Tokyo, December 16, 2014

Hitachi and ABB

New HVDC value proposition for Japanese customers
Evolving Japanese power market
Japanese government’s ‘Amended Electricity Business Act’

Emerging market drivers

- Grid reliability and stabilization
- Innovation in power systems
- Increased need for integration of renewables
- Wide area power transmission grids and potential offshore wind connections
Japan will need to strengthen power grid
Challenge: strengthen long distance power transmission

Enhance grid reliability
Renewable energy integration
Asynchronous connections
50-60Hz reinforcement
More effective energy spot exchange

HVDC is key enabling technology
Hitachi and ABB
Two complementary players

Together – in an ideal position to bring new HVDC value proposition to Japanese customers

**Hitachi**
- Strong presence in Japanese market
- Sales network
- Project management
- Quality assurance
- Delivery performance
- Civil design and EPC experience

**ABB**
- Pioneered HVDC
- State-of-the art HVDC and VSC-based technology (HVDC Light)
- Domain competence
- Unmatched global experience
New JV fully in line with ABB’s Next Level strategy

Hitachi and ABB

ABB Next Level strategy

Strong presence in Japanese market
Sales network
Project management quality assurance
Delivery performance
Civil design and EPC experience

Partnership with Hitachi on HVDC technology

New HVDC value proposition for Japanese customers

Spirit

Complementing partners

Customer value

Incremental growth

Criteria

Fit of offering and capabilities

Leading players in their fields

Good cultural fit
Why HVDC?
A proven technology

Distinct advantages

Efficient bulk power transmission over long distances
Transmission technology of choice for large scale renewable integration
Higher transmission capacity/lower capital costs
Smaller transmission corridor
Interconnection of networks on different frequencies
Grid interconnections to balance loads and facilitate power trading
Instant and precise power flow control

Stronger, smarter, more flexible grids
Why HVDC Light?
Special features make it ideal for many evolving trends

In the 1990’s ABB pioneered a new type of HVDC technology – HVDC Light

Technology of choice for

- Offshore wind power integration
- Cross border interconnections
- Power supply to islands
- Shore supply to offshore platforms
- City center in-feed
- Embedded DC in AC to strengthen AC network
- Suited for future DC grid applications

Offshore power and interconnections
ABB pioneered HVDC technology 60 years ago

Key milestones

- The Gotland link: The world’s first commercial HVDC link
- Murraylink: The world’s longest underground transmission link
- Xiangjiaba-Shanghai: The world’s first 800 kV commercial UHVDC link
- Hybrid HVDC Breaker: Solving a 100-year old technology puzzle
- HVDC Light: The world’s first VSC-HVDC installation
- NorNed: The world’s longest subsea connection
- BorWin1: The world’s first HVDC offshore wind connection
- Extruded HVDC cable system: Record voltage 525 kV, the world’s most powerful – over 2 GW capacity

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ABB’s unique position in HVDC
Complete key technology offering

In-house manufacturing capability for converters, semiconductors, cables, and all major components in the power value chain
ABB – the track record of a global leader
Supplied to more than half the world’s 190 HVDC projects

60 HVDC Classic projects since 1954
20 HVDC upgrades since 1990
20 HVDC Light projects since 1997

Continuous innovation in HVDC

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Continuous innovation in HVDC Light

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<tr>
<td>Distance (km)</td>
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ABB’s HVDC Light has delivered 14 of the 15 commissioned HVDC Light type of projects in the world
ABB’s global track record of HVDC innovation

Examples

- **China**
  - World’s longest / highest power capacity – first 800 kV commercial link

- **Norway-Netherlands**
  - World’s longest underwater power link

- **Norway**
  - World’s first offshore platform connected to shore power

- **Australia**
  - World’s longest underground cable link
World record 2014
ABB’s new HVDC power transmission cable system

Capacity 1000 MW to 2600 MW
Voltage 320kV to 525 kV
Distance 1000 km to 1500 km

525 kV voltage sets world record for extruded HVDC cable technology, doubling power flow and extending range to enable greater integration of distant renewables and interconnections

Enough capacity to power Paris

A single pair of ABB’s latest 525kV HVDC extruded cable will be able to transmit up to 2.6 GW of power from renewable energy resources

2.6 GW capacity

...enough to serve the electricity needs of Paris, City of Lights
Innovative solutions for a changing grid
Introducing the world’s first hybrid HVDC breaker

Removes a major technical barrier for DC grids

Combines electro-mechanics with power electronics

Enables ultrafast interruption while keeping losses down – capable of interrupting 1 gigawatt of power, equivalent to a large power station

Scalable for voltages and currents

Enables isolation of faults on point-to-point transmission line
  - Continuous operation in SVC mode
  - Fast restoration of active power transmission
New Hitachi-ABB HVDC joint venture

Summary

- Strengthening of Japanese power grid offers significant opportunities for HVDC
- Hitachi and ABB: two players with highly complementary strengths
- Joint venture brings together global HVDC technology leadership with strong Japanese presence
- Enables the two partners to bring new HVDC value proposition to Japanese customers
Power and productivity for a better world™