Management of High Voltage DC Transmission Systems in Pakistan

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BY

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When to use High Voltage DC

- Large amount of power over long distances
- Long underground/submarine cables
- Reduced right of way requirements for poles
- Interconnection of asynchronous systems
Elaboration of HVDC Supporting Criteria

Distance

400 – 500 Miles
Distance vs Cost and Losses Consideration
Right of Way Considerations

±500kV DC

500kV AC

±500kV vs. 500kV AC

800 kV AC

±800kV vs. 800kV AC
Underground Cable Construction

1. Conductor of copper-shaped wires
2. Insulation material
3. Core screen
4. Lead alloy sheath
5. Polyethylene jacket
6. Reinforcement of steel tapes
7. Bedding
8. Armour of steel flat wires
Inverter Station Layout
HVDC Transmission Station Layout

1. Quadruple Thyristor Valve
2. Converter Transformer
3. Air Core Smoothing Reactor
4. Control Room and Control Cubicle
5. AC Filter Capacitor
6. AC Filter Reactor
7. AC Filter Resistor
8. Circuit Breaker
9. Disconnecter
10. Current Transformer
11. Voltage Transformer
12. Combined Current-Voltage Transformer
13. Capacitive Voltage Transformer
14. Surge Arrester
15. Earthing Switch
16. AC PLC Filter
Challenges

- Inverter Station Technology
- Thyristors Valves Construction
- Converter Transformers
- Harmonic Filters
- DC Filters
Harmonic Filters

DC Filters
Project Sequence

- Planning
- Feasibility Study to evaluate preference of AC and DC systems based on energy capacity and distance
- Detailed design: inverter station & transmission line components
- Construction of the system
- Test trial and operation
- Dispatch and control centers
- Continuous maintenance
Training of Personnel for Each Phase

- Planning
- Designing
- Project Management and Construction
- Operational Maintenance
- Control Centre Operations
Schedule of Project

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Training Strategy of NTDC Staff

- Experience of Germany and Sweden in design of inverter station and its components
- Experience of China in maximum number of HVDC projects
- Experience of USA and Canada in long distance interconnection of energy sources and load centers
- Japanese experience of connection 50 and 60 Hertz systems
Planned Future HVDC Projects by 2020 in China

(The year means project in operation)

- Irkutsk (Russia) - Beijing
  - 800kV, 6400 MW, 2015
- Humeng - Shandong
  - 800kV, 6400 MW, 2015
- Hami – C. China
  - 800kV, 6400 MW, 2018
- Xianjilaba – Shanghai
  - 800kV, 6400 MW, 2011
- Xiluodu - Hanzhou
  - 800kV, 6400 MW, 2015
- Xiluodu - Hunan
  - 800kV, 6400 MW, 2014
- Jinsha River II – East China
  - 800kV, 6400 MW, 2016
- Jingping – East China
  - 800kV, 6400 MW, 2012
- Jinsha River II – East China
  - 800kV, 6400 MW, 2019
- Jinsha River II - Fujian
  - 800kV, 6400 MW, 2018
- Nuozhadu-Guangdong
  - 800kV, 5000-6000 MW, 2015
- Jinghong-Thaiand
  - 3000MW, 2013
- Yunnan - Guangdong
  - 800kV, 5000 MW, 2009

- BtB China-Russia (HeiHe)
  - 750 MW, 2006
- NEPG
- FarEast (Russia) – NE China
  - 3000 MW, 2010
- Humeng - Liaoning
  - 800kV, 6400 MW, 2018
- Hulunbeir (inner Mongolia) - Shenyang
  - 3000 MW, 2010
- BtB Northeast-North (Gaoling)
  - 1500 MW, 2008
- North Shaanxi-Shandong
  - 3000 MW, 2011
- BtB Shandong - East
  - 1200 MW, 2011
- BtB North - Central
  - 1000 MW, 2012
- Gezhouba-Shanghai Expansion
  - 3000 MW, 2011
- Lingbao BtB Expansion
  - 750 MW, 2009
- Guangdong
  - 3000 MW, 2016

ABB

(indicative map)
Opportunity of HVDC Projects

- Thar Coal area to Punjab load centers
- Hydel generating stations in KPK in northern Pakistan and connection to central and south Pakistan
- 10,000 MW from South to North
- 20,000 MW from North to Central
- CASA 1000 from Central Asia to Pakistan
Getting the Best Deal for Pakistanis

- Competitive bidding between the leading technology suppliers
- Training of Pakistani engineers in Europe, America, Japan and China
- Long term and low cost loans from international donors to reduce energy costs to other countries in South East Asia