Route Considerations

- Identify Potential Marine Utilities
- Define Bottom & Sub Bottom Conditions
- Avoid Navigational & Installation Challenges
- Mitigate Risks of Encountering Cultural Resources
- Address Logistics
- Minimize Impacts:
  - Means & Methods
  - Avoid Archaeological resources
  - Avoid Fisheries
Route Overview

• 97.5 Miles- Alburgh, VT → Benson VT
  – Within the deeper waters of Grand Isle, Chittenden, Addison and Rutland Counties
• (2) Submarine Cables and Control Fiber
• 10 Installation Segments
• Segment Lengths
  Approximately 15 Miles
• Cable Burial at Depths Less Than 150 Feet
• Surface Lay at Depths Greater Than 150 Feet
### Marine Cable - Manufactured in Karlskrona, Sweden

<table>
<thead>
<tr>
<th><strong>DC Voltage</strong></th>
<th>±320 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conductor</strong></td>
<td></td>
</tr>
<tr>
<td>Type / material</td>
<td>profiled strands / copper</td>
</tr>
<tr>
<td>Cross-section</td>
<td>2,500 mm²</td>
</tr>
<tr>
<td>Water blocking</td>
<td>compound</td>
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<tr>
<td>Diameter</td>
<td>2.27 inches (57.6 mm)</td>
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<tr>
<td><strong>Conductor binder</strong></td>
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<tr>
<td>Material</td>
<td>semi-conductive swelling tape</td>
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<tr>
<td>Thickness</td>
<td>24 mils (0.6 mm)</td>
</tr>
<tr>
<td><strong>Conductor shield</strong></td>
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</tr>
<tr>
<td>Material</td>
<td>semi-conductive polymer</td>
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<tr>
<td>Thickness</td>
<td>59 mils (1.5 mm)</td>
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<tr>
<td><strong>Insulation</strong></td>
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<tr>
<td>Material</td>
<td>cross-linked DC polymer</td>
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<tr>
<td>Thickness</td>
<td>709 mils (20 mm)</td>
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<tr>
<td><strong>Insulation shield</strong></td>
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<tr>
<td>Material</td>
<td>semi-conductive polymer</td>
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<tr>
<td>Thickness</td>
<td>55 mils (1.4 mm)</td>
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<tr>
<td><strong>Longitudinal water barrier</strong></td>
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<tr>
<td>Material</td>
<td>semi-conducting swell-able tape</td>
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<tr>
<td>Thickness</td>
<td>24 mils (0.6 mm)</td>
</tr>
<tr>
<td><strong>Metallic sheath</strong></td>
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</tr>
<tr>
<td>Type / material</td>
<td>extruded / lead alloy</td>
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<tr>
<td>Thickness</td>
<td>114 mils (2.9 mm)</td>
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<td><strong>Inner sheath</strong></td>
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<tr>
<td>Material</td>
<td>high-density polyethylene</td>
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<tr>
<td>Thickness</td>
<td>98 mils (2.5 mm)</td>
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<tr>
<td><strong>Tensile armour</strong></td>
<td></td>
</tr>
<tr>
<td>Type / material</td>
<td>wire / steel</td>
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<tr>
<td>Thickness</td>
<td>197 mils (5 mm)</td>
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<tr>
<td><strong>Outer serving</strong></td>
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<tr>
<td>Material</td>
<td>polypropylene yarn, 2 layers</td>
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<tr>
<td>Thickness</td>
<td>157 mils (4 mm)</td>
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<tr>
<td><strong>Complete cable</strong></td>
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<tr>
<td>Diameter</td>
<td>5.31 inches (135 mm)</td>
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<tr>
<td>Weight in air</td>
<td>35.2 lbs./ft. (52.4 kg/m)</td>
</tr>
<tr>
<td>Weight in water</td>
<td>25.6 lbs./ft. (38.1 kg/m)</td>
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</table>
Cable Sourcing

• Trans-Atlantic Transport
  – Karlskrona, Sweden to Port of Elizabeth, NJ

• Specialized Freighter
  – With cable transfer handling gears
  – Oval static cable tanks
  – 6,000 DWT

• Cable spooling
  – 4 lengths of cable – each approx. 15.15 miles
Cable Transfer from Port Elizabeth to Lake Champlain
  • Shipped using deck barges and tugs built specifically for the project
  • Access into Lake Champlain via the Canal

Canal Transport Limitations
  - 1, 159 tons maximum cable batch weight
  - 15.15 miles of single core cable
Lake Champlain Installation Parameters

• Environmental Conditions
  – Champlain Canal access is restricted by:
    • Vertical clearance of 17 ft.
    • Controlling depth of 9.5 ft.
    • Usable width of 44.5 ft. with vessels limited to 43.5 ft. beam
    • Purpose built tugs and barges will be used to transit the canal.
  – Max water depth approximately 400 feet
  – Shallow near the Canadian Border and Benson

• Installation Vessel
  – Splicing Accommodations
  – Towed Plow
  – Surface lay in deep water
  – Navigate to +/- 3 ft. of proposed route
  – Precise speed control for cable lay operations
  – ROV
Lake Champlain Installation Parameters

Lay Barge:
- Custom built for Lake Champlain
- Shear Plow: 3,000 ft./day
- Jet Plow: 4,000 ft./day
- Bottom Laid: 6,000 ft./day
- Dynamic positioning
- 3000 HP thrusters
- 6 thrusters
- 2 Supply barges with 15.15 miles of cable per tub
Work Phases

• Proposed Construction Windows:
  – MP 0-73: May to August
  – MP 73-98: September to December

• 2017 Route Clearance
• 2017 Supporting Infrastructure
  – Cofferdams/Receiver Casing
  – HDD
• 2018 Submarine Cable Installation
Benson
• 1000 ft. HDD
• Drill from the high bluff to the lake
• Emerge into a receiver casing installed in the lake bottom
• Alternative, install cofferdam
Tools: Horizontal Directional Drilling

1,000,000 lb force Drill Rig “Big Gun”

HDPE Casing Pull-Back
Tools: Jet Plow/Shear Plow Burial

- 4 foot burial depth
- Jet Plow uses high pressure water to assist in trench excavation
- Shear plow cuts sediment using tension in tow cable from cable lay vessel
- Install both cables simultaneously in a single trench
Cable Protection

- Utility crossings
- Bridging existing utilities
- Exposed ledge
- Anchor protection
- Scour
- Beach transition

Articulated matts

Split pipe segments