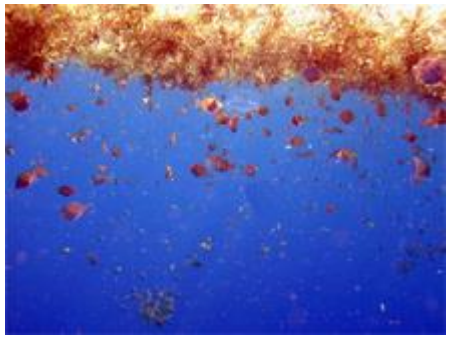


http://oceanexplorer.noaa.gov/explorations/03edge/background/sargassum/sargassum.html

Cable Laying and Repair - Cable Ship Operations

Dr. R.J. Rapp, Director, Industry & Marine Liaison, TE SubCom

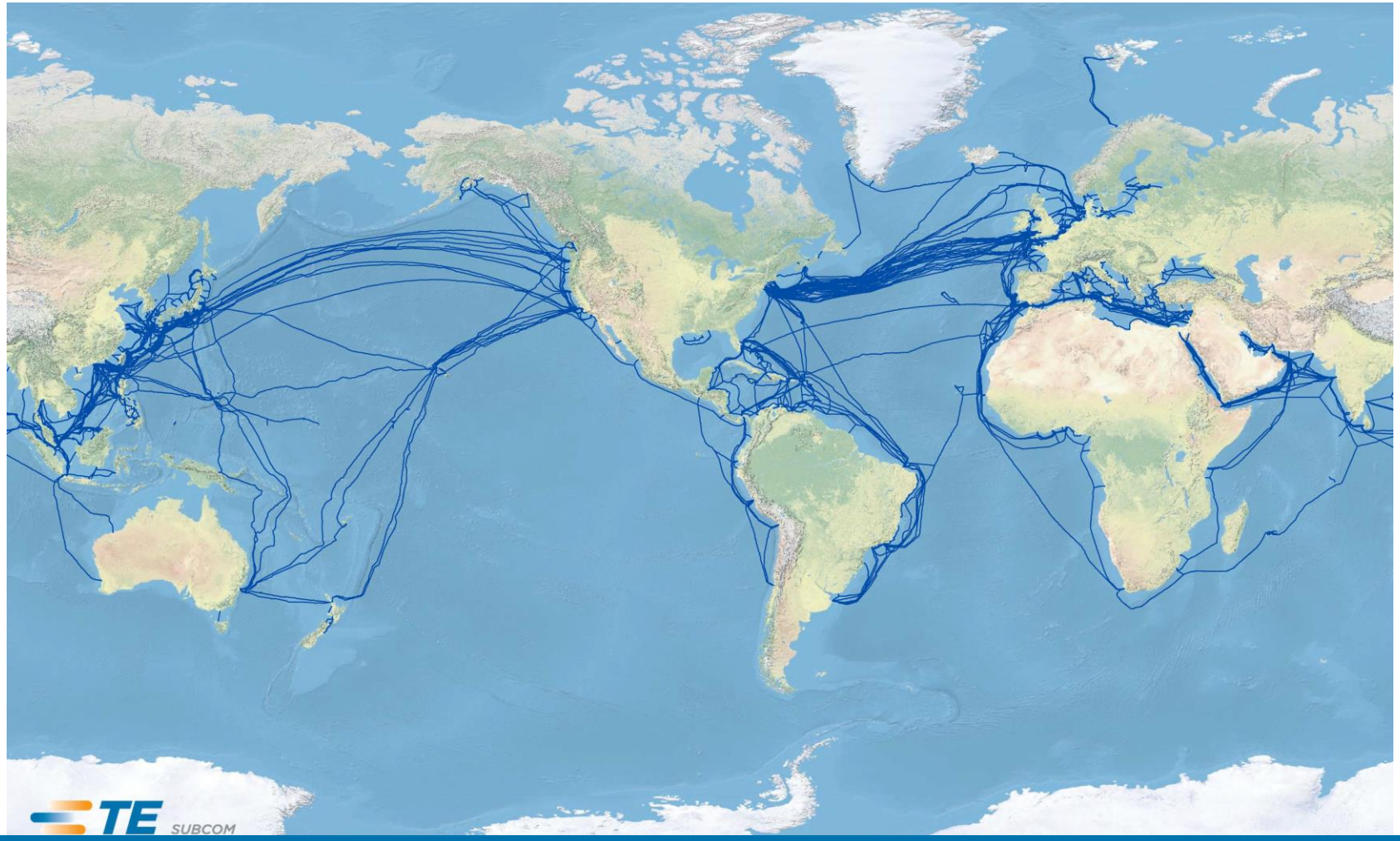
Submarine Cables in the Sargasso Sea

23 October, 2014

George Washington Law School

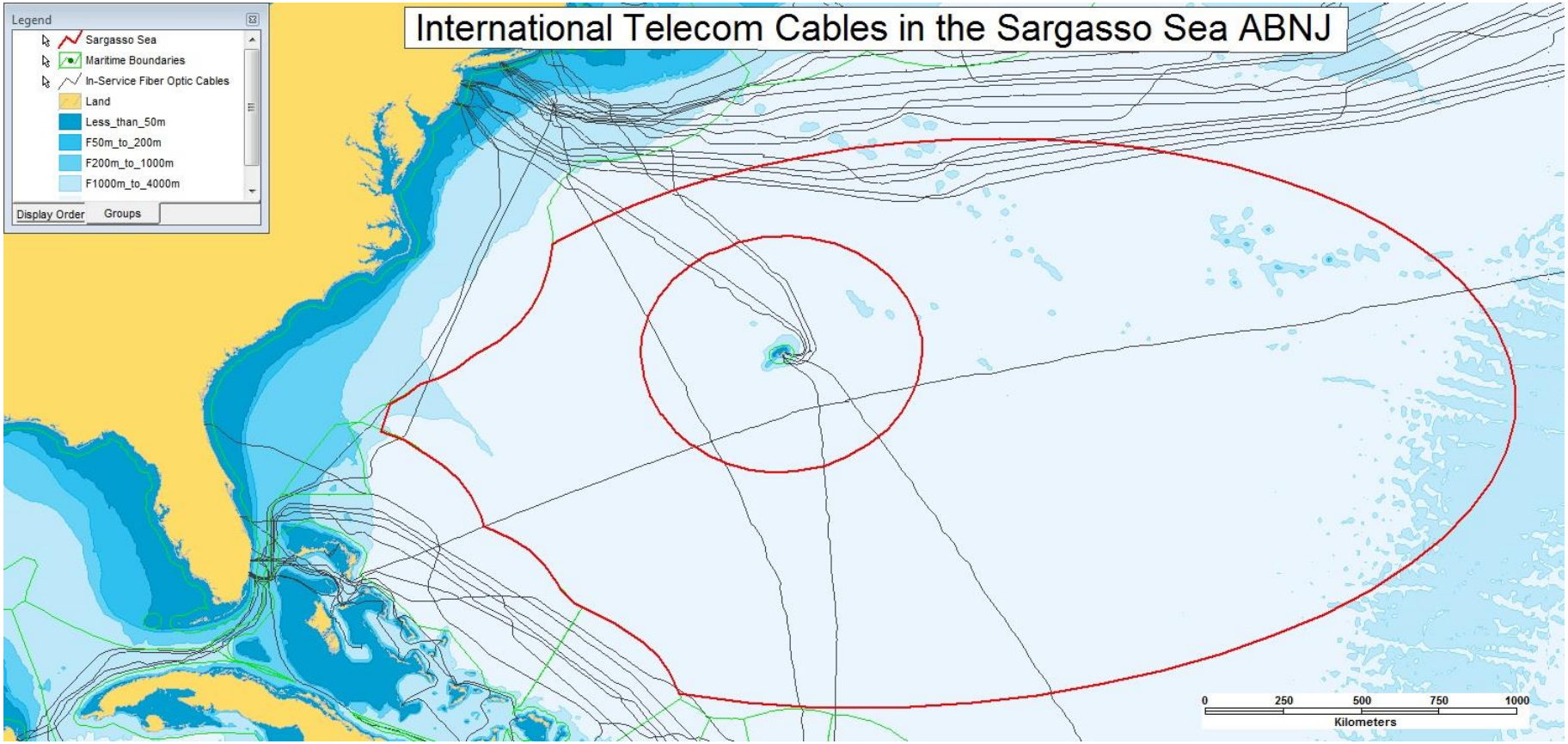
Washington, DC

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



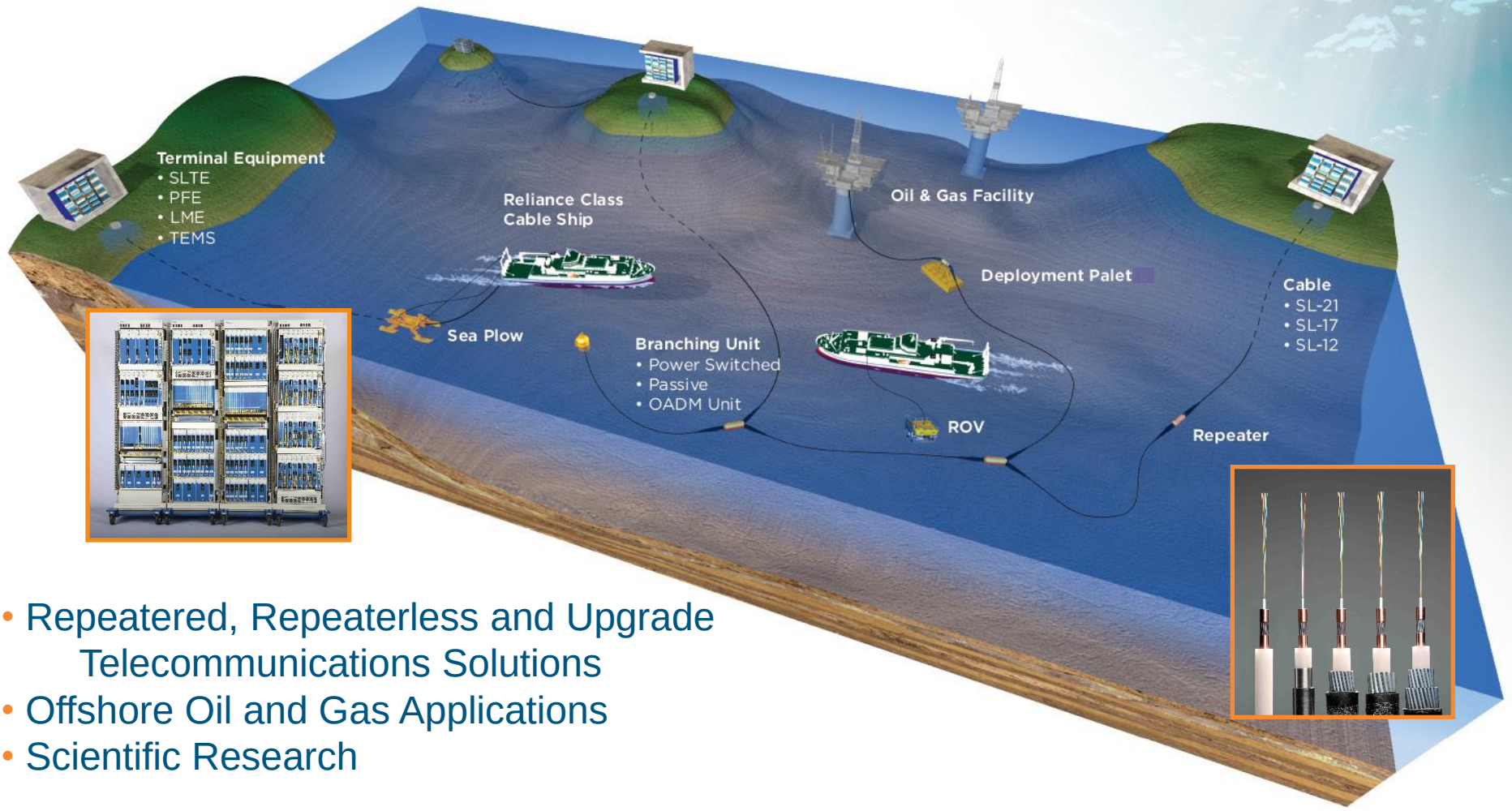
Last Trans Atlantic cable laid 12 years ago. Cable laid from NJ to Bermuda in 2012

Undersea Telecom – Principle Marine Activities

Planning	Desk Top Study Route Survey and Selection Burial Feasibility Installation Modeling	Focus on risk avoidance and risk mitigation
Installation	Shore Ends Cable Burial **Surface Lay** Branching Unit/Nodes	Utilization of best practices, tools and equipment
Post Installation Support	Marine Liaison **Cable Maintenance** GTSC – Global Technical Support Center	Education, network monitoring and cable repair services

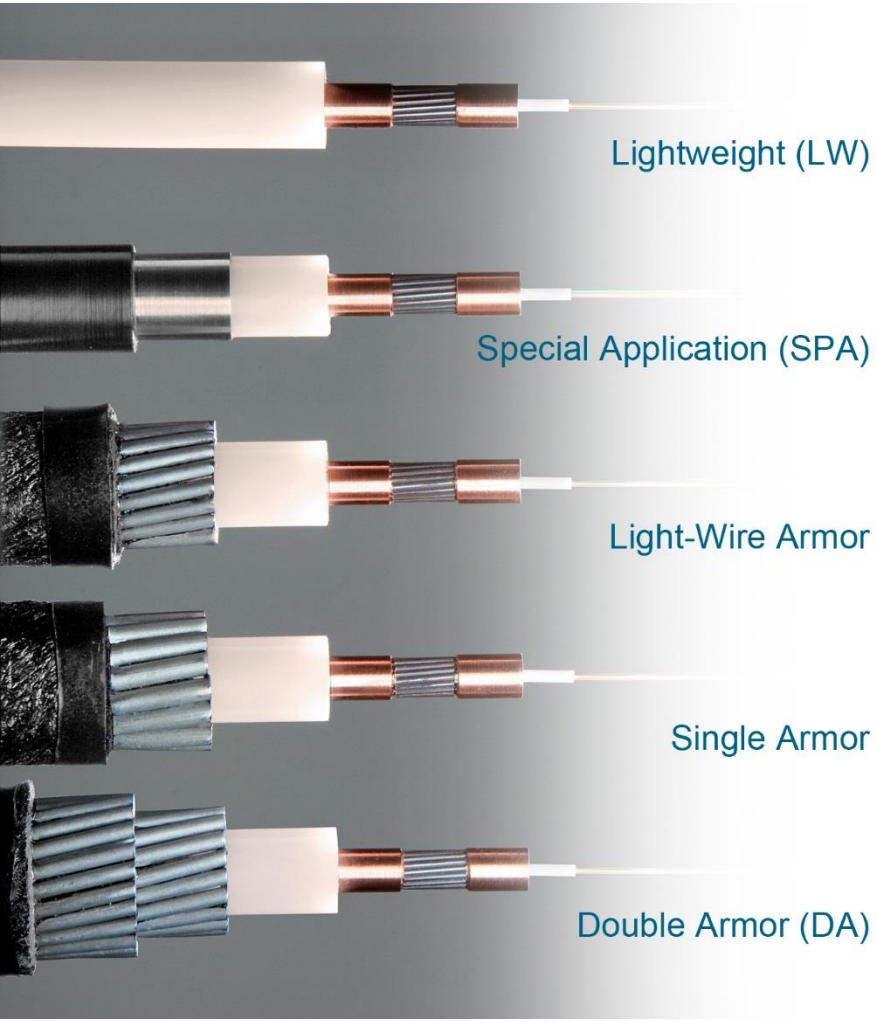
Of the many activities involved in planning, installing, and maintaining a cable system, only a few pertain to operations in the Sargasso Sea.

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 & re-deployment
- Non-threatening to the undersea environment
- Survive a variety of stresses: Temperature, tension, torsion, pressure, chemical exposure, bending/flexing

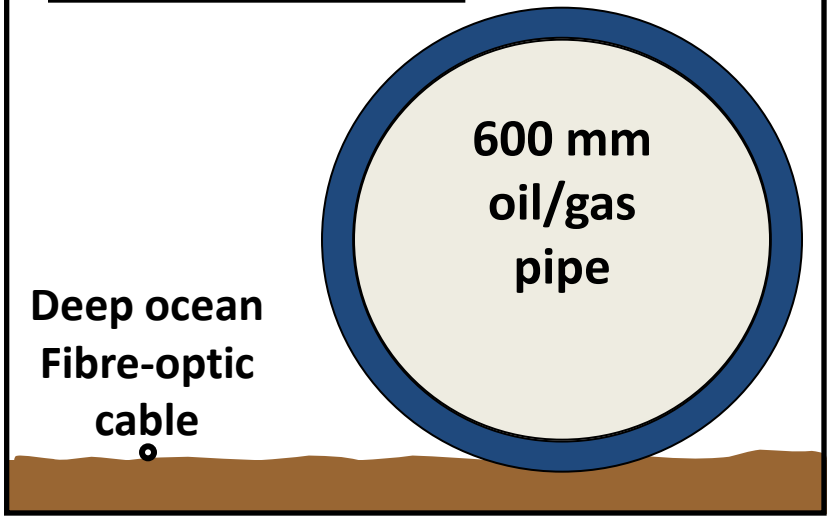
SL Lightweight (LW) Cable…

- 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

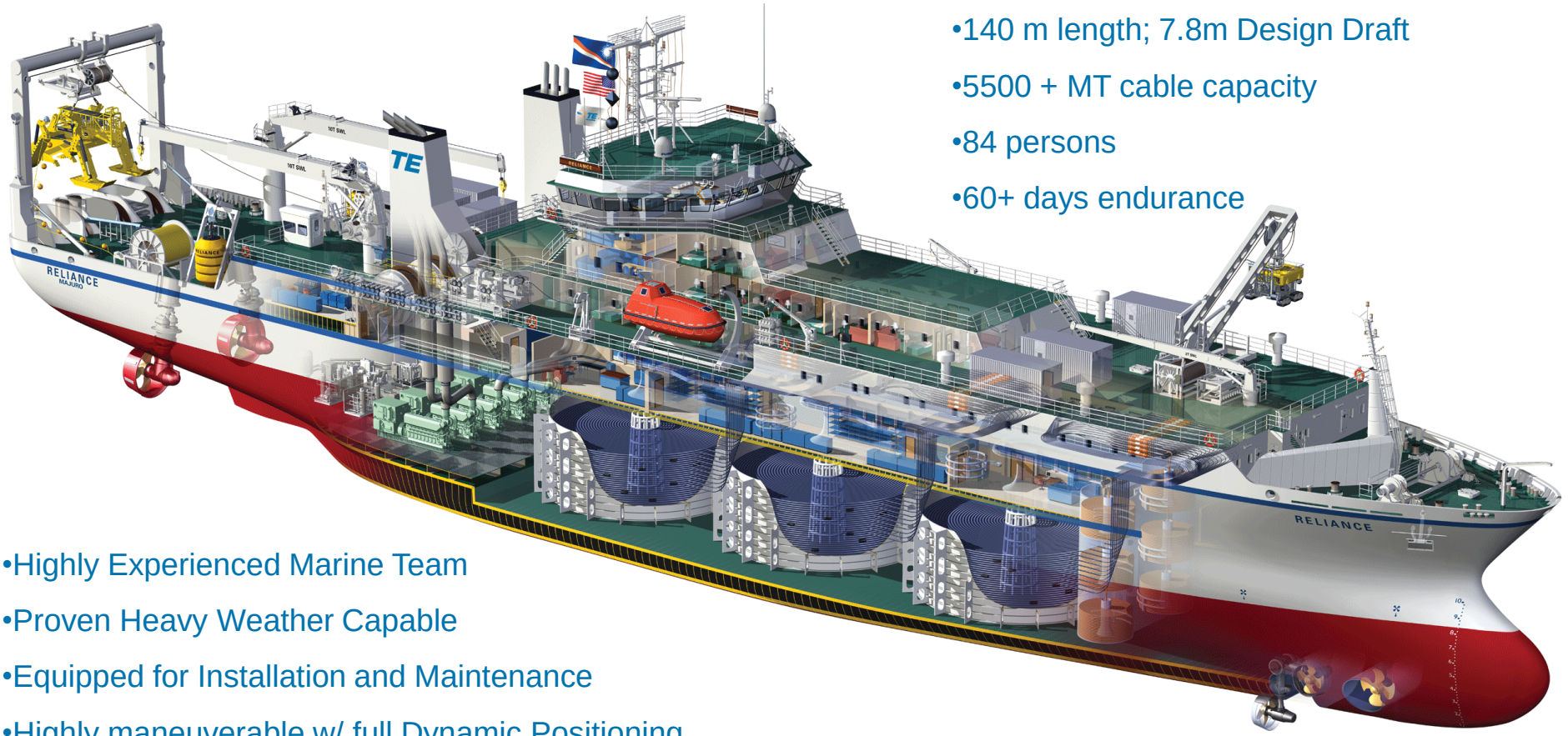
Deep-sea cable, (black) sectioned to show internal construction; fine strands at top are optical fibres used to transmit data



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

SubCom Reliance Class Cable Ships

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



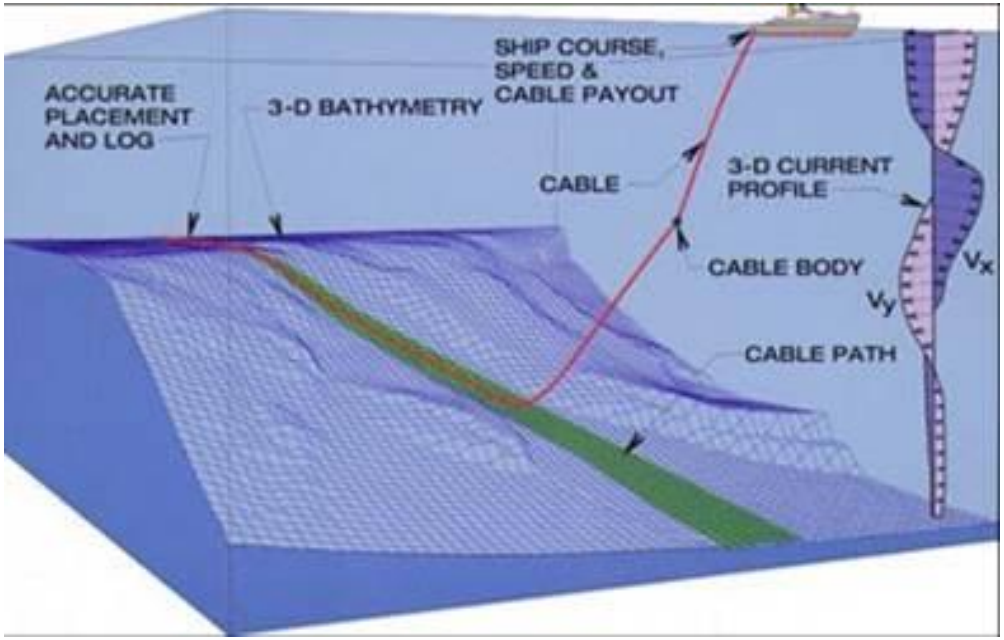
- Highly Experienced Marine Team
- Proven Heavy Weather Capable
- Equipped for Installation and Maintenance
- Highly maneuverable w/ full Dynamic Positioning
- 60 MT A Frame
- Plow and ROV equipped
- Full Cable Jointing & Testing facilities

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.



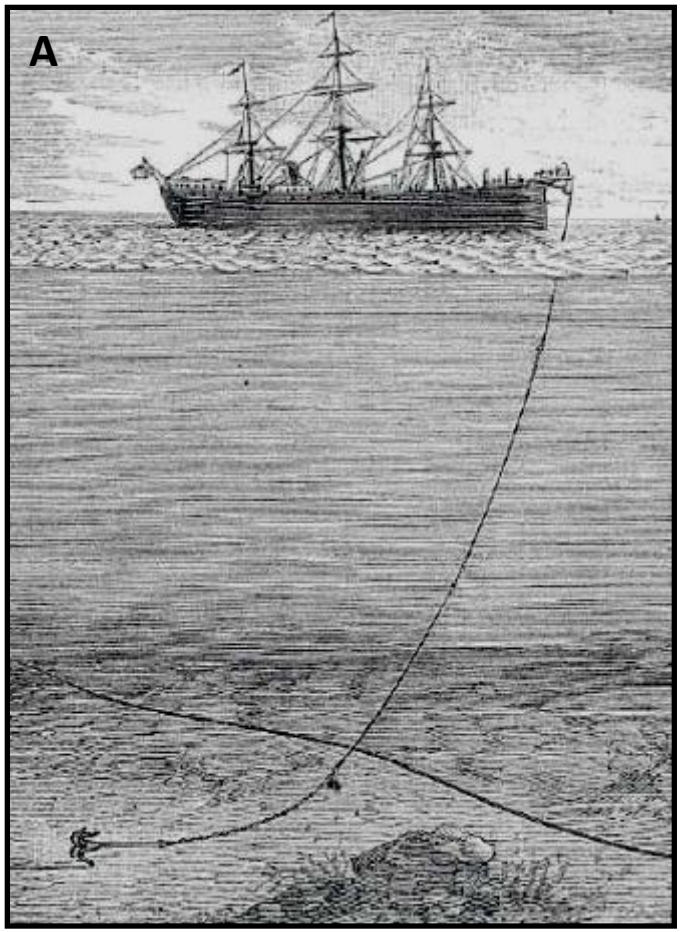
Computerized Cable Lay Plan

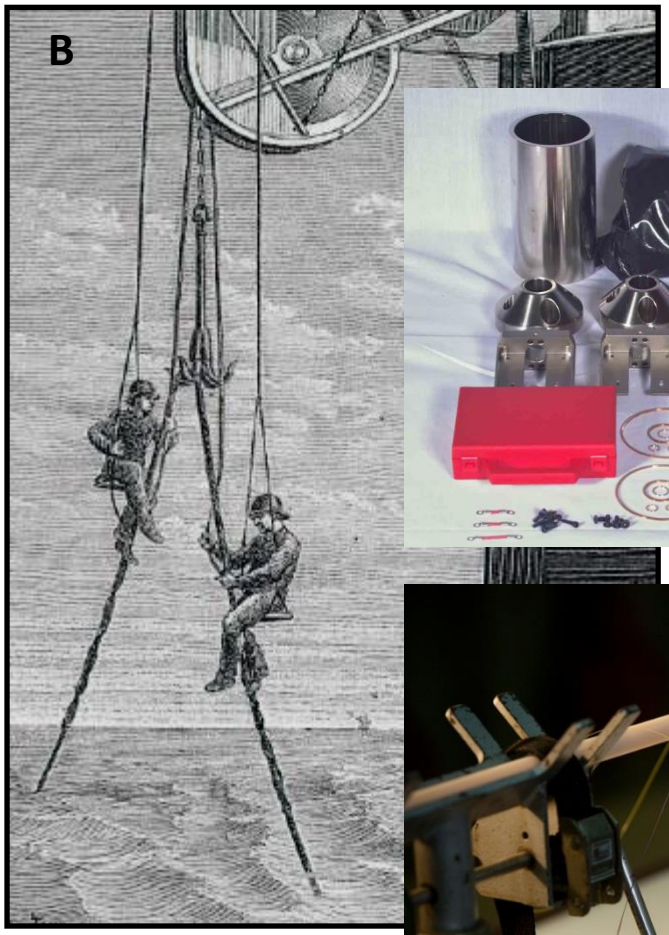
Linear Cable Engine (LCE**)** and cable drums used to control cable slack and provide hold back tension

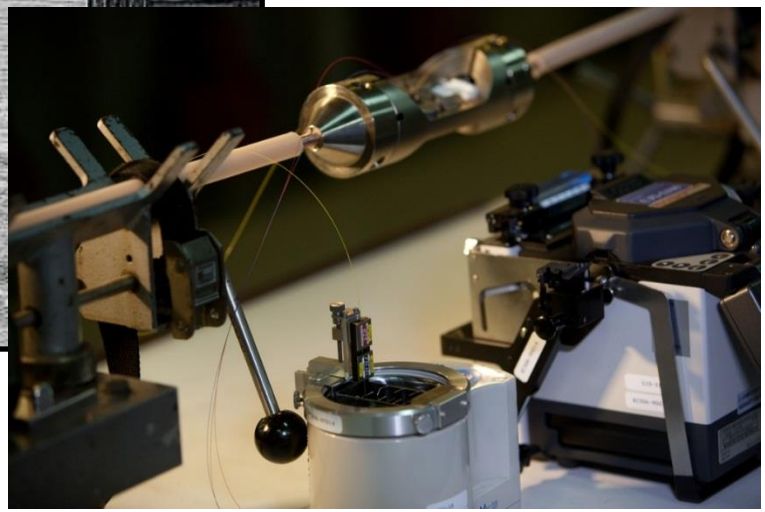
MARINE - Fleet Operations - Baltimore, Maryland

- 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

Cable Repair in 1888 and Today

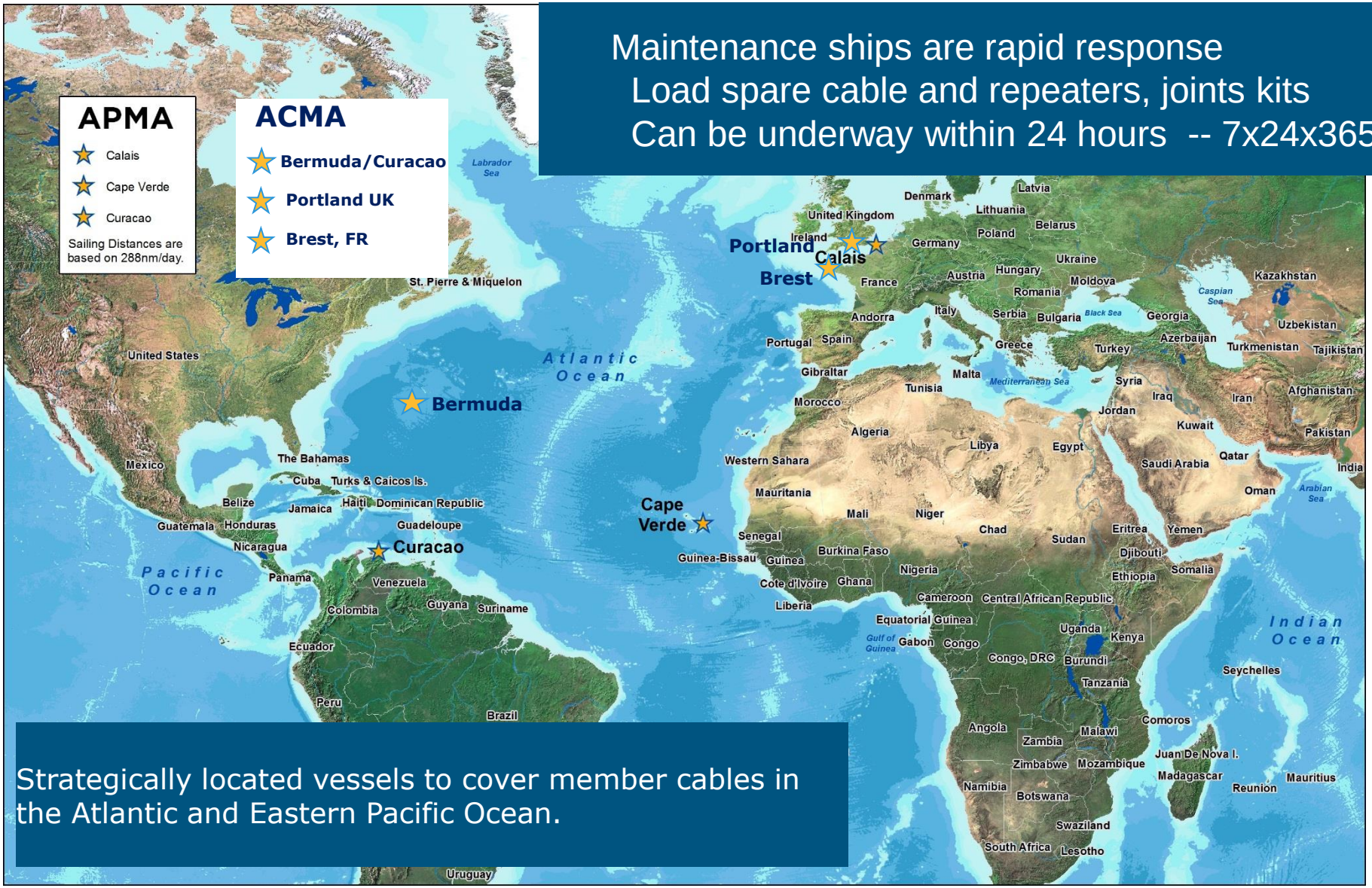






[A] Cable ship trailing grapnel to retrieve cable followed by
[B] securing of the cable ready for repair
Source: Traité de Télégraphie Sous-Marine by E. Wüschendorff, 1888

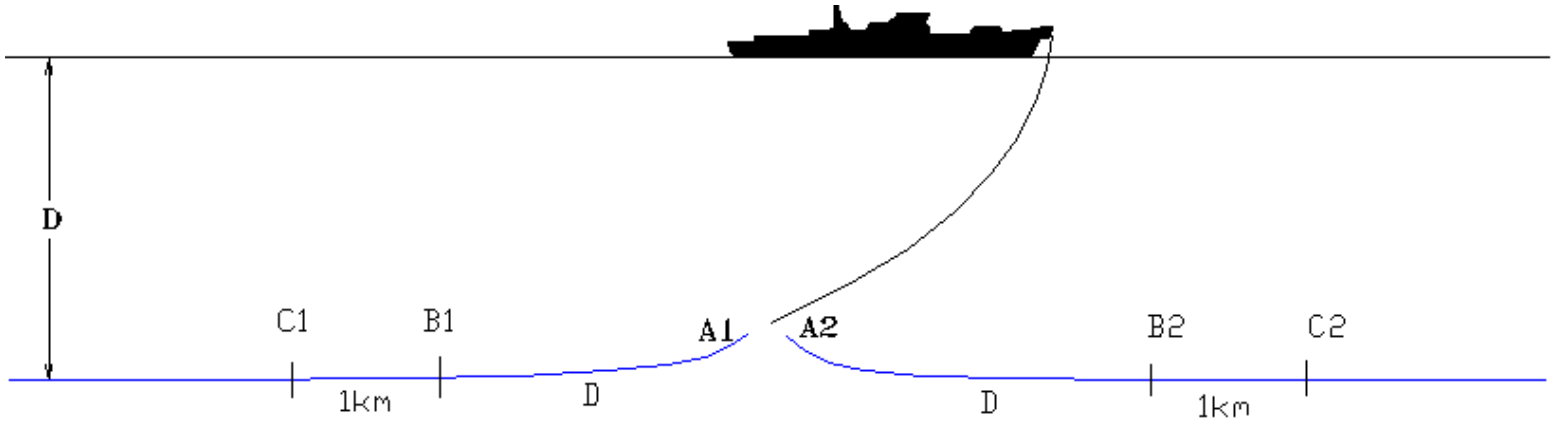
Atlantic Maintenance Agreements



Cable Repair Cutting Drive

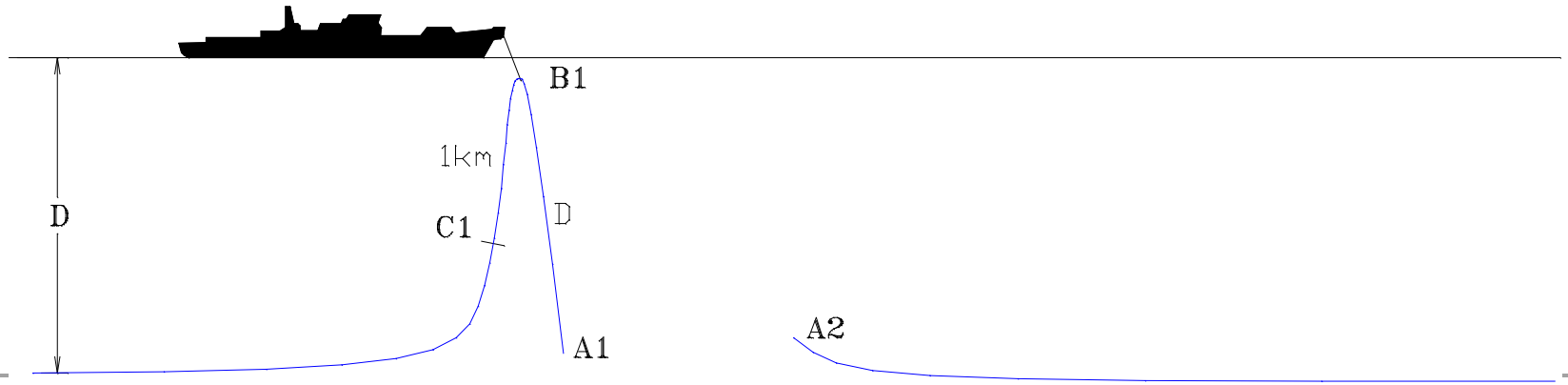
Note this series of slides to be replaced by video

- 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



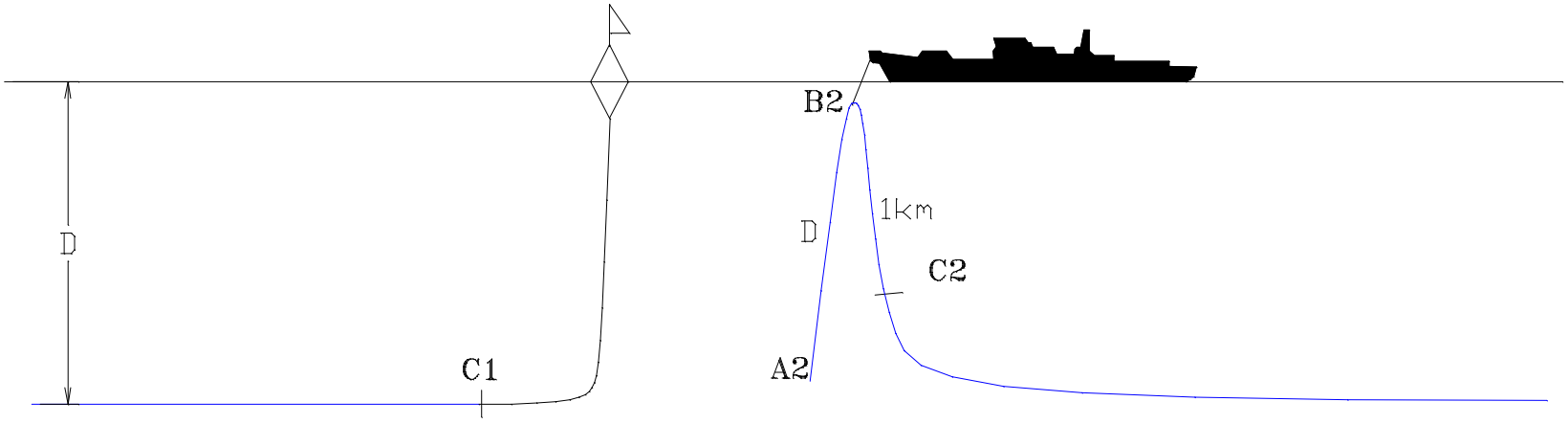
Cable Repair Recovering First End

- 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



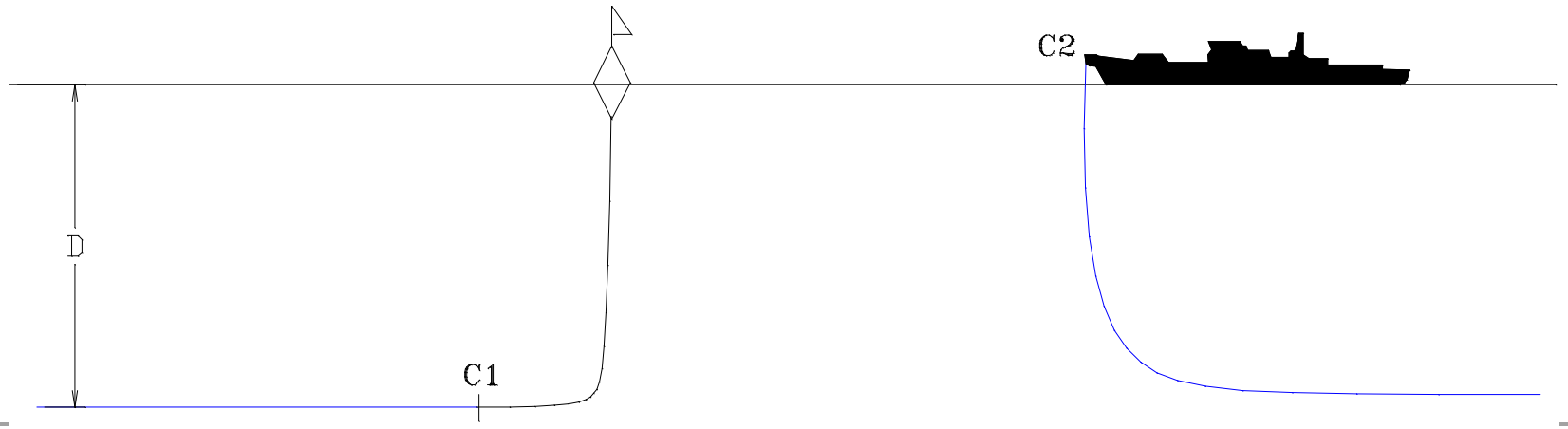
Cable Repair Recovering Second End

- 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



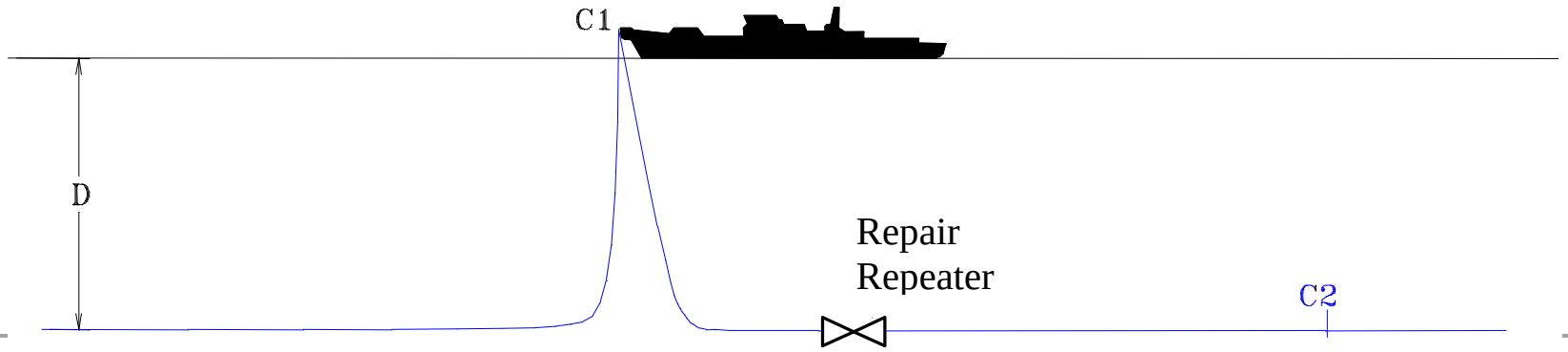
Splicing Spare Cable (Initial Splice)

- 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)



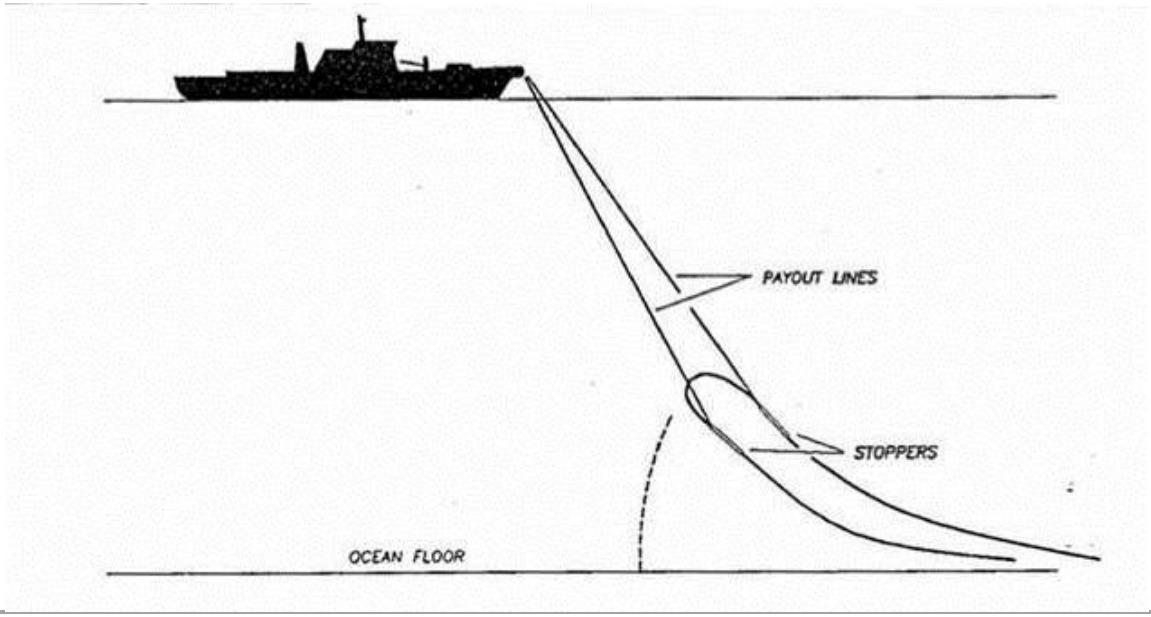
Repair Final Splice

- 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

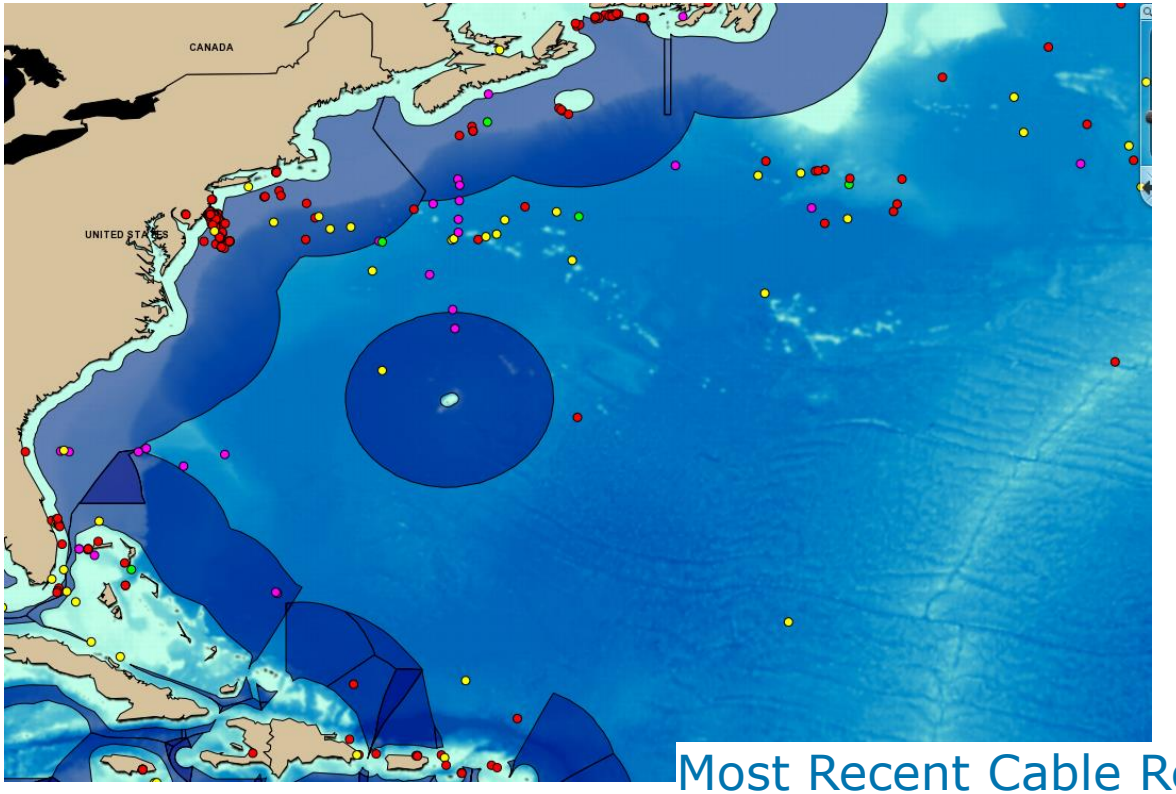


Laying Out & Burying Final Splice

- 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

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

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 matts 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!

Contact Information for further questions / information:

Dr. Ronald J. Rapp

Director, Industry and Marine Liaison – Undersea Maintenance

TE Subcom

250 Industrial Drive West

Eatontown, NJ USA 07724

(o) +1-732-578-7370

(c) +1-908-930-1146

rrapp@subcom.com