define the way we think about creating a practical, high-voltage high-current technology that can reliably overcome the challenges of renewable energy integration."

Polhem price 2014, Hans Björklund, Control and protection HVDC

Stora Teknikpriset 2008, 800kV DC

Polhem price 1999 Gunnar Asplund, HVDC Light

Uno Lamm, HVDC Founder 1929 - 1954
Power and productivity for a better world™