Introduction and Overview of HVDC: AC versus DC

Dr. Ram Adapa, Fellow IEEE
EPRI
radapa@epri.com

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Long Distance Transmission – AC versus DC

• AC versus DC debate goes back to beginnings of Electricity
  – DC was first (Thomas Edison)
  – AC came later (Tesla / Westinghouse)

• AC became popular due to transformers and other AC equipment

• Long Distance Transmission
  – AC versus DC - based on economics and technical requirements
Relative Cost of AC versus DC

• For equivalent transmission capacity, a DC line has lower construction costs than an AC line:
  – A double HVAC three-phase circuit with 6 conductors is needed to get the reliability of a two-pole DC link
  – DC requires less insulation
  – For the same conductor, DC losses are less, so other costs, and generally final losses too, can be reduced.
  – An optimized DC link has smaller towers than an optimized AC link of equal capacity.
AC versus DC: Break Even Distances

- The cost of a DC link depends on:
  - the cost of the substations
  - the cost of the line or cable

- HVDC is more economical than AC when the transmission distance:
  - is >300 miles for Overhead lines
  - is >30 miles for underground cables

Note: Assume right-of-way costs same for AC or DC
AC versus DC: Typical Breakeven distances

This graph is based on late 1990s technologies – old numbers are 500 miles but present breakeven distances are estimated as 300 miles for 2000 MW power transfer.

Source: Arrillaga (1998)
AC versus DC: Cost Comparison

When comparing costs for AC and DC, the following need to be considered:

- DC Converter / AC substation costs
- Line costs
- Corridor costs
- Operation & Maintenance costs
- Costs associated with losses (e.g. DC losses are lower than AC)

**Bottom line** – Complete life cycle cost should be considered over an estimated life span (30 to 40 years) of the equipment.
EPRI’s HVDC & FACTS Conference – August 28-29, 2013 @ EPRI, Palo Alto, CA

• Topics - HVDC & FACTS
• Participation - Utilities, Vendors, Academia
• Call for Papers
  – Abstracts due - June 28th
  – Full papers due – August 15th

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