Cable Laying and Repair - Cable Ship Operations

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Submarine Cables in the Sargasso Sea
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George Washington Law School
Washington, DC

http://oceanexplorer.noaa.gov/explorations/03edge/background/sargassum/sargassum.html
Global Undersea Cable Routes – Active Cables

Carry more than 98% of international internet, data, and telephone traffic. Comprise extremely high reliability components with redundant paths.
Atlantic Ocean Sargasso Sea – Area of Workshop Focus

Last Trans Atlantic cable laid 12 years ago. Cable laid from NJ to Bermuda in 2012
### Undersea Telecom – Principle Marine Activities

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Undersea Telecom - System Elements

- Repeatered, Repeaterless and Upgrade Telecommunications Solutions
- Offshore Oil and Gas Applications
- Scientific Research
Undersea Fiber Optic Cable

Undersea Cables…
• Protect optical fibers and electrical conductor
• Withstand harsh environmental conditions for 25 years
• Durable, yet flexible to support system deployment, recovery, repair & redeployment
• Non-threatening to the undersea environment
• Survive a variety of stresses: Temperature, tension, torsion, pressure, chemical exposure, bending/flexing

SL Lightweight (LW) Cable…
• For depths > 2500 meters (largest percentage of deployment)
• Serves as the core for all armored cables
Cable Size

- Cables are small: deep-ocean types, without protective armour, are typically 17-20 mm diameter – the size of a garden hose or beer bottle cap.
- Armoured fibre-optic cables may reach 50 mm diameter.
- In contrast, submarine oil/gas pipes can reach 900 mm diameter, and fishing trawls typically range over 5,000 – 50,000 mm wide.
- One of the longest cable systems is the South East Asia - Middle East - West Europe 3 system (SE-ME-WE-3), with a total installed length (including branches) of almost 40,000 km.

Deep-sea cable, (black) sectioned to show internal construction; fine strands at top are optical fibres used to transmit data.

Modern fibre-optic cable in hand (for scale) and relative to 600 mm diameter subsea pipe.

www.iscpc.org
SubCom Reliance Class Cable Ships

- Purpose Built:
  - 140 m length; 7.8m Design Draft
  - 5500 + MT cable capacity
  - 84 persons
  - 60+ days endurance

- Highly Experienced Marine Team
- Proven Heavy Weather Capable
- Equipped for Installation and Maintenance
- Highly maneuverable w/ full Dynamic Positioning
- 60 MT A Frame
- Plow and ROV equipped
- Full Cable Jointing & Testing facilities

Cable ships are operated by highly trained and experienced crews and specialist with concern for safety, fuel economy, environment and quality of installation and repair
Surface Laid Cable

Typical for deep sea (>1000-1500m water depth)

Lay according to pre-engineered method of procedure using shipboard slack management software so cable lays flat on the seabed and in the engineered and surveyed location.

Linear Cable Engine (LCE) and cable drums used to control cable slack and provide hold back tension

Computerized Cable Lay Plan
MARINE - Fleet Operations - Baltimore, Maryland

- 20 Acre Facility, 4 Deep water berths
- 150,000 sq foot office and warehouse space
- State of the art fleet of vessels and tools
- Approx. 100 marine engineering and seagoing professionals
- In-house route & cable engineering, GIS and documentation capability
- Extensive footprint, including pre-positioned repair ships and depots
- Jointing- Customized Training Courses- Baltimore, MD and Algeciras, Spain
- Land and Marine Training
  - Baltimore, MD and Algeciras, Spain
  - Field Training
  - Shipboard Training
  - Land and Marine Training
A] Cable ship trailing grapnel to retrieve cable followed by
[B] securing of the cable ready for repair

Source: Traité de Télégraphie Sous-Marine by E. Wüschendorff, 1888
Atlantic Maintenance Agreements

Maintenance ships are rapid response
Load spare cable and repeaters, joints kits
Can be underway within 24 hours -- 7x24x365

Strategically located vessels to cover member cables in the Atlantic and Eastern Pacific Ocean.
Cable Repair Cutting Drive

*Note this series of slides to be replaced by video*

- Different repair methods are used in different depths and conditions
- One common method starts with the ship dragging a cutting grapnel to cut the cable
- For cables buried deeper than 1 m into the seabed, multiple cutting runs may be needed to find the cable
Cable Repair Recovering First End

- After the cutting drive, the holding drive picks up one end of the cable.
- The end is tested to see if there are any more faults between it and shore.
- Any damaged cable is cut out until the end tests clear to shore.
Cable Repair Recovering Second End

- After any damaged cable is removed from the first end and it tests clear to shore, the first end is left on a buoy.
- The second end is picked up and tested, and any damaged cable is cut out.
Splicing Spare Cable (Initial Splice)

- After all damaged cable is removed, the ship adds a piece of spare cable long enough to reach between the ends.
- Below the ship is performing the Initial Splice (first end of the spare cable).
Repair Final Splice

- The length of spare cable needed depends on the amount of cable removed and the water depth.
- If much length is added, an extra repeater may be needed.
- Below the ship is making the Final Splice.
Laying Out & Burying Final Splice

- After the final splice is completed and tested, it is lowered carefully to the seabed

- The Final Splice may be buried with a Remotely Operated Vehicle (ROV) for protection, if seabed conditions allow
Cable Repairs in the Sargasso Sea Since 1960

There have been very few cables faults, therefore very few repairs in the Sargasso sea. Perhaps 1 every 2 years. Repairs take about 1 week after vessel arrives on cable grounds.

Most Recent Cable Repairs 2008-2013

<table>
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<tr>
<th>Fault Type</th>
<th>Water Depth</th>
<th>Location</th>
<th>Cause</th>
<th>LAT Deg</th>
<th>LAT Min</th>
<th>N/S</th>
<th>LON Deg</th>
<th>LON Min</th>
<th>E/W</th>
<th>Notification received</th>
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</thead>
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<tr>
<td>Fault A</td>
<td>Fibre break</td>
<td>5400 m</td>
<td>Mid Atlantic</td>
<td>39</td>
<td>0.000</td>
<td>N</td>
<td>048</td>
<td>0.000</td>
<td>W</td>
<td>Jan 13</td>
</tr>
<tr>
<td>Fault B</td>
<td>Cable Fault</td>
<td>5000 m</td>
<td>Mid Atlantic</td>
<td>37</td>
<td>22</td>
<td>N</td>
<td>63</td>
<td>40</td>
<td>W</td>
<td>12/25/2012</td>
</tr>
<tr>
<td>Fault C</td>
<td>Cable Fault</td>
<td>5000 m</td>
<td>Mid Atlantic</td>
<td>37</td>
<td>20</td>
<td>N</td>
<td>63</td>
<td>46</td>
<td>W</td>
<td>2/1/2013</td>
</tr>
</tbody>
</table>
Summary

• Most routes and transits follow Great Circle routes between US and UK on northern border of Sargasso Sea, no routes through central section except those to Bermuda.

• Sargasso Sea is deep sea. Cable burial is not an element of cable laying in this region. Cables are laid at a typical ship speed of 6 knots. Transit speeds are typically 10 to 12 knots. Slow enough to avoid whale collisions.

• Weed mats are typically avoided during transits if seen during daylight hours. During rare cable laying events, vessels must follow a precise route. Cable slack is automatically controlled so cable lays flat on the seabed; we avoid seamounts.

• The cable deployment is modeled and controlled so we lay cable on the prescribed route; we ensure sensors are in calibration. Vessel positioning using precise GPS.

• The deep-sea cable is very small diameter and inert with polyethylene covering.
Summary – Cont.

• There have been very few cables faults, therefore very few repairs in the Sargasso sea. Perhaps 1 every 2 years. Repairs take about 1 week after vessel is on cable grounds.

• We issue Notice to Mariners for operations, so others mariners are aware of operations.

• Vessel operations are done with concern for safety, fuel economy and environment.

• Cable ships are operated by highly trained and experienced crews and specialist.

• Quality systems are in place to report incidents and make corrective action and continual improvement.

• As-laid routes are documented and provided to Hydrographic Offices. Cable locations are precisely known with modern navigation.

Cables, cable laying operations and transits are of minor impact to Sargasso Sea eco-system.
Thank You!

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