The State of Technology in Various Industries

Underground Transmission Technology Is Proven, Fully Operable and Integrated with Grid

- Europe: Almost 5500 km (3400 miles) of high voltage HVDC and HVAC > 110 kV underground transmission – all integrated into grid (1)
  - % of all transmission >220 kV (by length) that is underground: Denmark 10%, United Kingdom 6%
  - 20% of new < 400 kV transmission in France is required to be underground
- Traditional and advanced underground HVAC transmission technologies provide high availability with manufacturer warranties, availability guarantees, liquidated damages, etc.
- Advanced underground HVAC technology implemented in Sweden (Gotland 1999), Australia (2002 Dunkirk multi-terminal and 2002 Murraylink) and US (2002 Cross Sound Cable)

Advanced Underground HVAC Transmission Technology: Low Impacts, Affordable

- Virtually no visual impacts
- Installation techniques are very simple
  - Installation similar to underground fiber optic cable
- No Electric Fields or AC EMFs
  - HVDC and HVAC underground cables have no electric fields
  - Advanced underground HVAC cables – DC magnetic fields directly over cable are within natural variations of the earth’s DC magnetic field
- Efficient use of existing rights-of-way (roads, pipelines, railroads, etc.)
- G&M cost of advanced underground HVAC less than overhead HVAC
- Advanced underground HVAC cost comparable to underground HVAC
- Advanced underground HVAC costs are declining, overhead HVAC costs are increasing

For More Information…….

- Our web sites:
  - General www.transenergieus.com
  - CSC www.crosssoundingcable.com
  - Australia www.transenergie.com.au
- Contact information:
  - Jeff Donahue (508) 870-9900 jeff.donahue@transenergieus.com
  - Ray Coxe (508) 870-9900 ray.coxe@transenergieus.com
  - José Rotger (508) 870-9900 jose.rotger@transenergieus.com

Murraylink Cable Installation

- 220 MW HVDC system based on VSC
- Distance 110 miles – all underground
- Average ROW width 13 feet (min 10 feet)
- Permitting ~ 24 months
- Construction ~ 21 months
- 1 cable failure, found and repaired in 6 days
- 392 cable joints - no failures
- Availability + 98%
- Cost (includes 132 kV and 220 kV interconnections) ~ US$ 97M
- Annual O & M cost ~ US$1.5M/year

Murraylink – World’s Longest Underground Transmission Link

- In operation since October 2002
- 220 MW HVDC system based on VSC
- Distance 110 miles – all underground
- Average ROW width 13 feet (min 10 feet)
- Permitting ~ 24 months
- Construction ~ 21 months
- 1 cable failure, found and repaired in 6 days
- 392 cable joints - no failures
- Availability + 98%
- Cost (includes 132 kV and 220 kV interconnections) ~ US$ 97M
- Annual O & M cost ~ US$1.5M/year

Murraylink – Environmental Awards

- Australian Case EARTH Award
- 2003 Environmental Excellence Award
- The Institution of Engineers, South Australia Division; 2003 Engineering Excellence Awards
  - Project infrastructure category
  - Overall project winner
- Environmental category
- Royal Australian Planning Institute of South Australia, Environmental Planning and Conservation Award
- LandCare Australia; National Recognition for Re-vegetation Along Cable Route
- Several studies confirm reliability of underground transmission
  - NC Utilities Commission (Nov. 2003) found that underground transmission had 97% less outages than overhead
  - NC Public Service Commission (Feb. 2006) found that underground transmission systems have fewer failures & shorter duration of outage
- Australian government (Nov. 1998) found that high voltage overhead distribution systems had 97% less outages than underground
Planned Underground/Sub-sea HVDC Light Projects

- 6 Converters
- 430 MW
- Undersea 100 km
- Sub-sea 290 km

DC Magnetic Fields

- The earth’s natural DC magnetic field total intensity varies around the earth from approximately 200 mG to 700 mG
- Murraylink’s maximum DC field intensity at 3 feet above the ground directly over the cable is 80 mG
- At distances from the cable greater than 10 feet, the change in the earth’s natural magnetic field is extremely small

Existing Underground/Sub-sea HVDC Light Projects

- 14 Converters
- 790 MW
- Sub-sea 40 km
- Underground 450 km