

Cable Installation Gotland - Rock Cutting



The State of Technology in Various Industries

	Then	Now
Automobiles	 1932 Ford Sedan	 2005 Ford Escape Hybrid
Computing Devices	 Comptometer	 Mac G5
Electric Transmission		

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 16%; United Kingdom 6%
 - 25% of new < 400 kV transmission in France is required to be underground
- Traditional and advanced underground HVDC transmission technologies provide high availability with manufacturer warranties, availability guarantees, liquidated damages, etc.
- Advanced underground HVDC technology implemented in Sweden (Gotland 1999), Australia (2000 Directlink multi-terminal and 2002 Murraylink) and US (2002 Cross Sound Cable)

(1) Commission of the European Community Background Paper - Undergrounding of Electricity Lines in Europe, December 10, 2003

Advanced Transmission Technologies

FERC Technical Conference
Hartford, Connecticut
October 13, 2004

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Ploughing of the HVDC Light Cable - Gotland









For More Information.....

- Our web sites:
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Advanced Underground HVDC 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 EMF issues
 - HVDC and HVAC underground cables have no electric fields
 - Advanced underground HVDC 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.)
- O&M cost of advanced underground HVDC less than overhead HVAC
- Advanced underground HVDC cost comparable to underground HVAC
- Advanced underground HVDC costs are declining, overhead HVAC costs are increasing

The State of Technology in Various Industries

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Automobiles	 1932 Ford Sedan	 2005 Ford Escape Hybrid
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Electric Transmission		 Is it the same?

Murraylink Cable Installation



BACKUP SLIDES

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)
- Converter station sites ~ 3.5 acres each
- 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

Commercially Available Advanced Transmission Technologies ⁽¹⁾

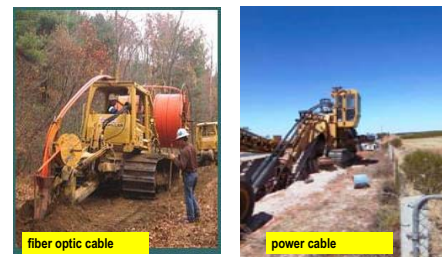


(1) U.S. DOE National Transmission Grid Study - May, 2002

Murraylink - Temporary Housing for Cable Splicing



Cable Installation Comparison



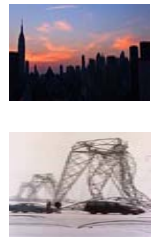
Murraylink - Environmental Awards



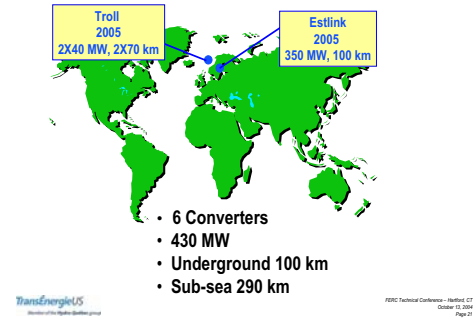
- Australian Case EARTH Award
 - 2002 Environmental Excellence Award
- The Institution of Engineers, South Australia Division; 2003 Engineering Excellence Awards
 - Project infrastructure category
 - Overall project winner
 - Environmental category
- Royal Australian Planning Institute of South Australia; Environmental Planning and Conservation Award
- LandCare Australia; National Recognition for Re-vegetation Along Cable Route

Advanced Transmission Technologies Increase Reliability

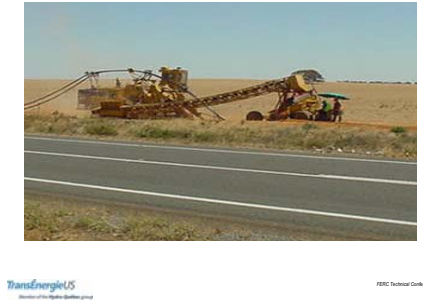
- Higher controllability over grid helps prevent cascading events
 - Prevents voltage / reactive power collapse
 - Prevents equipment overloads
- Undergrounding eliminates major causes of outages
 - Hurricanes, ice storms, tree contacts, lightning, fires
- Several studies confirm reliability of underground transmission
 - NC Utilities Commission (Nov. 2003) found that u/g outage rates are 50% less than overhead
 - MD Public Service Commission (Feb. 2000) found that u/g systems of urban utilities have lower frequency & duration of outages
 - Australian government (Nov. 1998) found that high voltage u/g systems had 80% less outages than overhead



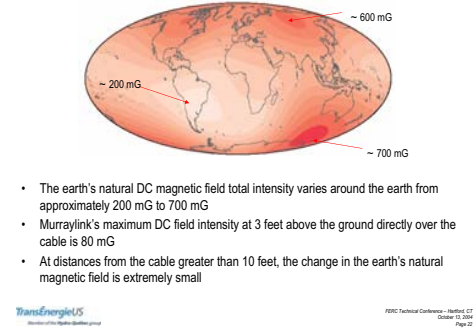
Planned Underground/Sub-sea HVDC Light Projects



Murraylink – Land Cable Trenching



DC Magnetic Fields



Murraylink – Open Cut Cable Trench



HVDC Light - Bridge Conduit / Cable Crossing



Existing Underground/Sub-sea HVDC Light Projects

