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WORKING GROUP 8
SUBMARINE CABLE
ROUTING AND LANDING

Final Report – Protection of Submarine Cables Through Spatial Separation

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1 EXECUTIVE SUMMARY

This Report 1 of the Submarine Cable Routing and Landing Working Group of CSRIC IV ("WG8") examines the natural and man-made risks to submarine cable infrastructure and recommends the adoption of additional protection measures, best practices, and policies by submarine cable operators and by the U.S. Government to mitigate those risks. Recent spatial conflicts between installed and planned submarine cables and other marine activities (including offshore dredging, beach replenishment, and offshore wind farms and marine hydrokinetic energy projects) highlight the urgent need for greater understanding of the spatial requirements for submarine cable installation and maintenance, recognition and implementation of spatial separation standards and methodologies (including default rules where coordination between marine activities does not occur or fails to resolve spatial conflicts), and development of additional standards and policies to ensure the resilience of U.S. submarine cable infrastructure and continuity of communications.

1.1 The Importance of Submarine Cables

Contrary to popular perception, more than 95 percent of all U.S. international voice, data, and Internet traffic travels by submarine cable—a percentage that continues to increase over time. Submarine cables provide higher-quality, more reliable, more secure, and less expensive communications than satellites provide. Submarine cables provide the principal domestic connectivity between the contiguous United States and Alaska, Hawaii, American Samoa, Guam, the Northern Marianas, Puerto Rico, and the U.S. Virgin Islands, and provide substantial intrastate or intra-territorial connectivity within each of Alaska, Hawaii, the Northern Marianas, and the U.S. Virgin Islands.

Submarine cables play a critical role both in ensuring that the United States can communicate domestically and with the rest of the world, and in supporting the critical economic and national security endeavors of the United States and its citizens. Submarine cables support U.S.-based commerce abroad and provide access to Internet-based content, a substantial proportion of which is located in the United States. They also carry the vast majority of civilian and military U.S. Government traffic, as the U.S. Government does not own and operate its own submarine cables.

The territorial-sea, exclusive economic zone ("EEZ"), and outer continental shelf ("OCS") areas of the United States and its territories contain significant existing and planned submarine cable infrastructure, and more is planned. At least 55 in-service submarine cable systems traverse these areas, and at least 12 more have been announced or are currently under construction.

Submarine cables—which typically have the diameter of a garden hose—are installed and repaired by cable ships built specifically for cable-related operations and designed for covering vast distances and multi-month deployments. Cable ships are crewed by highly

trained and experienced crews that use specialized equipment working on the surface of the sea, in the water column, and on the sea floor to install and repair submarine cables, which have a planned commercial lifespan of 25 years but are often used for longer periods of time. In deep-sea areas, submarine cables rest on the surface of the sea floor. In shallow coastal areas, submarine cables are typically armored externally with steel wire rod and buried to a depth of up to two meters. Cable maintenance providers contract with individual owners of submarine cable systems and/or with regional maintenance authorities for the provision of long-term maintenance services.

Although damage to submarine cables is rare, it is most often caused by human activities such as commercial fishing (in which trawl nets, clam dredges, and other bottom-contact gear ensnare cables), vessel anchoring, dredging related to sand and mineral extraction, petroleum extraction, pipeline construction and maintenance, renewable energy construction and maintenance, and other cable activity. Seabed uses change over time, and activities associated with renewable energy projects located near submarine cables raise the potential for damage to submarine cables and pose particular challenges for both the submarine and energy industries. Submarine cables are also at risk from natural hazards such as hurricanes, underwater landslides, and seismic events such as earthquakes and tsunamis resulting therefrom. These risks can be magnified by the clustering of cables in the same sea floor areas.

Damage to submarine cables can pose grave risks to U.S. national security and the U.S. economy, given the U.S. Government's reliance on such cables to communicate with its civilian and military personnel worldwide and with other governments, and given the dollar-value of commerce conducted using submarine cables. Timely repairs are therefore critical, and maintenance providers and cable ships must be prepared to respond rapidly, with vessels on stand-by with continuously-qualified personnel and appropriate equipment. In spite of these efforts, cable damage has in many cases resulted in significant disruptions of communications and slower Internet speeds.

Although numerous federal, state, and local government agencies issue licenses, easements, and permits governing installation and construction activities associated with submarine cables landing in the United States, in practice the Federal Communications Commission ("FCC") functions as the primary regulator (under the Cable Landing License Act of 1921) and is responsible for licensing all international submarine cables landing in the United States. The FCC is therefore in the best position to advocate for cable-protection initiatives and coordination among various governmental agencies. The FCC plays a coordinating role in various interagency processes, and other governmental agencies frequently look to the FCC for guidance on matters pertaining to submarine cables. No other agency collects as much timely or centralized information about planned and in-service cables and their locations.

1.2 Spatial Needs for Submarine Cable Installation and Maintenance

To install and maintain submarine cables and minimize outage time in connection with repairs, submarine cable operators require ready and unfettered access for cable ships and equipment to the ocean surface, water column, and seabed around a submarine cable. To achieve this and to minimize conflicts with other marine activities, submarine cable operators use a variety of coordination and cooperation mechanisms. These include cable spacing and crossing standards, cable awareness programs and outreach, coordination with other users of marine and coastal areas (particularly commercial fishermen), and marine spatial planning. An effective submarine cable protection regime must account for the physical characteristics of submarine cables and the mechanical characteristics of the installation vessels and tools. These characteristics—along with weather, sea, and seabed conditions—greatly determine the specifics of a given cable installation or repair.

Cable Characteristics. Cable armoring helps to protect a submarine fiber-optic cable from fault-triggering events in the marine and coastal environment. A "fault" is an event associated with an installed submarine cable requiring some maintenance or repair activity to ensure continued useful service of the cable and may be caused by natural or man-made factors. Cable manufacturers purposely build torque into armored cable to permit coiling in cylindrical storage tanks in warehouses and ships prior to deployment. Torque, however, also causes the cable to loop back on itself when slack. Loops can result in transmission failures if pulled tight, they can cause the cable to stand upright on the seabed, and they make the cable more susceptible to physical damage due to greater exposure above the seabed. To avoid having the cable throw loops when it is uncoiled, it is laid on the sea floor under tension.

Marine Route Study and Survey. To identify the safest and most economic route for a new submarine cable, the owner will commission a desktop study and a marine survey. These two undertakings will attempt to identify all of risks and define the safest cable route. Through the study, the owner and its supplier can often minimize or eliminate hazards and conflicts. With greater development of the sea floor in the U.S. territorial sea, EEZ, and OCS, however, the availability of suitable unused routes has been exhausted, forcing submarine cable operators to accept at least some risk. To ensure effective identification of existing and future hazards, submarine cable operators consult with commercial fishermen and their unions, government agencies, and other marine industries. Submarine cable operators then use the results of the route survey to modify the initial route identified in the desktop study.

Access for Vessels and Equipment. Cable ships are large vessels (often more than 125 meters in length) that require space in which to maneuver when installing or repairing submarine cables, and to accommodate the effect of bad weather on the ocean. Offshore developments involving large structures, like oil platforms, turbine towers, and submerged structures, present obstacles precluding cable ships from having ready access to the sea floor for new installations (and for repair of previously-installed cables).

Heavy vessel traffic, fishing or military operations and seasonal restrictions can also impede or delay installation.

Installation: Cable installation operations are conducted 24 hours per day. The cable end is floated ashore from the primary cable ship or from a smaller secondary one. If a secondary ship is used to pre-install the shore end, then the cable ship will splice to the shore end and continue the lay. In near-shore areas, cable is generally buried to protect it. In limited areas where there are no significant fishing or anchoring risks or where the seabed does not permit burial, it will be laid on the surface of the sea floor. During installation, it is critical that the cable lay flat.

Cable Retrieval. To recover a cable from the sea floor for repair purposes, a cable ship usually grapples for the cable by dragging a grapnel on the sea floor. ROV use is limited to surface-laid cable in shallower depths between 50 and 2000 meters with moderate currents and good visibility. The grapnel (whether for surface-laid or buried cable) is lowered to the sea floor from lines on the cable ship and dragged in a direction perpendicular to the cable. This allows the grapnel to dig into the seabed and under the cable, maximizing the chance that the grapnel will hook the cable (rather than graze or accidentally release it) and bring it to the surface of the seabed. Current ship positioning technology allows for extremely accurate placement of this gear and for controlled cable retrieval. Nevertheless, bad weather, heavy seas, or strong currents can decrease the accuracy of these operations—a situation which poses a greater risk to other submarine cables or sea floor installations in the vicinity of the target cable.

Splices and Repairs. A damaged submarine cable must be repaired onboard a cable ship. But a cable (whether tensioned or not) that is resting on, or buried in, the seabed will lack sufficient slack to reach the surface for repair. Unless a cable is already severed, therefore, it must first be cut in order to be brought to the surface. This retrieval operation takes at least three passes with the grapnel—one to cut the cable, a second to bring up and buoy one end of the cable, and a third to bring up and bring onboard the second end. After the ends are repaired and tested, a section of cable must be spliced in between the two ends in order to have them meet at the surface and restore connectivity. This additional section is typically two-and-a-half times the depth of water in length. This length permits what was previously a cable lying flat on the sea floor to reach up to the cable ship, provide length for manipulation and repair activities on board, and reach back down to the sea floor. This final configuration must be carefully placed back on the seabed in a direction perpendicular to the line of the original cable so that the cable lies flat on the sea floor and does not throw loops.

1.3 Risks of Damage to Submarine Cables

Submarine cables are subject to diverse natural and man-made risks of damage that vary depending on the state of implementation or operation of the system. These risks vary by physical conditions of the sea floor and ocean and by political and economic characteristics of adjacent coastal states and their marine activities and industries. Some of these risks are well-established while others are emerging. Some traditional risks have been contained or even minimized, while others continue to threaten submarine cables with some regularity.

In general, the more intensive use of U.S. coastal and marine areas for resource and infrastructure development activities creates a scarcity of unused and underused areas that might otherwise minimize risks to submarine cables simply due to wide spatial separations. First, these activities pose direct risks to submarine cables by threatening installed cables with equipment, anchors, infrastructure installation and operation, and resource exploration, exploitation, and transport. Second, these activities impair access to installed submarine cable systems, increasing repair costs and the length of communications outages. Third, these activities can distort routing and landing decisions, making it risky to use particular routes to reach well-established cable landing stations and terrestrial network POPs or, conversely, encouraging clustering of cables in narrow corridors and landings, which magnify the risks of damage and communications outages across multiple systems due to particular natural or man-made events.

- **Commercial Fishing**: Historically, commercial fishing has accounted for more than 40 percent of all submarine cable faults worldwide. Commercial fishing-related damage is most often caused by bottom-tending fishing gear such as trawl nets and dredges, but it is also caused by long lines anchored to the seabed and pot and trap fisheries using grapnels for gear retrieval. Submarine cable operators use cable armoring and burial, cable awareness and liaison programs, and programs to compensate fishermen for snagged gear, and these measures have been very effective in minimizing cable damage in the U.S. territorial sea and OCS.

- **Anchoring**: Anchoring is the second most common source of damage to submarine cables on a worldwide basis. Anchoring threats include: improperly-stowed anchors, which release or fall overboard and can be dragged for great lengths along the sea floor, damaging cables along its path; anchoring outside of approved anchorages and near installed submarine cables; anchors dragged by properly-anchored vessels, depending on sea conditions; and an anchor dropped in a marine emergency. Submarine cable operators seek to route around designated anchorages.

- **Dredging and Dumping**: Sand and gravel dredging and beach replenishment authorized by the Army Corps of Engineers and the Bureau of Ocean Energy

Management of the U.S. Department of the Interior ("BOEM") can damage submarine cables through the use of vessel anchors, barges, and pipelines used to recover, transport, and pump dredged material back onto shore. Moreover, sand and gravel dredging disturbs sea floor sediments, triggering erosion in other areas as sand migrates to fill the dredged area. This reduces the burial depth of submarine cables—exposing them to greater risk of damage by commercial fishing and anchoring—and can damage cables through abrasion.

- **Oil and Gas Development**: Historically, oil and gas development off the coasts of the United States has focused on the Gulf of Mexico, where there are relatively few submarine cables. As the demand for energy increases and as technology evolves, oil and gas infrastructure will likely move offshore into deeper waters and potentially to new areas along the Atlantic and Pacific coasts. Uncoordinated offshore oil and gas exploration, exploitation, and transport activities pose significant risks to submarine cables, including: direct physical disturbance through the use of anchors for production platforms and related exploration and production equipment; pipeline proximity to and crossings with cables, which pose direct physical disturbance risks with installation and maintenance and additional risks with cable-pipeline crossings; and impaired access to submarine cables both at the surface (for cable ships) and on the sea floor (for cables) during installation and maintenance, all of which increases the complexity, costs, and time required to complete installations and repairs and can increase the costs to customers of network outages.

- **Clustering of Submarine Cable Systems**: The clustering of submarine cables along particular routes (whether to avoid unfavorable sea floor topography, natural hazards, or man-made hazards such as dredging and dumping areas, fishing grounds, and energy infrastructure) increases the risk that installation or maintenance of one cable will cause direct physical disturbance to another, such as with plowing and grappling operations.

- **Earthquakes and Tsunamis**: Earthquakes can trigger subsea landslides that sever or abrade cables. They can also trigger tsunamis, the force of which can damage both submarine cables and cable landing stations.

- **Sea Floor Geology**: Submarine cable operators prefer to land their cables in locations that have stable, benign landing features. Bottom features such as pinnacles or boulder fields that would leave a cable exposed, high current areas that could lead to chafing, long tidal flats, evidence of trawling (trawl scars), etc. require special consideration for both installation and maintenance of submarine cable systems.

- **Weather**: Installation of submarine cable systems can be impacted or at risk from severe climate events. Severe seasonal weather conditions such as

hurricanes, gales, and storms, shore ice, and icebergs can dictate the available "weather window" for cable installation when considered in conjunction with the operational capabilities of the cable ship and its ability to lay and bury the cable.

- **Offshore Renewable Energy Development**: Demand for environmentally-friendly and domestic energy sources has created significant interest in three particular sources of renewable energy: (1) offshore wind; (2) wave, tidal, and ocean current (referred to generally as marine hydrokinetic ("MHK") energy); and (3) ocean thermal energy conversion ("OTEC"). These projects are authorized principally by BOEM and/or the Federal Energy Regulatory Commission ("FERC"). Offshore wind energy is the most familiar offshore renewable energy source because the technology is the most mature, but there is continuing interest in in-water testing of MHK and OTEC technologies with a goal of commercial-scale development. Ultimately, offshore renewable energy is expected to prove a significant source of low-carbon energy for the United States. Offshore renewable energy development will, however, pose risks to submarine cables and vice versa. Placement of offshore generating facilities and mooring anchors near submarine cables increases the likelihood of a cable fault due to the risk of sea floor scouring. The placement and maintenance of structures on the seabed or in the water column pose similar risks to submarine cables as do oil and gas development, absent sufficient spatial separation. Power transmission cables pose physical risks and personnel safety risks during submarine cable installation and maintenance operations and entail multiple crossings of submarine cables.

- **Deep-Sea Mining**: Deep-sea mining to harvest polymetallic nodules, cobalt-rich manganese crusts, and sea floor massive sulfides—both exploratory and exploitative—can cause direct physical disturbance of the seabed, threatening operation of undersea cables by anchoring of production support vessels and platforms and additional equipment on the sea floor. Minerals mining operations present a threat of erosion and abrasion similar to that presented by wind farm operations; destabilization of the sea floor; and redeposited sediments. All of these may result in exposing or suspending cables above the sea floor, thereby subjecting them to a heightened risk of damage from vessel traffic and fishing nets and anchors, as well as the risk of debris accumulating on cables. Finally, large offshore developments impede access to undersea telecommunications cable systems both at the surface (for cable vessels) and on the sea floor.

1.4 International and U.S. Legal Regimes

U.S. treaty obligations and customary international law (as observed by the United States) recognize unique freedoms for the installation and maintenance of submarine cables in a coastal state's exclusive economic zone (extending 200 nautical miles seaward) and on its continental shelf. These rights and freedoms are not accorded to energy-related activities, commercial fishing, or marine transport, and sometimes these

rights and freedoms take legal precedence over those of other marine activities. Various international treaties dating back to 1884 guarantee unique freedoms to lay, maintain, and repair submarine cables—freedoms not granted for any other marine activities—and restrict the ability of coastal states (*i.e.*, countries) to regulate them. These treaty obligations are now treated as customary international law, in particular by the United States. These treaty obligations also require coastal states to prevent willful or negligent damage to cables and "have due regard to cables or pipelines already in position." Submarine cables are thus afforded a great degree of protection from regulation or interference by coastal states, reflecting the vital role that submarine cables play in facilitating communications, commerce, and government.

Consistent with the 1884 Convention on cable protection, U.S. law provides that damaging a submarine cable—whether deliberately or through negligence—is a federal offense punishable by fine, imprisonment, or both. The penalties, however, are unlikely to deter negligent or willful damage and do not even cover the cost of the repair. For willful damage, U.S. law provides for a fine of up to $5,000 and/or a prison term not to exceed two years. For culpably negligent damage, U.S. law provides for a fine of up to $500 and a prison term not to exceed three months. Federal law imposes obligations on fishing vessels to keep their nets from interfering with or damaging submarine cables, and requires fishing vessels to maintain a minimum distance from any vessel engaged in laying submarine cable or any buoy placed to mark the position of a submarine cable. U.S. law provides for a fine up to $250 and a prison term not to exceed 10 days for fishing-related damage.

1.5 Cable Protection Methods

Most models of cable protection focus on spatial separation between submarine cables and other marine activities (including other submarine cables) and extensive coordination among marine activities. With sufficient separation, the risks of direct disturbance via equipment or anchors or impeded access for establishment of diverse routes or timely maintenance are minimized. Key protection methods include:

- **Industry Standards for Consultation, Coordination, and Spatial Separation**: Industry organizations—including the International Cable Protection Committee ("ICPC") and the North American Submarine Cable Association ("NASCA") have developed and/or endorsed recommendations (which, in spite of their names, are intended to be authoritative, not simply suggestions) for consultation and coordination among marine activities and spatial separation, including:
    - ***ICPC Recommendation 2 No. 10***, which recommends that parallel submarine cables maintain a separation distance of the lesser of 3 times depth of water or (where not achievable) 2 times the depth of water following consultation and agreement between affected parties—a

separation standard the principles of which also apply to spacing of submarine cables and other marine infrastructure;

- ***ICPC Recommendation 3 No. 10***, which establishes criteria for crossings of submarine cables, power transmission cables, and pipelines;
- ***ICPC Recommendation 4 No. 8***, which establishes coordination procedures for repair operations near in-service submarine cables;
- ***ICPC Recommendation 6 No. 8A***, which recommends actions for effective protection of installed submarine cables;
- ***ICPC Recommendation 7 No. 6***, which recommends coordination procedures between submarine cables and offshore civil engineering works;
- ***ICPC Recommendation 8 No. 7A***, which recommends coordination procedures for offshore seismic survey work in the vicinity of in-service submarine cables;
- ***ICPC Recommendation 13 No. 2***, which establishes a methodology for determining site-specific proximity limits between submarine cables and offshore wind facilities and a default separation distance in shallower waters of 500 meters on either side of an in-service submarine cable—a separation standard the principles of which also apply to other offshore renewable energy projects.
- ***Subsea Cables UK Guideline No. 6 (endorsed by NASCA)***, which establishes principles for determining safe proximity distances and negotiating proximity agreements between offshore wind farms and submarine cables and reflects extensive experience in the United Kingdom with managing spatial conflicts between offshore wind farms and submarine cables.

- **Cable Awareness Programs**: To reduce anchoring- and fishing-related risks, submarine cable operators notify nautical charting authorities of installed submarine cable locations, and share location information with commercial fishermen. As part of such efforts, NASCA regularly shares route position list ("RPL") data with commercial fishermen and government agencies. In some jurisdictions, such as Australia and New Zealand, the governments themselves disseminate cable route information and liaise directly with fishing and maritime industries.

- **Default and Minimum Separation Distances**: A default separation distance establishes a minimum separation distance between an existing submarine cable and another marine or coastal activity in the absence of any mutual agreement to allow the activity in closer proximity to the submarine cable. A minimum separation distance establishes an absolute minimum separation distance between

the submarine cable and the other marine or coastal activity. Although no U.S. federal, state, or local government agency has promulgated laws or regulations establishing default or minimum separation distances, BOEM has reached an informal agreement with the U.S. Coast Guard not to allow the installation of wind energy structures within one nautical mile of a traffic separation scheme, and the U.S. Coast Guard also regularly establishes safety zones around facilities energy exploration and exploitation activities on the U.S. outer continental shelf. Consistent with ICPC and other industry standards, many countries—as diverse as China, Denmark, Indonesia, Russia, Singapore, and the United Kingdom—have established default or minimum separation distances to protect submarine cables.

- **Cable Protection Zones and Corridors**: Unlike default separation distances or buffer zones, cable protection zones and corridors prohibit specified activities posing risks to submarine cables—including fishing, anchoring, and dredging—within fixed geographic areas. Cable protection zones grant protections to submarine cables that choose to locate—or are already located—therein. Corridors, by contrast, require submarine cable operators to route their infrastructure in defined geographic areas. Both Australia and New Zealand—which have the world's most advanced cable protection regimes—have established cable protection zones, which they enforce with air and sea patrols and for which they impose severe infringement penalties. By contrast, submarine cable operators have generally opposed cable corridors out of concern that such corridors (a) are likely to be narrow and therefore provide insufficient spatial separation from other submarine cables for installation and maintenance, (b) encourage geographic clustering of submarine cables, which magnifies the risk that a single natural or man-made event could damage multiple cables or cable landing stations and thereby impair the continuity of communications on particular geographic routes, and (c) limit landing options to particular coastal points, which might be inconveniently located with respect to terrestrial backhaul networks and customers.

- **Laws Establishing Civil and Criminal Liability for Cable Damage**: The 1884 Convention requires state parties to establish offenses for cable damage. As noted above, the United States has established offenses for willful and negligent injury to submarine cables, but the penalty amounts have not been updated since enactment more than 125 years ago. Other countries, such as Australia and New Zealand have established more substantial penalties, ones that are more likely to have a deterrent effect on those who might damage submarine cables. Countries such as Sweden require that if the owner of a cable or pipeline causes damage to another cable or pipeline, the owner shall pay the cost of repairing the damage.

- **Marine Spatial Planning**: To date, U.S. federal agencies have generally undertaken only site-specific analyses for individual cases and projects, which places the burden on the submarine cable operator to justify a particular method

of protection. Some U.S. states have been more inclined than others to address matters relating to cable separation, installation, available routing, and landing locations through spatial planning. NASCA participates directly as a stakeholder organization in the Mid-Atlantic Council on the Ocean ("MARCO") and the Northeast Regional Ocean Council ("NROC").

- **Cable-Fishing Committees**: Commercial fishermen (particularly those engaged in bottom trawling and crab pot fishing) and submarine cable owners have formed regional committees in specific areas around the world to address sharing of the seabed. In most of these cases, the parties have entered into a cooperative agreement on cable routing to avoid highly fished areas, declaration of no-fishing zones, and fishing procedures in the vicinity of submarine cables. Particularly in the United States, these agreements have proved very effective in reducing the risk of damage to submarine cables by commercial fishing activities.

- **Crossing Agreements**: Submarine cable owners have long entered into crossing agreements with pipeline and power transmission cable operators to define the locations of the respective infrastructures, agreed crossing notification procedures, and means and methods for the activity. With offshore renewable energy infrastructure, however, there have been no such agreements with submarine cable operators, although submarine cable operators remain interested in negotiating such agreements. This is due in part to the relative newness of such projects but also a general lack of awareness of submarine cables, a failure to consult with submarine cable operators, and a failure to comply with the consultation requirements of other agencies.

- **Mesh Networking**: In addition to the measures noted above, which focus on spatial separation of submarine cables from each other and other marine activities, some submarine cable operators also seek to minimize the risk of service outages from any one network component through the use of optical mesh-network topologies. A mesh network topology is a decentralized network design in which each node on the network connects to at least two other nodes on the network and in which the network permits reconfiguration and routing around broken or unreliable nodes, ensuring a self-healing capability. The use of optical mesh topologies by service providers serves to enhance the resiliency of submarine cable networks, but it is not a substitute for other cable protection measures.

1.6 Evaluation and Recommendations

Existing submarine cable protection mechanisms in the United States are inadequate in absolute terms and fall far short of measures adopted by other developed and developing countries. Although the U.S. Government has identified submarine cables as critical infrastructure, no U.S. federal agency has transposed that finding in practical terms to adopt or enforce cable-protection standards or policies. Moreover, federal agencies

generally fail to coordinate among themselves and with their state and local counterparts on even an *ad hoc* basis to ensure submarine cable protection, resulting in continuing problems with proposals and licenses for offshore energy installations and dredging projects, and beach replenishment projects directly over or adjacent to installed submarine cables. Consequently, this disconnect between the acknowledged importance of submarine cable infrastructure and U.S. Government policies and mechanisms for protecting that infrastructure continues to pose a serious threat to U.S. national security and the U.S. economy. Although the United States leads the world in submarine cable connectivity, its cable protection regime is significantly underdeveloped in comparison to developed and developing countries.

Due to a lack of awareness of submarine cables, their operational requirements, and their national security and economic significance, federal, state, and local agencies can exacerbate risks to submarine cable infrastructure. The self-help mechanisms traditionally used by submarine cable operators to coordinate with offshore oil and gas and commercial fishing activities have thus far proven wholly inadequate for addressing emerging issues with offshore renewable energy development and increasingly fail to address continuing issues with oil and gas development, dredging, and beach replenishment. To enhance and supplement existing industry efforts, WG8 recommends that the FCC endorse the following recommendations:

- **Early Consultation**: The FCC and submarine cable operators should work with other U.S. Government agencies and other stakeholders to consult with and among each other at the earliest possible time to address spatial requirements for submarine cables and their relationship to other proposed marine activities and infrastructure.

- **Multiple Measures**: The FCC and submarine cable operators should promote development and implementation of multiple measures—some existing, some yet to be developed—by government agencies and industry. Submarine cable protection is a complex undertaking that requires more than just a default separation distance from other marine activities, helpful though such a default separation distance can be.

- **Categorical Exclusion Zones Around Existing Submarine Cables**: The FCC should endorse and explore with other federal, state, and local government agencies the creation of exclusion zones around existing submarine cables that would exclude on a categorical basis activities within a defined distance of a submarine cable absent agreement with the submarine cable owner. These zones should reflect well-established spatial requirements for cable installation and maintenance. Technological developments by other marine activities are irrelevant to these minimum spatial requirements, and no amount of consultation will change these minima. Where submarine cables traverse lease blocks for potential energy leases and rights of way for energy infrastructure, energy

agencies should either (a) require lessees to maintain specified separation distances between offshore energy facilities and submarine cables or (b) decline to authorize development and installation offshore energy facilities within specified areas of lease blocks containing submarine cables.

- **Default Separation Distances**: In the absence of a specific methodology or separation distances for specific offshore activities in relation to submarine cables, and in the absence of agreement among agencies and stakeholders for particular activities or particular projects, the FCC should—consistent with ICPC and other industry recommendations and the best practices of other governments—endorse a default separation distance of 500 meters in water depths of less than 75 meters and the greater of 500 meters or two times the depth of water in greater depths of water. The FCC should also urge other federal, state, and local government agencies to recognize such default separation distances. Such a default separation distance would not prohibit closer proximity between a submarine cable and another offshore activity, but it would require consultation and agreement.

- **Endorsement of Existing International and UK Standards**: The FCC should recognize—and urge other federal, state, and local government agencies to recognize—ICPC, NASCA, and Subsea Cables UK recommendations as standards and best practices regarding submarine cable protection.

- **Development of New and Updated Standards**: The FCC should encourage NASCA, ICPC, and other industry bodies to update existing recommendations and develop new ones to address emerging risks, such as specific developments with renewable energy facilities and activities.

- **Greater Public Dissemination of Standards**: The FCC should encourage ICPC to undertake measures to enhance the public availability and dissemination of its recommendations and model crossing agreement. Historically, many of these documents have been available only on request, a practice that can limit awareness of these critical cable-protection tools.

- **Recharacterization of ICPC "Recommendations"**: The FCC should encourage ICPC to consider re-labelling its recommendations as standards, given that other marine activities and regulators often claim that "recommendations" are not authoritative.

- **ICPC Membership**: The FCC should explore whether it or another U.S. Government agency should join ICPC as a member, as ICPC's 2013 change in membership rules means that ICPC now welcomes government participation. Such membership and participation would provide the FCC with more up-to-date

information about submarine cable operations and deployments and provide a useful forum for engaging on cable-protection and marine-spatial-planning issues.

- **Standardize Treatment of Route Position List ("RPL") Data Across Agencies**: The FCC should work with submarine cable operators and other U.S. Government agencies to develop a standardized approach to RPL data dissemination—and favor dissemination of such data—in order to promote awareness of installed submarine cables and the spatial requirements for existing and future cables. At present, submarine cable operators receive conflicting requests from various U.S. Government agencies. Some agencies seek to limit distribution of RPL data for security reasons, out of a fear that RPL data will provide terrorists with sensitive information about the location of critical infrastructure. Other agencies seek to disclose RPL data in full during a permitting process. Consequently, submarine cable operators often hesitate to share such data out of a concern that one or more U.S. Government agencies will oppose such sharing.

- **Mesh Networking**: The FCC and submarine cable operators should promote the use of mesh networking as a critical supplement to traditional cable-protection activities, recognizing that such methods may not be possible for all but the largest carriers.

- **Greater Statutory Penalties for Cable Damage**: The FCC should highlight for other U.S. Government agencies and the U.S. Congress the need for legislation substantially increasing the civil and criminal penalties for damage to submarine cable infrastructure. The current penalty levels are far too low to deter activities that might damage installed submarine cables and do not even cover the cost of repair. These penalties do not reflect global best practices.

- **FCC Rule Modification**: The FCC should revoke or revise the standard licensing condition in 47 C.F.R. § 1.767(g)(2), providing that a cable must be moved upon request of the Secretary of the Army—a condition that could be invoked for a dredging or beach replenishment project. This condition is inconsistent with the status of submarine cables as critical infrastructure and unworkable as a practical matter.

2 BACKGROUND ON CSRIC IV AND WORKING GROUP 8

2.1 Objectives and Methods

The FCC has tasked WG8 with examining the risks posed to submarine cable infrastructure and how proximity to other marine activities, governmental permitting processes, and clustering of cable routes and landings can increase the risk of cable

damage and harm U.S. network resilience. WG8 will recommend separation standards and alternative architectures, government policies, and interagency coordination mechanisms to promote a more resilient submarine cable infrastructure.

WG8 will produce three separate reports:

- ***Report 1*** recommends approaches for spatial separation of submarine cables and other offshore activities/infrastructure to ensure infrastructure protection and continuity of communications.
- ***Report 2*** will examine gaps, conflicts, and sources of delay in existing federal, state, and local interagency coordination for offshore permitting and recommend mechanism for enhancing coordination without increasing regulatory burdens.
- ***Report 3*** will address industry best practices and government policies for promoting geographic diversity of submarine cable routes and landings.

For this Report 1, WG8 focused on identifying risks to submarine cable infrastructure—both natural and man-made—and possible protection measures used to mitigate such risks. As the subject matter of this Report 1 is likely unfamiliar to non-specialists, WG8 also developed a summary of submarine cable technology, operations and spatial needs, and the legal regime for regulating and protecting submarine cables.

2.2 Membership

WG8 consists of approximately 25 members. They represent diverse interests including submarine cable operators, cable system customers, marine services consultants, federal energy agencies, and state regulators, all with subject matter expertise to accomplish WG8's objectives.

WG8 CHAIR: Kent Bressie, Harris, Wiltshire & Grannis LLP on behalf of the North American Submarine Cable Association

FCC LIAISON: Michael Connelly, Public Safety and Homeland Security Bureau

WG8 MEMBERS AND PARTICIPANTS

NAME	ORGANIZATION
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* *As an independent regulatory agency, FERC and its personnel are not formal members of WG8 and participate only in an informal, advisory capacity.*

3 BACKGROUND ON SUBMARINE CABLES AND THE FCC'S ROLE IN REGULATING THEM

3.1 Submarine Cables Are Critically Important to U.S. National Security and the U.S. Economy

Contrary to popular perception, more than 95 percent of all U.S. international voice, data, and Internet traffic travels by submarine cable[1]—a percentage that continues to increase over time.[2] Submarine cables provide higher-quality, more reliable, more secure, and less expensive communications than do satellites.[3] Submarine cables provide the domestic principal connectivity between the contiguous United States and Alaska, Hawaii, American Samoa, Guam, the Northern Marianas, Puerto Rico, and the U.S. Virgin Islands, and provide substantial intrastate or intra-territorial connectivity in Alaska, Hawaii, the Northern Marianas, and the U.S. Virgin Islands.

Submarine cables play a critical role both in ensuring that the United States can communicate domestically and with the rest of the world, and in supporting the critical economic and national security endeavors of the United States and its citizens. Submarine cables support U.S.-based commerce abroad and provide access to Internet-based content, a substantial proportion of which is located in the United States. They also carry the vast majority of civilian and military U.S. Government traffic, as the U.S. Government does not own and operate its own submarine cables.

The territorial-sea and outer continental shelf ("OCS") areas of the United States and its territories contain significant existing and planned submarine cable infrastructure, and more is planned. As described in Appendix A and identified in the map in Appendix B to this Report, at least 55 in-service submarine cable systems traverse these areas, and at least 11 more have been announced or are currently under construction. Some of these systems have multiple cable segments, for example, the Apollo and TGN Atlantic systems each have two roughly parallel cables traversing the Atlantic.

Submarine cables—which typically have the diameter of a garden hose—are installed and repaired by cable ships built specifically for cable-related operations and designed for

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1 The terms "submarine cables" and "undersea cables" are used interchangeably here to refer to telecommunications cables deployed in the marine environment. They are distinguished from "power cables" and "power transmission cables."

2 *See Submarine Cables and the Oceans: Connecting the World*, United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) Biodiversity Series No. 31 (UNEP-WCMC and ICPC, 2009) at 8, www.iscpc.org/publications/ (noting that more than 95 percent of the world's telecommunications and Internet traffic is routed via submarine cable) ("UNEP-WCMC-ICPC Report").

3 *Id*. at 15-16.

covering vast distances and multi-month deployments. Cable ships are crewed by highly trained and experienced merchant mariners, marine engineers, and cable operations staff. These ships use a variety of sea plows, lines, and grapnels, and depending on sea conditions, remotely operated vehicles ("ROVs"), for manipulating cable and repeaters whether in the water column or laying on or buried in the seabed.

The normal planned commercial lifespan of submarine cable systems is 25 years.[4] Nevertheless, the commercial lifespan of submarine cable systems may extend well beyond 25 years, particular where the systems have been upgraded or redeployed. Consistent with these characteristics, the Federal Communications Commission ("FCC") grants cable landing licenses for a term of 25 years (subject to renewal) from commencement of commercial service.[5]

Cable maintenance providers contract with individual owners of submarine cable systems and/or with regional maintenance authorities (consisting of cable operator consortia in particular geographic areas that contract jointly for maintenance services) for the provision of long-term maintenance services. They also occasionally contract with system owners for one-off maintenance operations. Cable and repeaters used for repairs (commonly referred to as "spares") are typically manufactured on a system-specific basis and kept on hand for immediate use by the maintenance provider.

Although damage to submarine cables is rare, it is most often caused by human activities such as commercial fishing (in which trawl nets, clam dredges, and other bottom-contact gear ensnare cables), vessel anchors, dredging related to sand and mineral extraction, petroleum extraction, pipeline construction and maintenance, and other cable activity.[6] Seabed uses change over time, and newer activities, such as renewable energy projects, located near submarine cables raise the potential for damage to submarine cables and pose particular challenges for both the submarine cable and energy industries. Submarine cables are also at risk from natural hazards such as hurricanes, underwater landslides, and seismic events such as earthquakes and tsunamis resulting therefrom.[7] These risks can be magnified by clustering of cables in the same sea floor areas. This Report explores these risks in greater detail in Section 5 below.

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4 UNEP-WCMC-ICPC Report at 33.

5 47 C.F.R. § 1.767(g)(14).

6 *See* UNEP-WCMC-ICPC Report at 43-48; International Cable Protection Committee, *Fishing and Submarine Cables: Working Together* (2d ed. 2009), http://cil.nus.edu.sg/wp/wp-content/uploads/2009/10/ICPC-Fishing-Booklet-090223.pdf; International Cable Protection Committee, *Loss Prevention Bulletin: Damage to Submarine Cables Caused by Anchors* (Mar. 18, 2009), https://iscpc.org/publications/; International Cable Protection Committee, *About Submarine Telecommunications Cables* (presentation), Oct. 2011, www.iscpc.org/publications/ ("About Submarine Telecommunications Cables").

7 *See* About Submarine Telecommunications Cables at 37.

Damage to submarine cables can pose grave risks to U.S. national security and the U.S. economy, given the U.S. Government's reliance on such cables to communicate with its civilian and military personnel worldwide and with other governments, and given the dollar-value of commerce conducted using submarine cables.[8] Timely repairs are therefore critical, and maintenance providers and cable ships must be prepared to respond rapidly, with vessels on stand-by with continuously-qualified personnel and appropriate equipment. Recent damage to submarine cables in Alaska in 2013 and 2014, east Africa in 2012, in the Pacific following the Tohoku earthquake in 2011, and in East Asia, South Asia, and West Africa in July and August of 2009, underscores the importance of such maintenance operations.[9] In many of these cases, cable damage resulted in significant disruptions of communications and slower Internet speeds.

3.2 Scope and Elements of Submarine Cables

Submarine cables are large infrastructure projects that can vary in cost from tens of millions to billions of dollars depending on the length and complexity of the system. First developed in the 1850s as submarine telegraph cables, they currently use the most advanced fiber-optic technologies to provide breathtaking amounts of capacity over a facility the diameter of a garden hose.

As shown in Figure 3A, a submarine cable system has three main components:

(1) the "wet" or marine segment, *i.e.*, subsea cable, repeaters, and branching units resting on or buried in the seabed;

(2) shore-end facilities connecting the wet segment to the cable landing station, including the beach manhole (where the cable emerges from the sea) and duct and conduits connecting the beach manhole to the cable station; and

(3) terminal equipment historically housed in a single structure known as the cable landing station, including power feed equipment that powers the system in

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8 *See, e.g.*, *Economic Impact of Submarine Cable Disruptions*, APEC Policy Support Unit (Feb. 2013), www.apec.org/Projects/~/media/Files/Projects/TendersRFPs/2012/20120203_SubmarineCableDisruptionsRFP_FINAL.ashx.

9 *See* Pat Forgey, *5.9 earthquake causes telecom outage in Southeast Alaska*, ALASKA DISPATCH NEWS (July 25, 2014), www.adn.com/article/20140725/59-earthquake-causes-telecom-outage-southeast-alaska; David Smith, *East Africa internet access slows to a crawl after anchor snags cable*, THE GUARDIAN (UK) (Feb. 28, 2012), http://www.guardian.co.uk/world/2012/feb/28/east-africa-internet-access-anchor; Solomon Moore, *Ship Accidents Sever Data Cables Off East Africa*, WALL ST. J. ONLINE (Feb. 28, 2012), http://online.wsj.com/article/SB10001424052970203833004577249434081658686.html; Owen Fletcher & Juro Osawa, *Rush to Fix Quake-Damaged Undersea Cables*, WALL ST. J. ONLINE (Mar. 15, 2011), http://online.wsj.com/article/SB10001424052748704893604576199952421569210.html; Sean Buckley, *Southeast Asia undersea cable suffers major damage*, FIERCETELECOM.COM (Aug. 13, 2009), http://www.fiercetelecom.com/story/southeast-asian-undersea-cable-suffers-major-damage/2009-08-13.

addition to the transmission electronics known as submarine line terminating equipment ("SLTE"), the line monitoring system ("LMS") that monitors the performance of submarine plant, and the network management system ("NMS") that controls the system.

Traditionally, a submarine cable operator or its customers contracted with backhaul providers—owners of terrestrial facilities connecting a cable landing station to metropolitan and intercity networks—but these backhaul facilities have never been considered part of the submarine cable system (and are not licensed by the FCC under the Cable Landing License Act). To reduce latency (the milliseconds of delay between transmission and receipt of a fiber-optic signal) and improve performance for customers, submarine cable operators increasingly locate the SLTE in points of presence ("POPs," *i.e.*, points where different networks connect with each other) or data centers closer to or in metropolitan areas, rather than in cable stations.

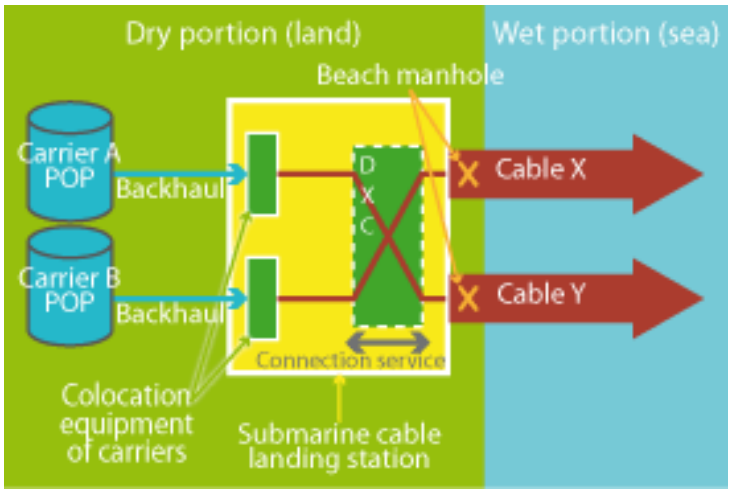

Figure 3A: Diagram of a Submarine Cable System[10]

The process by which a submarine cable system is designed, manufactured, and installed can last between 18 and 30 months and consists of the following phases:

- System design and route planning
- Permitting and licensing
- Marine and coastal surveys for route and landing point assessment
- Manufacturing of the system (cable, repeaters, etc.)
- Marine and shore installations
- Testing

[10] Source: International Telecommunication Union, *Liberalizing International Gateways*, http://www.itu.int/itunews/manager/display.asp?lang=en&year=2009&issue=01&ipage=26&ext=html.

The development and procurement process starts even earlier, with the development of the business case for a new system and development and execution of the procurement process for soliciting bids among competing suppliers, of which there are comparatively few.

3.3 Complex Federal Regulation

Submarine cables landing in the United States are subject to complex regulation at the federal, state, and local levels. Submarine cable installation activities are often regulated though the same processes as other offshore infrastructure that pose greater environmental issues.

3.3.1 *The FCC Functions as the Primary Regulator of Submarine Cables Landing in the United States*

Although numerous federal, state, and local government agencies issue licenses, easements, and permits governing installation and construction activities associated with submarine cables landing in the United States (as discussed further in Section 6 of this Report 1), in practice the FCC functions as the primary regulator and is responsible for licensing all international submarine cables landing in the United States. The FCC is therefore in the best position to advocate for cable-protection initiatives and coordination among various governmental agencies.

To land or operate a submarine cable in the United States, an operator must obtain a cable landing license from the FCC pursuant to the Cable Landing License Act of 1921.[11] As part of the application process, an operator must provide a general route map and specific geographic landing-point information to the FCC.[12] Before granting any cable landing license, the FCC must seek to obtain the approval of the U.S. Department of State (acting through its Office of International Communications and Information Policy), which coordinates with the U.S. Department of Commerce's National Telecommunications and Information Administration and the U.S. Department of Defense's Defense Information Systems Agency.[13] The FCC's rules provide that the location of any cable in the U.S. territorial sea and on shore must conform to plans approved by the Secretary of the Army and that a cable must be moved at the licensee's expense upon a request of the Secretary

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[11] An Act Relating to the Landing and Operation of Submarine Cables in the United States, *codified at* 47 U.S.C. §§ 34-39; Executive Order 10,530, *reprinted in* 3 U.S.C. § 301 (delegating President's authority under Cable Landing License Act to the FCC); 47 C.F.R. § 1.767. A cable system (including all cable stations for the system) lying wholly within the continental United States is exempt from this licensing requirement. 47 U.S.C. § 34.

[12] 47 C.F.R. § 1.767(a).

[13] *Id.* §§ 1.767(b), (j).

of the Army for reasons of public interest, national defense, or harbor improvement.[14] To extend or relocate part of a submarine cable system licensed by the FCC, an operator must obtain the FCC's prior consent.[15]

The FCC plays a coordinating role in various interagency processes, and other governmental agencies frequently look to the FCC for guidance on matters pertaining to submarine cables. No other agency collects as much timely or centralized information about planned and in-service cables and their locations.

It was for this reason that the White House Office of Science and Technology Policy ("OSTP") looked to the FCC to implement a new system of reporting on submarine cable outages and restoration arrangements in 2008.[16] Reinforcing the FCC's central role, the U.S. Departments of Defense, Homeland Security, and Justice (collectively known as "Team Telecom" in this context) seek to enforce security-related requirements on foreign-owned and international submarine cables by petitioning the FCC to add conditions to cable landing licenses and FCC orders granting consent for assignments and transfers of control of cable landing licenses.

3.3.2 *Other Federal Regulation*

The installation of a submarine cable system involves a multitude of other federal, state, and local permits, most of which are not coordinated at all with the FCC—or with each other. The U.S. Army Corps of Engineers ("Army Corps") grants permits for submarine cables as structures located in the navigable waters of the United States pursuant to the Rivers and Harbors Act of 1899 and also under the Clean Water Act, to the extent the cables traverse coastal wetlands or involve certain discharges. The Army Corps typically completes an environmental review under the National Environmental Policy Act before issuing the permit and will consult with other agencies on fisheries and endangered species issues, including the U.S. Fish and Wildlife Service and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration ("NOAA"). If a cable system will traverse a national marine sanctuary, the cable owner must also obtain a permit from NOAA's National Ocean Service under the National Marine Sanctuaries Act.

3.3.3 *State/Territorial and Local Regulation*

State/territorial and local regulation of a particular submarine cable system depends on the locations of its U.S. landings. State regulation tends to focus on environmental regulation in the state territorial sea (which extends three nautical miles seaward from the

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[14] *Id.* § 1.767(g)(2).

[15] *Id.* § 1.767(e).

[16] *Federal Communications Commission, Notice of Public Information Collection(s) Being Submitted for Review by the Office of Management and Budget*, 73 Fed. Reg. 23,460 (April 22, 2008).

shore) and on coastal land and beaches. There is significant variation in the regulatory processes and requirements, ranging from the lengthy processes of California's Coastal Commission and State Lands Commission to more streamlined requirements elsewhere. Local governments generally conduct environmental and land use reviews in connection with easements and rights of way between the beach manhole and other near-shore facilities, although certain localities have more substantial jurisdiction over adjacent marine areas (*e.g.*, the City of Hermosa Beach, California).

Federal permits are subject to state review for their consistency with state coastal zone management plans approved by the Secretary of Commerce under the Coastal Zone Management Act ("CZMA"). Under the CZMA, states generally have the right to review federal activities affecting coastal areas within the state's jurisdiction.

4 Spatial Requirements for Submarine Cable Installation and Maintenance

Submarine cable operators require ready and unfettered access to their cables for installation and maintenance needs and to minimize outage time in connection with a repair. To achieve this and to minimize conflicts with other marine activities, submarine cable operators use a variety of coordination and cooperation mechanisms. These include extensive coastal and marine spatial planning, cable spacing and crossing standards, cable awareness programs and outreach, and coordination with other users of marine and coastal areas, particularly commercial fishermen.

4.1 Cable Characteristics

Any cable protection regime must account for the physical characteristics of submarine cables and the mechanical characteristics of the installation and repair vessels and tools. These characteristics—along with weather, sea, and seabed conditions—greatly determine the specifics of a given cable installation or repair and its impact, if any, on the marine and coastal environment. Since most submarine cables installed in near-shore areas use armored fiber-optic cable, this discussion will focus on that type of cable.

Figure 4A: Examples of Unarmored and Armored Fiber-Optic Cable[17]

Cable armoring helps to protect a submarine fiber-optic cable from fault-triggering events in the marine and coastal environment. A "fault" is an event associated with an installed submarine cable requiring some maintenance or repair activity to ensure continued useful service of the cable. Faults may be caused by external or natural aggression. "External aggression"—fault-triggering events caused by third parties and their equipment—accounted for more than 80 percent of submarine cable system faults. Among these external aggression events, commercial fishing remains the major cause, second only to ship anchoring. "Natural aggression"—fault-triggering events caused by wear and tear resulting from abrasion and geological activity, and by component failure—account for the remainder of the faults.

Armored cable is distinguished by high tensile strength, abrasion and crush resistance, and inherent torque. The tensile strength and crush and abrasion resistance serve to protect the cable not only in the marine and coastal environment but also from the installation and maintenance operations themselves (namely, from being passed through the sea plow). Cable manufacturers purposely build torque into the cable to permit coiling in cylindrical storage tanks in warehouses and ships prior to deployment. Storing cables in coils is efficient both in terms of storage space and ease of manipulation, whether adding to or removing from a storage tank. Torque, however, also causes the cable to loop back on itself when slack. Loops can result in transmission failures if pulled tight, they can stand upright on the seabed, and they are more susceptible to physical damage due to greater exposure above the seabed. To avoid having the cable throw loops when it is uncoiled, it is laid on the sea floor under tension.

[17] Source: Tyco Electronics Subsea Communications, LLC.

4.2 Marine Route Study and Survey

To identify the safest and most economic route for a new submarine cable, the owner will commission a desktop study and a marine survey. These two undertakings will attempt to identify all of the risks discussed in Section 5 below and define the safest cable route. Through the study, the owner and its supplier can often minimize or eliminate hazards and conflicts. With greater development of the sea floor in the U.S. territorial sea, EEZ, and OCS, however, the availability of suitable unused routes has been exhausted, forcing submarine cable operators to accept at least some risk.

To ensure effective identification of existing and future hazards, these processes typically include consultation with commercial fishermen and their unions, local, state, and federal agencies, and other marine industries.

Submarine cable operators evaluate potential routes and landing sites to account for a number of physical factors that could determine costs and risks, including:

a) the tectonic setting and associated sea floor morphology and lithology,
b) geological history,
c) seismicity,
d) surface faulting,
e) turbidity currents,
f) sediment waves,
g) sand waves,
h) coral reefs (tropical and cold water),
i) volcanic activity,
j) beach and near shore seabed stability: this includes determining the nature and composition of beach and near shore soils as well as examining indicators of shoreline instability such as the presence of offshore bars, washouts, beach erosion and slumping,
k) offshore geology and burial assessment: this includes sections along the proposed routing where cable burial will probably be required (i.e. high levels of activity / external aggression) and where soils are likely to prove good/difficult for cable burial,
l) Other geohazards, not covered in above sections [18]

They also examine other technical and man-made factors, such as previous fault history for cables in the area, commercial fishing trends, sediment borrow practices, military exercise patterns, sensitive environmental areas, and other seabed structures. Submarine cable operators then use the results of the route survey to modify the initial route identified in the desktop study.

[18] ICPC Recommendation No. 9 "Minimum Technical Requirements for a Desktop Study" Issue 4, 6 March 2012, page 5

4.3 Cable Operations

4.3.1 *Access for Vessels and Equipment*

Cable ships are large vessels (often more than 125 meters in length) that require space in which to maneuver when installing or repairing submarine cables, and to accommodate the effect of bad weather on the ocean. Offshore developments involving large structures, like oil platforms, turbine towers, and submerged structures, present obstacles precluding cable ships from having ready access to the sea floor for new installations (and for repair of previously-installed cables). Heavy vessel traffic, fishing or military operations and seasonal restrictions can also impede or delay installation.

Figure 4B: A typical cable ship, the C.S. *Dependable*[19]

Offshore developments that cover large areas of sea floor have the effect of forcing new submarine cable projects into "gaps" on the sea floor between offshore developments. This, in turn, limits the access that cable vessels and the equipment necessary for cable installation (sea plows) and repair (grapnels and ROVs) have to the sea floor and the cable laid there. The result is to make the already complex tasks of cable installation and maintenance exponentially more complex, meaning that cable faults will be repaired less quickly and communications system outages will last longer, and that the costs to operators and the customers they serve could increase considerably.

4.3.2 *Installation*

Cable installation operations are conducted 24 hours per day. The cable end is floated ashore from the primary cable ship or from a smaller secondary one. If a secondary ship is used to pre-install the shore end, then the cable ship will splice to the shore end and continue the lay. In near-shore areas, cable is generally buried to protect it from the

[19] Source: Tyco Electronics Subsea Communications, LLC.

hazards described above. In limited areas where there are no significant fishing or anchoring risks or where the seabed does not permit burial, it will be laid on the surface of the sea floor. During installation, it is critical that the cable lay flat. Loops are undesirable for a variety of reasons, as noted above. Cable installers use various slack management techniques and software to minimize these outcomes.

4.3.3 *Cable Retrieval*

To recover a cable from the sea floor for repair purposes, a ship can either grapple for the cable (dragging a grapnel on a line from the ship) or deploy an ROV depending on sea conditions. ROV use is limited to shallower depths between 50 and 2000 meters with moderate currents and good visibility. ROV use is also limited to cable laid on the surface of the sea floor. Therefore most cable retrieval is done with grapnels. To retrieve a surface-laid cable in deeper water, a cable ship uses grapnels. And to retrieve a buried cable at any depth, a cable ship uses a de-trenching grapnel, the size and weight of which increases with the depth of water.

The grapnel (whether for surface-laid or buried cable) is lowered to the sea floor from lines on the cable ship and dragged in a direction perpendicular to the cable. This allows the grapnel to dig into the seabed and under the cable, maximizing the chance that the grapnel will hook the cable (rather than graze or accidentally release it) and bring it to the surface of the seabed. Current ship positioning technology allows for extremely accurate placement of this gear and for controlled cable retrieval. Nevertheless, bad weather, heavy seas, or strong currents can decrease the accuracy of these operations—a situation which poses a greater risk to other submarine cables or sea floor installations in the vicinity of the target cable.

Figure 4C: Typical 1-Meter Grapnel for Recovery of Buried Cable[20]

[20] Source: Tyco Electronics Subsea Communications, LLC.

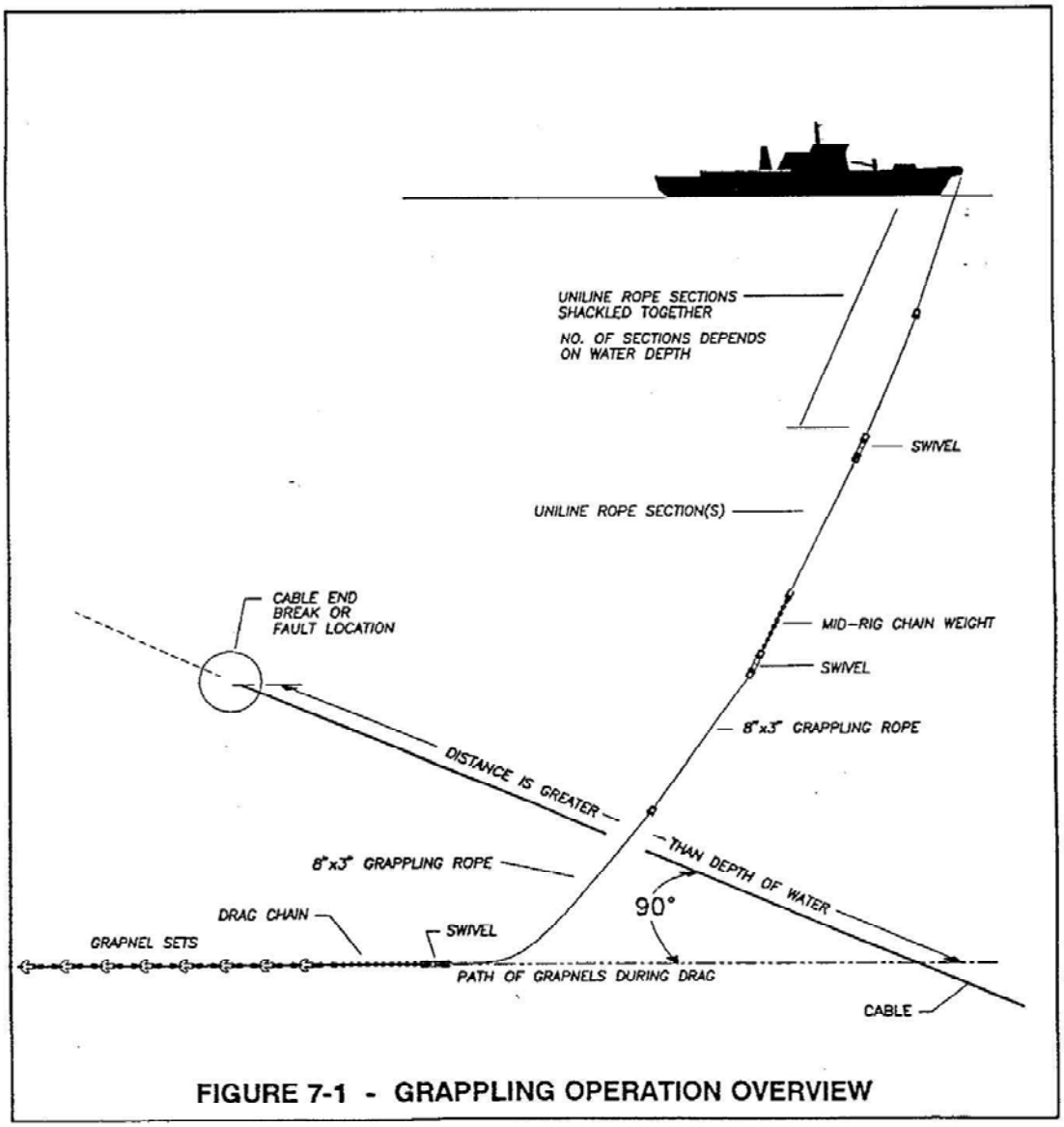

Figure 4D: Grappling Operation Overview[21]

4.3.4 *Splices and Repairs*

A damaged submarine cable must be repaired onboard a cable ship. But a cable (whether tensioned or not) that is resting on, or buried in, the seabed will lack sufficient slack to reach the surface for repair. Unless a cable is already severed, therefore, it must first be cut in order to be brought to the surface. This retrieval operation takes at least three

[21] Source: Tyco Electronics Subsea Communications, LLC.

passes with the grapnel—one to cut the cable, a second to bring up and buoy one end of the cable, and a third to bring up and bring onboard the second end. After the ends are repaired and tested, a section of cable must be spliced in between the two ends in order to have them meet at the surface and restore connectivity. This additional section is typically two and a half times the depth of water in length. This length permits what was previously a cable lying flat on the sea floor to reach up to the cable ship, provide length for manipulation and repair activities on board, and reach back down to the sea floor.

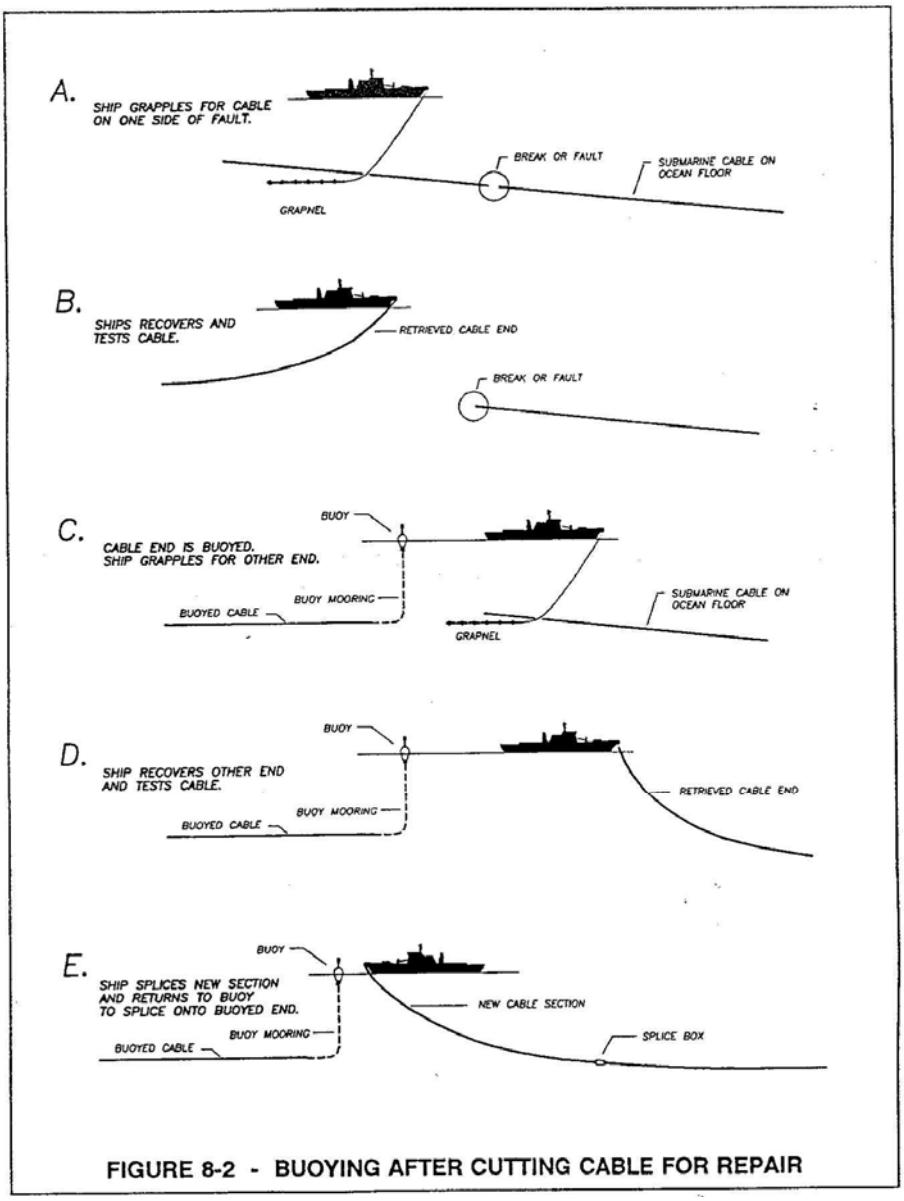

Figure 4E: Ship Operations During a Cable Repair[22]

[22] Source: Tyco Electronics Subsea Communications, LLC.

This final configuration (known as the final bight) must be carefully placed back on the seabed. The ship uses additional rope to pull the bight in a direction perpendicular to the line of the original cable and then lower it to the seabed. Only with this careful placement can the repair ship have any chance of laying the cable flat.

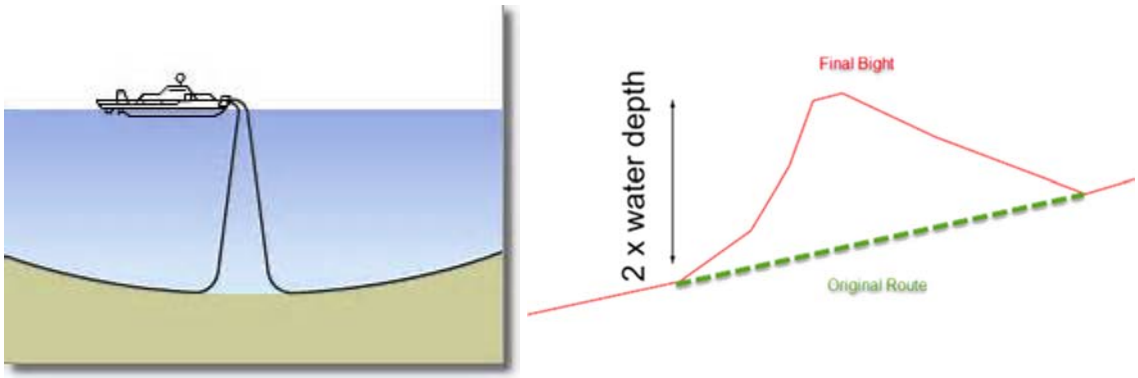

Figure 4F: Diagrams Showing Installation of Final Bight and Location on Sea Floor[23]

5 Risks of Damage to Submarine Cables

Submarine cables are subject to diverse natural and man-made risks of damage that vary depending on the state of implementation or operation of the system. These risks vary by physical conditions of the sea floor and ocean and by political and economic characteristics of adjacent coastal states and their marine activities and industries. Some of these risks are well-established while others are emerging. Some traditional risks have been contained or even minimized, while others continue to threaten submarine cables with some regularity.

In general, the more intensive use of U.S. coastal and marine areas for resource and infrastructure development activities creates a scarcity of unused and underused areas that might otherwise minimize risks to submarine cables simply due to wide spatial separations. First, these activities pose direct risks to submarine cables by threatening installed cables with equipment, anchors, infrastructure installation and operation, and resource exploration, exploitation, and transport. Second, these activities impair access to installed submarine cable systems, increasing repair costs and the length of communications outages. Third, these activities can distort routing and landing decisions, making it risky to use particular routes to reach well-established cable landing stations and terrestrial network POPs or, conversely, encouraging clustering of cables in

[23] Source: ICPC Recommendation 13, No. 2, at 27.

narrow corridors and landings, which magnify the risks of damage and communications outages across multiple systems due to particular natural or man-made events.

5.1 Traditional Risks

5.1.1 *Commercial Fishing*

Historically, commercial fishing has accounted for more than 40 percent of all submarine cable faults worldwide, as indicated by the fault data shown in Figure 5A below. This data reflects the fact that for most of the past 160 years, submarine cable operators and commercial fishing were the two principal marine industries making use of the seabed. Commercial fishing-related damage is most often caused by bottom-tending fishing gear such as trawl nets and dredges, but it is also cause by long lines anchored to the seabed and pot and trap fisheries using grapnels for gear retrieval.

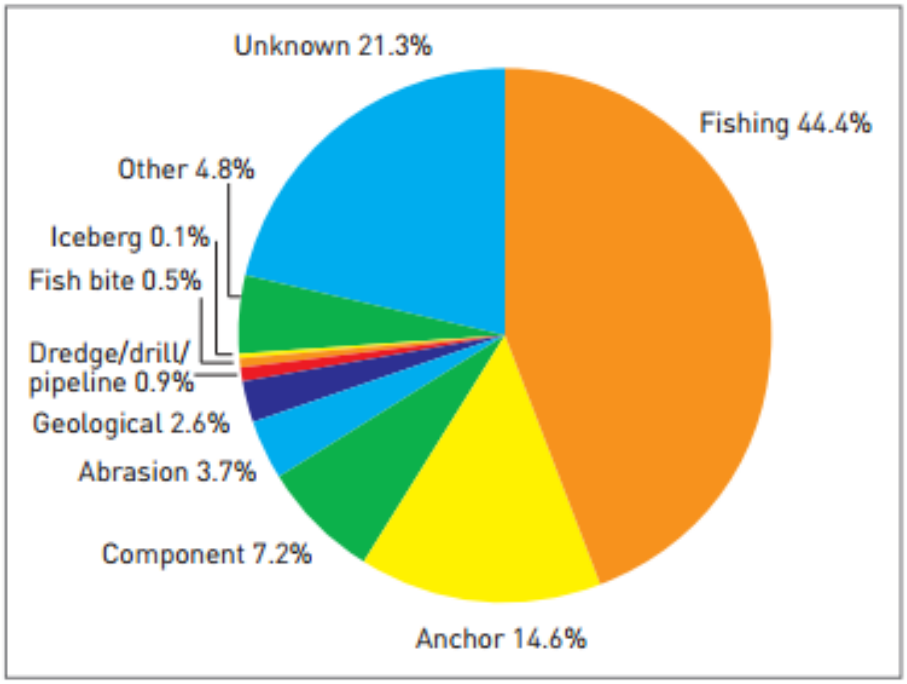

Figure 5A: Proportion of Cable Faults by Cause from a Database of 2,162 Records Spanning 1959 to 2006[24]

The submarine cable industry has implemented a number of mitigation strategies to limit cable faults resulting from fishing. These include:

[24] Source: UNEP-WCMC-ICPC Report, Figure 7.4 at 45.

1. Cable armoring,
2. Cable burial (from 0.5 meters to 3 meters) for cable installed at water depths less than 1500 meters,
3. Cable awareness and liaison programs designed to educate fishing fleets regarding the location of submarine cables, and actions to take if gear is snagged, and
4. Programs to compensate fishermen for snagged gear (so that they abandon snagged gear rather than damage cables in trying to free it).

While commercial fishing continues to pose the most significant risk of damage to submarine cables worldwide, it is relatively rare in the U.S. territorial sea and OCS, as the mitigation strategies pursued by submarine cable operators have proved very effective in the United States.

5.1.2 *Anchoring*

Anchoring accounts for approximately 15 percent of cable faults worldwide.[25] Anchoring threats include: improperly-stowed anchors, which release or fall overboard and can be dragged for great lengths along the sea floor, damaging cables along the anchor's path; anchoring outside of approved anchorages and near installed submarine cables; anchors dragged by properly-anchored vessels, depending on sea conditions;[26] and an anchor dropped in a marine emergency.[27] Submarine cable operators seek to route around designated anchorages.

5.1.3 *Dredging and Dumping*

The Army Corps of Engineers and the Bureau of Ocean Energy Management of the U.S. Department of the Interior ("BOEM") frequently authorize sand and gravel dredging in the U.S. territorial sea and OCS. U.S. beaches are often replenished by the Army Corps and its contractors or state and local authorities acting under permits issued by the Army Corps using sand from offshore borrow areas. These practices can be highly incompatible with submarine cables, which can be damaged by the dredging process itself and by anchors used by vessels, barges, and pipelines used to recover, transport, and pump dredged material back onto shore.

Moreover, sand and gravel dredging disturbs sea floor sediments, triggering erosion in other areas as sand migrates to fill the dredged area. This reduces the burial depth of submarine cables—exposing them to greater risk of damage by commercial fishing and

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[25] UNEP-WCMC-ICPC Report at 45.

[26] Doug Madory, *Beware the Ides of March, Subsea Cable Cut Trend Continues*, DYN RESEARCH (Mar. 31, 2014), http://research.dyn.com/2014/03/beware-the-ides-of-march/.

[27] *See, e.g.*, Consent Judgment, *General Communications, Inc. v. United States*, Case No. 10-cv-00856-RAJ (W.D. Wash., May 20, 2011); Complaint, *General Communications, Inc. v. United States*, Case No. 10-cv-00856-RAJ (W.D. Wash., filed May 21, 2010).

anchoring—and can damage cables through abrasion. While marine sand and gravel are often obtained from designated and charted borrow areas, sometimes they are not—particularly in response to storms such as Hurricane Sandy. Without systematic consultation by the Army Corps of its own permit records for submarine cables and systematic and direct notification to submarine cable operators regarding planned dredging operations well in advance of operations, these dredging projects will continue to pose a significant threat of damage to submarine cables.

Similarly, navigational dredging of harbors and channels such as the Intracoastal Waterway can pose risks to installed submarine cables, and submarine cable operators generally seek to avoid these areas if possible. The spoils from these dredging projects are often deposited in designated areas offshore, known as dredge deposit areas, and are usually maintained by the Army Corps. The Army Corps will often, but not always, prohibit installation of submarine cables through dredge deposit areas.

5.1.4 *Oil and Gas Development*

Historically, oil and gas development off the coasts of the United States has focused on the Gulf of Mexico, where there are relatively few submarine cables. As the demand for energy increases and as technology evolves, oil and gas infrastructure will likely move offshore into deeper waters and potentially to new areas along the Atlantic and Pacific coasts. The prospect of more intensive oil and gas uses of the U.S. OCS therefore requires significant and improved coordination with submarine cable operators.

Uncoordinated offshore oil and gas exploration, exploitation, and transport activities pose significant risks to submarine cables. Absent sufficient spatial separation and coordination, oil and gas activities threaten submarine cables with:

- Direct physical disturbance through the use of anchors for production platforms and semi-submersible drill rigs, support vessels, barges, and tankers; core sampling; drills, dredges, hydraulic jets, and cutting tools; and ROVs;
- Pipeline proximity to and crossings with cables, which pose direct physical disturbance risks during installation, operation, and maintenance and add significant complexity, costs, and time requirements for repair operations for a submarine cable (as well as the adjacent or crossing pipeline); and
- Impaired access to submarine cables both at the surface (for cable ships) and on the sea floor (for cables)—given the spatial needs for large-vessel cable ships to maneuver in variable ocean conditions on the ocean's surface (which can be impeded by the presence of platforms, rigs, tankers, and support vessels) and for sea plows, grapnels, and ROVs on the sea floor during installation and maintenance (which can be impeded by a variety of oil and gas equipment)—all of which increases the complexity, costs, and time required to complete installations and repairs and can increase the costs to customers of network outages.

With ICPC Recommendation 3, the submarine cable industry has sought to address the risks of submarine cable-pipeline crossings. Crossing agreements are often required where a cable and a pipeline (or another cable) must cross. These agreements specify the obligations and liabilities of each party during the installation and life cycle of the crossing. They are often required by the crossed party (whichever utility was there first) prior to giving permission to be crossed. In this case risk is reduced by agreeing the technical details of the crossing prior to the commencement of any work. Commercial liabilities are also agreed in the event of one party damaging the cable or pipeline of the other. Nevertheless, these mechanisms do not establish principles for minimizing crossings or limits on the total number of crossings for a particular cable.

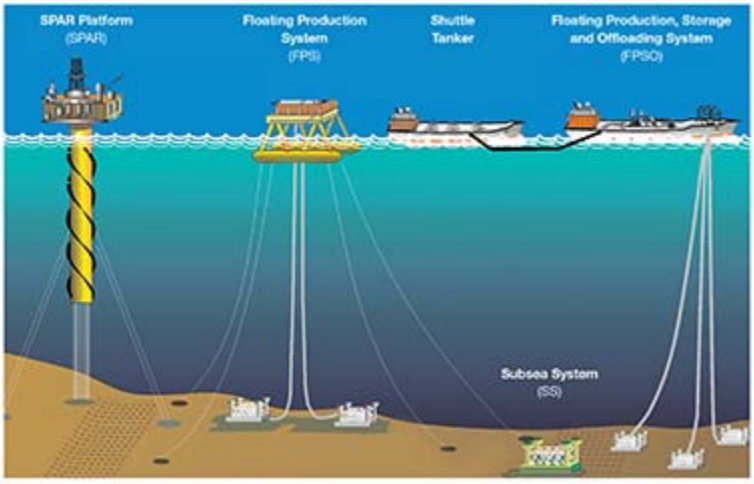

Figure 5B: Depiction of Subsea Infrastructure of Offshore Oil and Gas Platforms and Drill Ships[28]

Although the submarine cable and offshore oil and gas industries have a long history of working with each other, the renewed focus on U.S. domestic energy production and possible opening of the U.S. Atlantic OCS regions to oil and gas development (in the event the current development moratorium expires in 2017) will increase the risks to submarine cables. Indeed, 39 of the installed or planned submarine cable systems listed in Appendix A transit OCS planning areas identified by BOEM in preparation for its next

[28] Source: American Petroleum Institute, Oil and Gas Overview, http://www.api.org/oil-and-natural-gas-overview/exploration-and-production/offshore/~/media/Oil-and-Natural-Gas-images/Offshore-Primer-images/Thumbnails/Producing-Offshore-2_150x88.jpg.

five-year plan for oil and gas lease sales in the U.S. OCS, which will take effect in 2017.[29]

5.1.5 *Clustering of Submarine Cable Systems*

The clustering of submarine cables along particular routes (whether to avoid unfavorable sea floor topography, natural hazards, or man-made hazards such as dredging and dumping areas, fishing grounds, and energy infrastructure) increases the risk that installation or maintenance of one cable will cause direct physical disturbance to another, such as with plowing and grappling operations. Adherence to ICPC recommendations can reduce these risks.

5.1.6 *Earthquakes and Tsunamis*

Earthquakes and resulting tsunamis in the United States are concentrated in the Pacific and Caribbean islands, along the West Coast, and in Alaska. Earthquakes can trigger subsea landslides that sever or abrade cables. They can also trigger tsunamis, the force of which can damage both submarine cables and cable landing stations.

5.1.7 *Sea Floor Geology*

The geology of a cable landing and the area immediately offshore play a critical role in determining potential landing sites for submarine cable systems. Submarine cable operators prefer to land their cables in locations that have stable, benign landing features. Bottom features such as pinnacles or boulder fields that would leave a cable exposed, high current areas that could lead to chafing, long tidal flats, evidence of trawling (trawl scars), etc. require special consideration for both installation and maintenance of submarine cable systems. Such considerations may include horizontal directional drilling to bypass the feature of concerns, pinning cable to the bottom to avoid chafe, use of post-lay jetting machines to bury cable, and use of backhoe and construction equipment at low tide for burial in extended tidal flats.

5.1.8 *Weather*

The potential weather conditions associated with a region play an important role in the installation and maintenance of a cable system. For submarine cable systems there are installation and operational risks related to weather.

Installation of submarine cable systems can be impacted or at risk from severe climate events. Severe seasonal weather conditions such as hurricanes, gales, and storms, shore ice, and icebergs can dictate the available “weather window’ for cable installation when

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[29] *See Department of the Interior, Bureau of Ocean Energy Management, Request for Information and Comments on the Preparation of the 2017-2022 Outer Continental Shelf (OCS) Oil and Gas Leasing Program*, 79 Fed. Reg. 34,349 (June 16, 2014).

considered in conjunction with the operational capabilities of the cable ship and its ability to lay and bury the cable.

In the United States, the most common extreme weather event impacting the installation or maintenance of subsea telecom cable systems is a hurricane or typhoon. The Atlantic/Caribbean Sea/Gulf of Mexico hurricane season runs from June 1st through November 30th. The Eastern Pacific hurricane season runs from May 15th through November 30th.[30]

In addition to the direct effect weather has on installation or maintenance, secondary effects, such as flooding after a storm may also affect cable landing stations.

5.2 Emerging Risks

5.2.1 *Offshore Renewable Energy Development*

Demand for environmentally-friendly and domestic energy sources has created significant interest in three particular sources of renewable energy: (1) offshore wind; (2) wave, tidal, and ocean current (referred to generally as marine hydrokinetic ("MHK") energy); and (3) ocean thermal energy conversion ("OTEC"). Offshore wind energy is the most familiar offshore renewable energy source because the technology is the most mature, but there is continuing interest in in-water testing of MHK and OTEC technologies with a goal of commercial scale development. Ultimately, offshore renewable energy is expected to prove a significant source of low-carbon energy for the United States. Offshore renewable energy development will, however, pose risks to submarine cables and vice versa. Because offshore renewable energy is an emerging industry, the risks remain uncertain. Consequently, submarine cable operators, offshore renewable energy developers, and regulators have yet to develop systematic risk-minimization strategies and consultation and coordination mechanisms, which has resulted in some unresolved conflicts.

5.2.1.1 *Offshore Wind*

To date, BOEM has issued five offshore commercial wind energy leases, and plans on issuing up to eight additional commercial wind leases in 2014 and 2015. Most interest has focused on development on the Atlantic coast, but BOEM is also considering a proposal for a floating wind facility off the Oregon coast. In order to inform its planning and leasing efforts, BOEM has established twelve state-level Intergovernmental Task Forces, which consist of relevant federal agencies and the state, local and tribal entities that may be affected by or have an interest in offshore wind development.

[30] Source: National Hurricane Center, National Oceanic and Atmospheric Administration, www.nhc.noaa.gov.

Typically, all offshore wind energy turbines are interconnected with subsea power cables, as shown in Figure 5C, with an export cable that brings the power to shore.

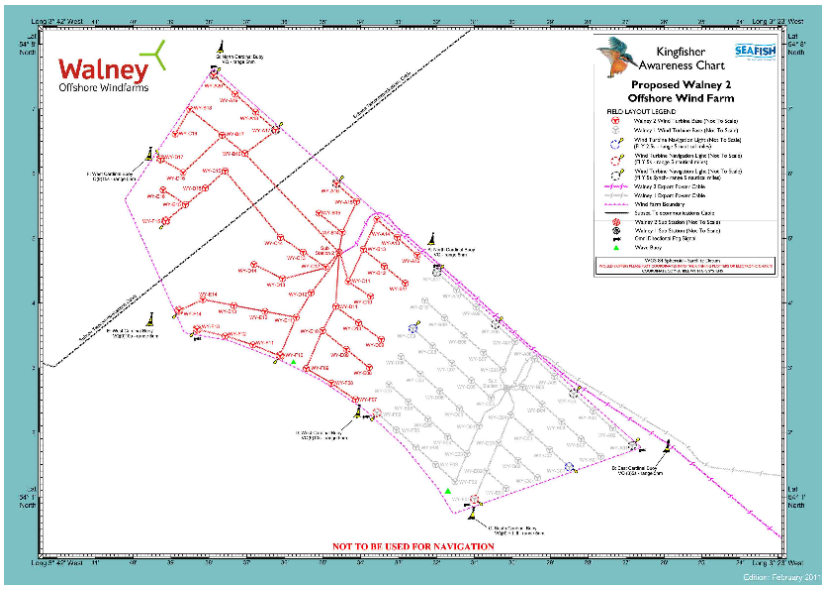

Figure 5C: Offshore Wind Energy Turbine Field Power Cable Interconnections[31]

The Delaware area has been leased to an offshore wind developer, and the lessee is currently assessing the site. The areas offshore New Jersey and Maryland are currently in the leasing stage of BOEM's process, and the area offshore New York is still in the planning stage.

5.2.1.2 *Marine and Hydrokinetic Projects*

MHK projects use the undulation of waves or the velocity of current from tides, ocean currents, or instream flow to generate electricity without the use of a dam. Interest in MHK technology in the United States has been emerging for the past 10 years or so, but only recently have projects been licensed and deployed. So far, MHK projects (mainly tidal projects) have been located in the territorial sea and have been for the purpose of testing the technology, the site, and environmental and other potential effects. The Federal Energy Regulatory Commission ("FERC") has jurisdiction for licensing MHK projects in the territorial sea.[32] On the U.S. OCS, BOEM is responsible for issuing the lease, easement, or right-of-way for MHK projects, while FERC is responsible for issuing the license. The agencies have agreed to coordinate their actions to ensure MHK projects

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31 Source: John Williamson/Seakeeper.org, http://www.seakeeper.org/wp-content/uploads/2013/06/Walney-OWF.bmp

32 *See* Section 23(b)(1) of the Federal Power Act, 16 U.S.C. § 817(1).

meet the public interest, including the adequate protection, mitigation, and enhancement of fish, wildlife, and marine resources and other beneficial public uses.[33]

Given the U.S. wave, tidal, and ocean current energy resource, most of the MHK proposals are for wave projects off the west coast and off Alaska; for tidal projects in tidal areas in the east, northwest, and Alaska; and for ocean current projects off Florida. There are currently four FERC licensed tidal pilot projects, which allow for installation of one to a few turbines for testing purposes. These are located in Cobscook Bay, Maine; East River, New York City; and Estero Bay and Point Estero, California. The project preliminarily licensed in Admiralty Inlet, Washington, was cancelled late in 2014.

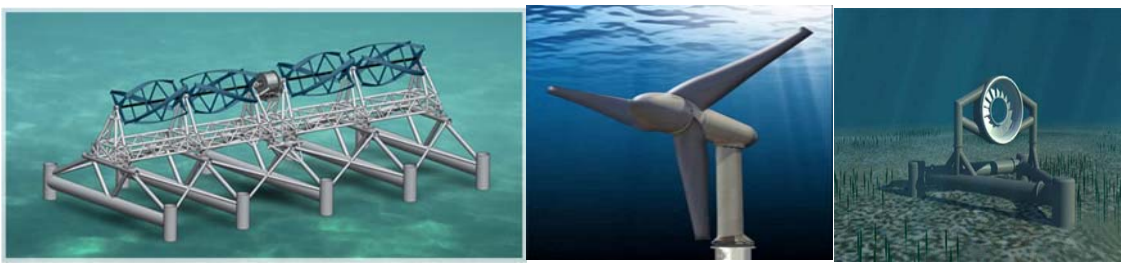

Figure 5D: Examples of Tidal Energy Infrastructure

In May 2014, BOEM issued a five-year Interim Policy lease to Florida Atlantic University that will allow for the testing of non-grid-connected ocean current devices offshore Florida. BOEM also recently determined that there is no competitive interest in a proposed wave energy research project offshore Oregon. This MHK project, the Pacific Marine Energy Center South Energy Test Site Research Project, will be the first project to undergo the joint BOEM/FERC leasing and licensing process outlined in the 2009 Memorandum of Understanding between the two agencies.

5.2.1.3 *Ocean Thermal Energy Conversion Projects*

OTEC projects use the temperature difference between cooler deep water and warmer shallow or surface ocean waters to generate electricity. Projects will be located in deep water allowing for the thermal gradient required for energy conversion. The basic principle is to pump deep cold water to the surface to cool a refrigerant fluid, such as ammonia, which is then compressed and vaporized using surface water before entering the turbine/generator unit. This would require OTEC siting to be in island environments or areas where there is a relatively narrow continental shelf allowing for deep water near the coastal region. Currently there are no projects or test projects in the United States though Lockheed Martin has a contract to develop a 10 MW plant off China. In the

[33] Memorandum of Understanding between the U.S. Department of the Interior and the Federal Energy Regulatory Commission, April 9, 2009, http://www.ferc.gov/legal/mou/mou-doi.pdf.

United States, the National Ocean Atmospheric Administration is responsible for authorizing construction and operation of this technology.

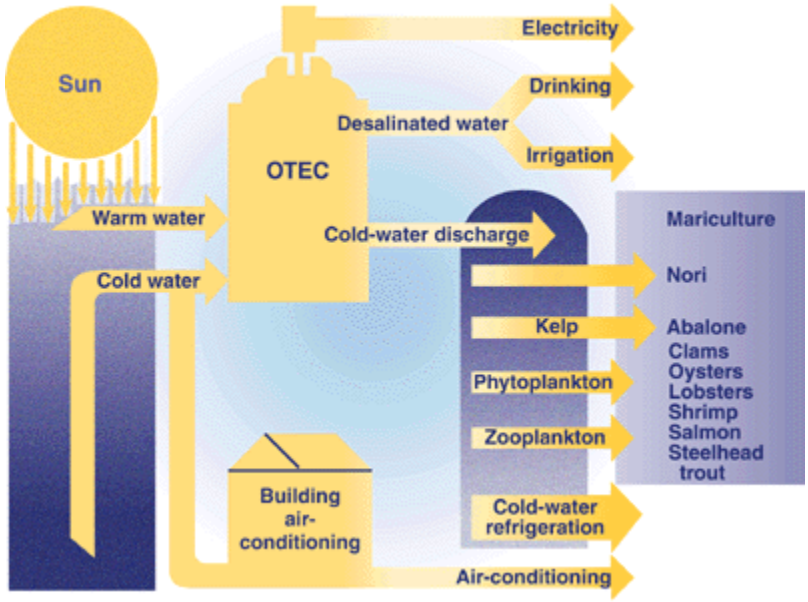

Figure 5E: Overview of a Typical OTEC Project

5.2.1.4 *Risks of Renewable-Energy Development to Submarine Cables*

Uncoordinated renewable energy development poses numerous risks to submarine cables. These risks are highly dependent on the site selected and the project design. The sheer newness of renewable energy projects means that renewable energy developers are not always sufficiently aware of nearby activities of submarine cable operators, and vice versa.

Placement of offshore generating facilities and mooring anchors near submarine cables increases the likelihood of a cable fault due to the risk of sea floor scouring. Sea floor scouring is the effect of currents eroding sediment in the areas around a structure on the sea floor. Scouring can lead submarine cables, which are typically laid either directly on or trenched into the sea floor, to be exposed to current and potential threats. As noted in Section 4 above, when submarine cables throw loops or are suspended above the sea floor, they face increased risk of damage because of exposure to anchors, fishing nets, and other environmental aggressors. All offshore structures affect current conditions near the sea floor, which increases the likelihood of scouring.[34] Thus, sea floor scouring

[34] *See* RAVE-Projekt zur Geologie, Untersuchungskonzept - Erste Ergebnisse, Bundesamt Für Seeschifffahrt Und Hydrographie Oct. 10, 2010, www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUKplus/Praesentationen10Mai2010/Praes_Lambers-Huesmann.pdf (in German); *see also*

around submerged support structures, may lead nearby submarine cables to be exposed. Scouring could also lead submarine cable operators to require that cables be buried more deeply, making installation and subsequent retrieval for repairs more difficult, time-consuming, and costly. And submarine cables can be made more vulnerable because of modifications in sea floor topography—disturbed sediments may redeposit above a cable, but in a looser state, increasing the risk of erosion and abrasion.[35]

Renewable energy projects, which entail the placement and maintenance of structures on the seabed or in the water column, also pose similar risks to submarine cables as do traditional energy projects, such as oil and gas development, absent sufficient spatial separation.

Large offshore renewable-energy projects—if sited in shallow water relatively close to shore, with both power-generation facilities and power transmission cables connecting back to shore—can impede sea floor access for installation and maintenance of submarine cable, force them into *de facto* cable "corridors," or force them to assume risks for transiting heavily fished areas, anchorages, dumping grounds, or dredged areas where the risk of damage might still be lower than for transiting a wind farm array, for example. As noted above, cable concentration magnifies other risks, such as from anchors and fishing nets, which can damage multiple cables in a single incident. Unsurprisingly, a U.S. National Research Council report evaluating marine hydrokinetic energy resources identifies submarine cable areas as a constraint on development of marine energy (such as tidal and wave technologies) describing cable areas as "restricted" for purposes of energy development.[36]

Power transmission cables pose physical risks and personnel safety risks during submarine cable installation and maintenance operations With respect to wind farms, these often consist of multiple cables (typically three to six for larger operations) running in parallel with 50 to 100 meter separation to meet capacity requirements. Where crossings are unavoidable, crossing agreements are critical for identifying and managing risks.

Tom McNeilan & Kevin Smith (Fugro), Larry Atkinson & Jose Blanco (Old Dominion University), TA&R Study 656, Presentation to Atlantic Wind Energy Workshop (July 12, 2011), http://www.boem.gov/Renewable-Energy-Program/AWEW_Program_Agenda-pdf.aspx.

35 *See id.*

36 *An Evaluation of the U.S. Department of Energy's Marine and Hydrokinetic Resource Assessments*, National Research Council, National Academy of Sciences, at 87 (May 2013), http://www.nap.edu/catalog/18278/an-evaluation-of-the-us-department-of-energys-marine-and-hydrokinetic-resource-assessments .

Submarine cable planning, installation, and maintenance may become more difficult without specific infrastructure separation guidelines and clear definition of rights and privileges of infrastructure owners.

5.2.1.5 *Deep-Sea Mining*

Deep-sea mining seeks to harvest polymetallic nodules, cobalt-rich manganese crusts, and sea floor massive sulfides.[37] At present, deep-sea mining present a low risk to installed cables, as the mining of particular marine minerals has not yet proved economic. Nevertheless, it is very likely that improved (and cheaper technologies) and increasing demand for particular minerals (and/or a more stable supply thereof) will pose greater threats to installed submarine cables and limit routes for future cables. Mining operations—both exploratory and exploitative—cause direct physical disturbance of the seabed, threatening operation of undersea cables by anchoring of production support vessels, barges, and mining platforms; the use of ROVs; core sampling; drills, dredges, hydraulic jets, and cutting tools; and continuous-line bucket systems or hydraulic systems used to transport minerals from the seabed to the surface.[38] Likewise, minerals mining operations present a threat of erosion and abrasion similar to that presented by wind farm operations; destabilization of the sea floor; and redeposited sediments. All of these may result in exposing or suspending cables above the sea floor, thereby subjecting them to a heightened risk of damage from vessel traffic and fishing nets and anchors, as well as the risk of debris accumulating on cables. Finally, large offshore developments impede access to undersea telecommunications cable systems both at the surface (for cable vessels) and on the sea floor.

To address these concerns in deep-sea areas beyond national jurisdiction, ICPC has concluded a memorandum of understanding with the International Seabed Authority—which regulates deep-sea mining in regions beyond national jurisdiction known as "the Area" pursuant to the United Nations Convention on the Law of the Sea, which the United States has signed but not ratified—providing for data exchanges to assist submarine cable owners to avoid deep-sea mining areas, and vice versa.[39] Within territorial-sea, EEZ, and continental shelf areas, where coastal states have jurisdiction, submarine cable operators must coordinate with national regulators of those coastal

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[37] *See* G.P. Glasby, *Lessons Learned from Deep-Sea Mining*, SCIENCE, July 28, 2000, at 551.

[38] *See, e.g.*, Kristi Birney, *et al*., *Potential Deep-Sea Mining of Seafloor Massive Sulfides: A Case Study in Papua New Guinea* at 23-28 (2006), www.bren.ucsb.edu/research/documents/ventsthesis.pdf; Nautilus Minerals Inc. – Resource Extraction, http://www.nautilusminerals.com/s/resourceextraction.asp#SPT; Nautilus Minerals Inc. – Solwara 1 Project – High Grade Copper and Gold, www.nautilusminerals.com/s/Projects-Solwara.asp.

[39] Memorandum of Understanding between the International Cable Protection Committee and the International Seabed Authority, dated 25 February 2010, http://www.isa.org.jm/files/documents/EN/Regs/MOU-ICPC.pdf.

states. In the case of the United States, BOEM has jurisdiction over such matters beyond the state territorial seas (which extend three nautical miles seaward from the shore).

6 International and U.S. Legal Regimes

6.1 Submarine Cables Enjoy Unique Treaty Rights and Protections Granted to No Other Activity in the Marine Environment

U.S. treaty obligations and customary international law (as observed by the United States) recognize unique freedoms for the installation and maintenance of submarine cables. These rights and freedoms are not accorded to energy-related activities, commercial fishing, or marine transport, and sometimes these rights and freedoms take legal precedence over those of other marine activities.

Various international treaties dating back to 1884 guarantee unique freedoms to lay, maintain, and repair submarine cables—freedoms not granted for any other marine activities—and restrict the ability of coastal states (*i.e.*, countries) to regulate them.[40] Principles articulated in these treaties have since been recognized as customary international law.

Specifically, these treaties guarantee:

- The freedom to install submarine cables on the high seas beyond the continental shelf and to repair existing cables without impediment or prejudice;[41]

[40] *See* Convention for the Protection of Submarine Telegraph Cables, Mar. 14, 1884, 24 Stat. 989, 25 Stat. 1424, T.S. 380, (entered into force definitively for the United States on May 1, 1888) ("1884 Convention"); Geneva Convention on the High Seas, Apr. 29, 1958, 13 U.S.T. 2312, T.I.A.S. 5200, 450 U.N.T.S. 82 (entered into force definitively for the United States on Sept. 30, 1962) ("High Seas Convention"); Geneva Convention on the Continental Shelf, Apr. 29, 1958, 15 U.S.T. 471, T.I.A.S. 5578, 499 U.N.T.S. 311 (entered into force definitively for the United States on June 10, 1964) ("Continental Shelf Convention"); Law of the Sea Convention, Dec. 10, 1982, 1833 U.N.T.S. 397 (entered into force on Nov. 16, 1994) ("UNCLOS").

[41] High Seas Convention, arts. 2 ("Freedom of the high seas is exercised under the conditions laid down by these articles and by the other rules of international law. It comprises, *inter alia*, both for coastal and non-coastal States: . . . Freedom to lay submarine cables and pipelines." (italics in original)), 26(1) ("All States shall be entitled to lay submarine cables and pipelines on the bed of the high seas."), 26(3) ("When laying such cables or pipelines the State in question shall pay due regard to cables or pipelines already in position on the seabed. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced."); UNCLOS art. 112(1) ("All States are entitled to lay submarine cables and pipelines on the bed of the high seas beyond the continental shelf.").

- The freedom to install and maintain submarine cables on the continental shelf,[42] subject to reasonable measures for the exploration of the continental shelf and the exploitation of its natural resources;[43]
- The freedom to install and maintain submarine cables in the exclusive economic zone of all states;[44]
- The ability to install submarine cables in a state's territory or territorial sea subject to conditions and exercise of national jurisdiction;[45] and
- The freedom to maintain existing submarine cables passing through the waters of an archipelagic state without making landfall.[46]

These treaty obligations are now treated as customary international law,[47] in particular by the United States.[48]

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[42] UNCLOS arts. 79(1) ("All States are entitled to lay submarine cables and pipelines on the continental shelf, in accordance with the provisions of this article"), 79(5) ("When laying submarine cables or pipelines, States shall have due regard to cables or pipelines already in position. In particular, possibilities of repairing existing cables or pipelines shall not be prejudiced."). *See also* UNCLOS, art. 78(2) ("The exercise of the rights of the coastal State over the continental shelf must not infringe or result in any unjustifiable interference with navigation and other rights and freedoms of other States as provided for in this Convention.").

[43] Continental Shelf Convention, art. 4 ("Subject to its right to take reasonable measures for the exploration of the continental shelf and the exploitation of its natural resources, the coastal State may not impede the laying or maintenance of submarine cables or pipe lines on the continental shelf."); UNCLOS, arts. 79(2) ("Subject to its right to take reasonable measures for the exploration of the continental shelf, the exploitation of its natural resources and the prevention, reduction and control of pollution from pipelines, the coastal State may not impede the laying or maintenance of such cables or pipelines"), 79(4) ("Nothing in this Part affects the . . . [coastal state's] jurisdiction over cables and pipelines constructed or used in connection with the exploration of its continental shelf or exploitation of its resources or the operations of artificial islands, installations and structures under its jurisdiction."). The course of a pipeline on the continental shelf is subject to coastal-state consent, while the course of a submarine cable is not. *See id.*, art. 79(3) ("The delineation of the course for the laying of such pipelines on the continental shelf is subject to the consent of the coastal State.").

[44] UNCLOS art. 58(1) ("In the exclusive economic zone, all States, whether coastal or land-locked, enjoy, subject to the relevant provisions of this Convention, the freedoms referred to in article 87 of navigation and overflight and of the laying of submarine cables and pipelines.").

[45] *Id.*, art. 79(4) ("Nothing in this Part affects the right of the coastal State to establish conditions for cables or pipelines entering its territory or territorial sea").

[46] *Id.*, art. 51(2).

[47] *See* Delimitation of the Maritime Boundary in the Gulf of Maine Area (Can. v. U.S.), 1984 I.C.J Rep. 246, 294 ¶ 94 (1984).

[48] The United States recognized these freedoms starting in 1983, even though the United States has never ratified the UNCLOS (it signed only in 1994) and even though the Convention did not enter into force for those states that had ratified it until 1994. Presidential proclamations by two different U.S. presidents expressly stated that the establishments of an Exclusive Economic Zone ("EEZ") and a

For purposes of the EEZ and the continental shelf, submarine cables are distinguished from (1) artificial islands, (2) structures and installations used for exploration or exploitation of living or nonliving natural resources or for "other economic purposes," and (3) installations and structures which may interfere with the exercise of the rights of the coastal state in the EEZ or on the continental shelf.[49] Although these treaties permit coastal states to take reasonable measures respecting natural resource exploitation on the Continental Shelf, they bar states from taking such measures with respect to submarine cables, the construction and repair of which are not undertaken for natural resource exploration or exploitation.[50] These treaty provisions are reflected in the official position of the United Nations' Office of Legal Affairs of the Division for Ocean Affairs and the Law of the Sea, which states that:

> [B]eyond the outer limits of the 12 nm territorial sea, the coastal State may not (and should not) impede the laying or maintenance of cables, even though the delineation of the course for the laying of such pipelines [but not submarine cables] on the continental shelf is subject to its consent. The coastal State has jurisdiction only over cables constructed or used in connection with the exploration of its continental shelf or exploitation of its resources or the operations of artificial islands, installations and structures under its jurisdiction.[51]

Thus, a coastal nation must forbear from imposing any restrictions on the installation or maintenance of submarine cables unless those submarine cables themselves are used for natural resource exploration or exploitation.

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contiguous zone, respectively, did not infringe on the high-seas freedoms to lay and repair submarine cables. *See* Presidential Proc. No. 5030, 48 Fed. Reg. 10,605 (Mar. 10, 1983) ("Pres. Proc. No. 5030") (establishing the U.S. EEZ); Presidential Proclamation No. 7219, 64 Fed. Reg. 48,701 (Aug. 2, 1999) (establishing the U.S. contiguous zone).

[49] UNCLOS, arts. 56, 60(1), 80.

[50] *Id.*, art. 79(2); Continental Shelf Convention, art. 4.

[51] *Maritime Space: Maritime Zones and Maritime Delimitations—Frequently Asked Questions*, United Nations Department of Oceans and Law of the Sea, Office of Legal Affairs (responding to Question #7, "What regime applies to the cables and pipelines?"), http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/frequently_asked_questions.htm.

Coastal states also have obligations to prevent willful or negligent damage to cables.[52] All states "shall have due regard to cables or pipelines already in position."[53] Coastal states and archipelagic states have the right to adopts laws and regulations to protect submarine cables with respect to foreign vessels' exercise of the right of innocent passage.[54] Submarine cables are thus afforded a great degree of protection from regulation or interference by coastal states, reflecting the vital role that submarine cables play in facilitating communications, commerce, and government.

6.2 Federal Offenses for Cable Damage

U.S. law provides that damaging a submarine cable—whether deliberately or through negligence—is a federal offense punishable by fine, imprisonment, or both.[55] The penalties, however, are unlikely to deter negligent or willful damage and do not even cover the cost of the repair. For willful damage, U.S. law provides for a fine of up to $5,000 and/or a prison term not to exceed two years. For culpably negligent damage, U.S. law provides for a fine of up to $500 and a prison term not to exceed three months.[56] Federal law imposes obligations on fishing vessels to keep their nets from interfering with or damaging submarine cables, and requires fishing vessels to maintain a minimum distance from any vessel engaged in laying submarine cable or any buoy placed to mark the position of a submarine cable.[57] As with other penalty provisions under U.S. law, the penalties for interference or damage to cables by fishermen have little deterrence value, as they permit a fine up to $250 and a prison term not to exceed 10 days. Submarine cable owners do have, however, a right under U.S. law to sue for damages to their cables. As noted in Section 7 of this report, countries such as Australia and New Zealand—which have implemented the world's most advance cable-protection regimes—impose substantial penalties for cable damage and achieve much greater deterrence.

As discussed in Section 7 below, submarine cable operators themselves have developed industry standards and private contractual arrangements for managing marine spatial

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52 *See* UNCLOS, art. 113 ("Every State shall adopt the laws and regulations necessary to provide that the breaking or injury by a ship flying its flag or by a person subject to its jurisdiction of a submarine cable beneath the high seas done willfully or through culpable negligence, in such a manner as to be liable to interrupt or obstruct telegraphic or telephonic communications, and similarly the breaking or injury of a submarine pipeline or high-voltage power cable, shall be a punishable offence. This provision shall apply also to conduct calculated or likely to result in such breaking or injury. However, it shall not apply to any break or injury caused by persons who acted merely with the legitimate object of saving their lives or their ships, after having taken all necessary precautions to avoid such break or injury.").

53 *Id.*, art. 79(5).

54 *Id.*, arts. 21(c), 52.

55 47 U.S.C. §§ 21 (willful damage), 22 (negligent damage).

56 *Id.*

57 *See* 47 U.S.C. § 25.

conflicts and minimizing cable damage. These tools include cable-crossing agreements and minimum separation distances from cables.[58] Such self-help remedies, however, appear increasingly insufficient given the increase in offshore marine activities.

7 Models for Cable Protection

Most models of cable protection focus on spatial separation between submarine cables and other marine activities (including other submarine cables). With sufficient separation, the risks of direct disturbance via equipment or anchors or impeded access for establishment of diverse routes or timely maintenance are minimized. Industry organizations have developed recommendations and standards for separation—and network configurations to maintain the continuity of communications even in the event of cable damage. They have also developed coordination mechanisms with other marine industries to minimize risks. Many foreign governments have adopted more systematic cable-protection legislation and regimes, including formal spatial-separation schemes. In addition, the cable industry has entered into arrangements with local commercial fishing organizations to agree to coordinate cable routing and trawling operations in fishing areas where cables are present and with oil and gas companies to manage pipeline crossings.

7.1 Industry Standards and Cable-Awareness Programs

Submarine cable operators have a long history of developing industry standards and cable-awareness programs to enhance cable protection and to educate other persons operating in the marine environment. These efforts include standards regarding the spatial separation of marine infrastructure, notification of nautical charting authorities of installed submarine cable locations, and sharing of location information with commercial fishermen. These activities help to raise awareness and understanding of submarine cable operations and promote risk-mitigation measures, which governments may reflect in their domestic legal regimes and which may be reflected in voluntary cross-industry agreements. In the case of Australia and New Zealand, the Australian Communications and Media Authority ("ACMA") and the Ministry of Transport, respectively, undertake themselves the dissemination of cable route information and liaise directly with fishing and maritime industries, supplementing industry efforts.

[58] Industry standards have been developed over many decades to facilitate cable installation, retrieval, and repair operations above and below the ocean surface. These standards minimize the risk of damage to neighboring cables during installation and maintenance operations and ensure access to a damaged cable with both a cable ship and other equipment to be used on the sea floor. *See, e.g.*, International Cable Protection Committee Recommendation No. 2, at 5, available from the International Cable Protection Committee at www.iscpc.org (ICPC Recommendation No. 2).

7.1.1 *International Cable Protection Committee*

At the international level, the International Cable Protection Committee ("ICPC") is the leading international submarine cable industry association. It was established in 1958 and is based in London. ICPC currently has 143 members representing more than 60 countries. Members include submarine cable owners, maintenance authorities, system manufacturers, cable ship operators, route survey companies, and governments. ICPC seeks to protect submarine cables from man-made and natural hazards.

Among its many activities, ICPC has promulgated recommendations that define the minimum standards for cable route planning, installation, operation, maintenance and protection:

No.	Issue	Recommendation
1	12	Recovery of Out of Service Cables This document provides the ICPC's recommendations in relation to recovery of a submarine cable system that is redundant or has been taken out of service. Taken into consideration are legal requirements, environmental concerns, salvage, and proximity to adjacent infrastructure (other cables, oil and gas facilities, etc.)
2	10	Cable Routing and Reporting Criteria This Recommendation provides generalized cable routing and notification criteria that the ICPC recommends be used when undertaking cable route planning activities where the cable to be installed crosses, approaches close to or parallels an existing or planned cable system. For parallel submarine cables, this Recommendation recommends a separation distance of the lesser of 3 times depth of water, or where not achievable, 2 times the depth of water following consultation and agreement between affected parties.
3	10	Telecommunications Cable and Oil Pipeline / Power Cables Crossing Criteria The continued increase in both the numbers of submarine cables and the exploitation of oil and gas from the seabed inevitably means that there will be more cases of crossings between telecommunications cables, power cables, and pipelines. The purpose of this document is to give guidance to those who are faced with this situation and provides some basic questions that need to be asked as the first step in considering any proposed crossing so that areas of concern can be identified and mutually acceptable solutions developed.
4	8	Co-ordination Procedures for Repair Operations Near In Service Cable Systems This document provides recommended procedures with respect to any repair operations that are undertaken near active cable systems. The procedures apply to the repair operations of active cable systems in the vicinity of any cable crossing or cables that are closely parallel. Considerations to be addressed include proximity to each other, ship operations, cable retrieval options, repair scheduling, establishing points of contact, and other non-site specific guidelines.

No.	Issue	Recommendation
6	8A	Actions for Effective Cable Protection (Post Installation) This recommendation concerns post-installation measures to mitigate the risk of cable faults caused by human activities such as fishing and vessel anchoring. Such measures are often referred to as marine liaison, offshore liaison, or cable awareness. Different measures may be appropriate in different areas, even when a single cable system is involved. Such measures must take into account the characteristics of the different mariners active in each area, such as fishermen, merchant mariners, pilots, port authorities, military officers, marine traffic control officials, operators of resource extraction vessels, etc. These conditions and risks may change over time.
7	6	Offshore Civil Engineering Work in the Vicinity of Active Submarine Cable Systems This document recommends the procedure to be followed when civil engineering or offshore construction work is undertaken in the vicinity of active submarine cable systems. The construction company responsible for the civil/structural work should discuss their plans with the responsible cable owner in order to determine operational and maintenance issues and liabilities that may impact on the submarine cable or the planned structure. The construction company should work with the cable owner to accurately identify the physical location of the cable systems in the vicinity of the planned civil works. Depending on the circumstances, the location work could require either divers or a Remotely Operated Vehicle (ROV) to assist in the cable locating work.
8	7A	Offshore Seismic Survey Work in the Vicinity of Active Submarine Cable Systems An active submarine cable system includes electro-optic devices that are required to manage the signal at intervals along its route. If the internal components of these submerged devices are subjected to acceleration greater than specification there is a risk of serious damage. This document recommends the procedure to be followed while offshore seismic survey work is undertaken in the vicinity of active submarine cable systems where these are installed in water depths of 200 meters or less.
13	2	The Proximity of Offshore Renewable Wind Energy Installations and Submarine Cable Infrastructure in National Waters This document provides guidance on the considerations that should be given in the development of projects requiring proximity agreements between offshore wind farm projects and submarine cable projects within national waters. The document addresses installation and maintenance constraints related to wind farm structures, associated cables and other submarine cables where such structures and submarine cables will occupy proximate areas of seabed.

ICPC Recommendation 13, Issue 2, is designed to apply to offshore wind energy projects, however, it states that its recommendations for the process of stakeholder consultation and consideration of safety zones can apply equally well to wave and tidal marine hydrokinetic (MHK) projects. Although the recommendation establishes a

methodology for determining site-specific proximity limits, it establishes a default separation distance for shallower waters:

> The Working Zone for traditional repair scenarios is likely to be in the order of 500m either side of the existing submarine cable. This is based on the expected area required to undertake cable fault location using trailed electrodes, grapnel and final bight deployment operations. Guidance in this document is considered appropriate for water depths up to 75m.

ICPC Recommendation 13, Issue 2 was based on the Subsea Cables UK Guideline No. 6, discussed further below.

7.1.2 *North American Submarine Cable Association*

In the United States, the North American Submarine Cable Association ("NASCA") is the leading submarine cable industry and cable-protection organization. NASCA develops standards and procedures for federal, state, and local government approval of new submarine cables, consults regularly with other marine industries, disseminates information about installed submarine cables (including route position list ("RPL") data for its members' installed submarine cables), and promotes public awareness of submarine cables. NASCA participates directly as a stakeholder organization in the Mid-Atlantic Council on the Ocean ("MARCO") and the Northeast Regional Ocean Council ("NROC"). With respect to mitigation of risks associated with renewable energy infrastructure, NASCA has endorsed ICPC recommendations and Subsea Cables UK's key guideline regarding spatial separation of submarine cables and offshore wind energy facilities, discussed below.

7.1.3 *Subsea Cables UK*

Subsea Cables UK is the principal submarine cable industry organization in the United Kingdom and focuses on marine safety and protection of submarine cables from man-made and natural hazards—efforts of critical importance given the intensive use of adjacent ocean areas for vessel traffic, commercial fishing, offshore wind farms, and other marine activities. Subsea Cables UK has extensive experience working with commercial fishing industry and the offshore wind energy industry in matters relating to shared use of the seabed.

As the United Kingdom's offshore wind energy industry is far more developed than that of the United States, the submarine cable and offshore wind energy industries have had significantly more experience in working to coordinate and protect their respective activities off the UK coast than they have had off the U.S. coast. Subsea Cables UK worked with the Crown Estate and offshore wind farm developers to develop *SCUK Guideline 6, The Proximity of Offshore Renewable Energy Installations & Submarine Cable Infrastructure in UK Waters* ("SCUK Guideline 6"), which addresses the

"installation and maintenance constraints related to wind farm structures, associated cables and other submarine cables where such structures and submarine cables will occupy proximate areas of seabed."[59] SCUK Guideline No. 6 establishes basic principles for determining safe proximity distances and negotiating proximity agreements that can be applied equally well to tidal and wave energy projects. SCUK Guideline 6, and its underlying principles, should be followed for all projects, until such time as the industry develops guidelines specific to wave and tidal energy infrastructure.

7.2 Default and Minimum Separation Distances

A default separation distance establishes a minimum separation distance between an existing submarine cable and another marine or coastal activity, absent mutual agreement to allow the activity in closer proximity to the submarine cable (which sometimes includes assumption of liability or up-front payments to cover the risk of potential damage to submarine cables). A minimum separation distance establishes an absolute minimum separation distance between the submarine cable and the other marine or coastal activity.

Although no U.S. federal, state, or local government agency has promulgated laws or regulations establishing default or minimum separation distances, various federal agencies have long used the broader concept of spatial separation to minimize conflicts between marine activities. For example, BOEM has reached an informal agreement with the U.S. Coast Guard not to allow the installation of wind energy structures within one nautical mile of a traffic separation scheme.[60] The U.S. Coast Guard also regularly establishes safety zones around facilities energy exploration and exploitation activities on the U.S. outer continental shelf "to promote the safety of life and property on the facilities, their appurtenances and attending vessels, and on the adjacent waters within the safety zones."[61]

Consistent with ICPC and other industry standards, many foreign governments have established default or minimum separation distances to protect submarine cables. For example:

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[59] *The Proximity of Offshore Renewable Energy Installations & Submarine Cable Infrastructure in UK Waters*, Subsea Cables UK, Guideline No. 6, Issue 4 at 6 (August 2012), www.subseacablesuk.org.uk/download/?Id=123&source=guidelines.

[60] *See, e.g.*, Bureau of Ocean Energy Management, Atlantic Wind Lease Sale 3 (ATLW3) Commercial Leasing for Wind Power on the Outer Continental Shelf Offshore Maryland—Final Sale Notice, 79 Fed. Reg. 38,060 (July 3, 2014). The U.S. Coast Guard stated that "it may determine in the future that a larger setback is necessary under certain circumstances."

[61] 33 C.F.R. §§ 147.1, 147.15.

- **China**: National law establishes protection zones around submarine cables of 50 meters in harbor areas, 100 meters in narrow coastal-water areas, and 500 meters in broad coastal waters.[62]
- **Denmark**: National regulations require establishment of a cable protection zone of 200 meters on each side of an installed submarine cable system and prohibiting anchoring, pipeline installation, dredging, boulder removal, and use of equipment on the seabed in such protection zones.[63]
- **Indonesia**: National regulations provide for the establishment of a restricted area of 3500 meters in width around any submarine cable and requiring any additional cable to be located at least 500 meters apart.[64]
- **Japan**: Japan's cable protection law provides for the designation of protection area not exceeding 1000 meters around a submarine cable.[65]
- **Russia**: National regulations require the establishment of a security zone of 0.25 nautical miles on either side of a submarine cable.[66]
- **Singapore**: National maritime law allows for the establishment of protection areas around existing submarine cables (which Singaporean law calls "corridors") and may require vessels that fail to observe them to indemnify cable owners for damage.[67]
- **United Kingdom**: The Marine Management Organization, which acts as the UK marine regulator, recommends a 500 meter "exclusion" zone around cables (250 meters each side of the cable), plus an additional 250 meter "buffer" zone for all seabed uses "to avoid damage."[68]

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62 Provisions on the Protection of Submarine Cables and Pipelines, Order of the Ministry of Land and Resources of the People's Republic of China (No. 24), art. 7 (Dec. 30, 2003).

63 Order on Protection of Submarine Cables and Pipelines (The Order on Cables), No. 939, arts. 1-4 (Nov. 27, 1992).

64 Minister of Transportation Decision 94/1999 on the Protection and Security of Submarine Telecommunication Cable System, art. 1 (Oct. 14, 1999).

65 Telecommunications Business Law, Law No. 86, art. 141(1) (Dec. 25, 1984), last amended by Law No. 125 (July 24, 2003), http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Resources/laws/2001TBL.pdf.

66 Rules for the Protection of Lines and Structures, Order No. 578, art. II(4)(a) (June 9, 1995).

67 Singapore Maritime and Port Authority Act, § 46(8), http://www.mpa.gov.sg/sites/port_and_shipping/maritime_legislation_of_singapore/maritime_and_port_authority_of_singapore_act.page.

68 UK Marine Management Organization ("MMO"), Strategic Scoping Report for Marine Planning in England, at 115 (Aug. 2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/312327/ssr-august2013.pdf.

7.3 Cable Protection Zones and Corridors

Unlike default separation distances or buffer zones, cable protection zones and corridors prohibit specified activities posing risks to submarine cables—including fishing, anchoring, and dredging—within fixed geographic areas. Cable protection zones grant protections to submarine cables that choose to locate—or are already located—therein. Corridors, by contrast, require submarine cable operators to route their infrastructure in defined geographic areas. Both Australia and New Zealand—which have the world's most advanced cable protection regimes—have established cable protection zones. Most countries have refrained from establishing corridors except in harbors or other constricted marine areas.

Under the Australian Telecommunications Act, ACMA can proclaim a protected zone over one or more cables. These protected zones may operate in the territorial sea, the EEZ or on the continental shelf. The protection zones under the Act extend up to one nautical mile on either side of the cable, or in an area between the cables. Within this protection zone a range of activities may be prohibited or restricted and special permitting processes are available as appropriate. In the event a person suffers cable damage either directly or indirectly, that person may recover against the person who breached the protection zone and damaged the cable.

In New Zealand, the Submarine Cables and Pipelines Protection Act 1996 ("SCCPA," based largely on Australia's legislative framework)[69] and the Prosecution Protocol issued by the Ministry of Transport in consultation with the owners of major submarine cables or pipelines landing in in New Zealand, establish a framework of protection areas for submarine cables, power transmission cables, and oil and gas pipelines and criminal offenses and fines for damage to submarine cables, power transmission cables, and pipelines. New Zealand currently has 11 cable protection zones, which are monitored by sea and air patrols. Fines range from NZ $2,000 for recreational boating offenses in protection areas to NZ $100,000 for fishing or anchoring that involves commercial gain in protection areas.

Submarine cable operators have generally taken a favorable view of cable protection zones. Cable protection zones, such as those of Australia and New Zealand, typically cover large marine areas in order to provide sufficient separation between cables for installation and maintenance purposes and to provide at least some measure of geographic diversity farther off shore. The size of cable protection zones could make them infeasible in marine and coastal areas that are already intensively developed.

By contrast, submarine cable operators have generally expressed concern about cable corridors out of concern that such corridors (a) are likely to be narrow and therefore

[69] Submarine Cables and Pipelines Protection Act of 1996, Public Act 1996 No. 22 (May 16, 1996). www.legislation.govt.nz/act/public/1996/0022/latest/DLM375803.html.

provide insufficient spatial separation from other submarine cables for installation and maintenance, (b) encourage geographic clustering of submarine cables, which magnifies the risk that a single natural or man-made event could damage multiple cables or cable landing stations and thereby impair the continuity of communications on particular geographic routes, and (c) limit landing options to particular coastal points, which might be inconveniently located with respect to terrestrial backhaul networks and customers.

7.4 Laws Establishing Civil and Criminal Liability for Cable Damage

The 1884 Convention requires state parties to establish offenses for cable damage. As noted in part 5.2 above, the United States has established offenses for willful and negligent injury to submarine cables, but the penalty amounts have not been updated since enactment more than 125 years ago. Other countries, such as Australia and New Zealand (as noted in Section 7.3 above) have established more substantial penalties, ones that are more likely to have a deterrent effect on those who might damage submarine cables. Countries such as Sweden require that if the owner of a cable or pipeline causes damage to causing another cable or pipeline damaged, the owner shall pay the cost of repairing the damage.[70] Russian law provides for recovery of the repair and consequential damages resulting from submarine cable damage.[71]

7.5 Marine Spatial Planning

To date, U.S. federal agencies have generally undertaken only site-specific analyses for individual cases and projects, which places the burden on the submarine cable operator to justify a particular method of protection. The most recent efforts for spatial planning in the U.S. territorial sea and EEZ are largely focused on environmental protection.[72] Although these efforts have considered traditional and renewable energy development, fisheries, shipping, and recreational use, they have generally failed to address submarine cables.

Although no federal agency has developed spatial separation standards for submarine cables and energy infrastructure, some U.S. states have been more inclined than others to address matters relating to cable separation, installation, available routing, and landing

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[70] Law (1996: 518) on liability for damage to submarine cables and pipelines, etc., http://rkrattsbaser.gov.se/cgi-bin/thw?%24{HTML}=sfst_lst&%24{OOHTML}=sfst_dok&%24{SNHTML}=sfst_err&%24{BASE}=SFST&%24{TRIPSHOW}=format%3DTHW&BET=1996:518.

[71] Rules for the Protection of Lines and Structures, Order No. 578, art. V(53) (June 9, 1995).

[72] *See* Executive Order 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes, 75 Fed. Reg. 43,023 (July 19, 2010).

locations. The State of Oregon, for example, has incorporated cable protection considerations into its marine spatial plan, adopted pursuant to state regulations.[73] Spatial planning for ocean use has recently been initiated on a regional and state level in some cases. Most of these efforts have not resulted in adoption of default or minimum separation distances for protection of submarine cables. The current status of these efforts is summarized in Appendix C.

7.6 Private Coordination Arrangements

7.6.1 *Cable-Fishing Committees*

Commercial fishermen (particularly those engaged in bottom trawling and crab pot fishing) and submarine cable owners have formed regional committees in specific areas around the world to address sharing of the seabed. In most of these cases, the parties have entered into a cooperative agreement on cable routing to avoid highly fished areas, declaration of no-fishing zones, and fishing procedures in the vicinity of submarine cables. Most, if not all of these agreements, are region- and cable-specific, such as with the Oregon Fishermen's Cable Committee ("OFCC") and the Central California Joint Cable/Fisheries Liaison Committee ("CCFLC"), which cover 15 submarine cables landing on the U.S. Pacific coast. In the 14-year history of the OFCC and the CCFLC, there has been only one instance of cable damage attributable to fishing activity. In most of the world (Japan is the notable exception), submarine cable operators compensate commercial fishermen for the loss of snagged gear but not for the inability to fish in close proximity to submarine cables.

7.6.2 *Private Agreements with Infrastructure Owners*

Submarine cable operators have a long history of negotiating private agreements with other offshore infrastructure owners to manage cable protection risks, but such efforts require the willing participation of other offshore infrastructure owners. Consistent with ICPC recommendations, submarine cable owners have long entered into crossing agreements with pipeline and power transmission cable operators. These agreements define the locations of the respective infrastructures, agreed crossing notification procedures, and means and methods for the activity.

With offshore renewable energy infrastructure, there have been no such agreements with submarine cable operators, although submarine cable operators remain interested in negotiating such agreements. This is due in part to the relative newness of such projects, but also a general lack of awareness of submarine cables on the part of the offshore renewable energy industries and the failure of those industries to consult with submarine

[73] Oregon Admin. Rules 141-083-0810 to 0870, Rules for Granting Easements for Fiber Optic and Other Cables on State-Owned Submerged and Submersible Land within the Territorial Sea, http://arcweb.sos.state.or.us/pages/rules/oars_100/oar_141/141_083.html.

cable operators in the planning stages of their projects or indeed comply with regulatory requirements for such consultations.[74]

7.7 Supplement to Spatial Separation: Mesh Networking

In addition to the measures noted above, which focus on spatial separation of submarine cables from each other and other marine activities, some submarine cable operators also seek to minimize the risk of service outages from any one network component through the use of optical mesh-network topologies. A mesh network topology is a decentralized network design in which each node on the network connects to at least two other nodes on the network and in which the network permits reconfiguration and routing around broken or unreliable nodes, ensuring a self-healing capability. Mesh networking is used with other resilience strategies, such as the dispersal of key functions across multiple service providers, systems, and supply chains—to enhance the continuity of communicates and reduce outage recovery times.

Mesh-network topologies are used most commonly with mobile wireless networks, but are also used in submarine and terrestrial fiber-optic networks to achieve the same result: maintaining continuity of communications between the originating and terminating points on a network. Network operators can configure mesh topologies using facilities that they own, hold via IRU, or lease. The use of optical mesh topologies by service providers serves to enhance the resiliency of submarine cable networks, but it is not a substitute for other cable protection measures. Figure 7 shows Verizon's trans-Atlantic optical mesh network, which has been designed with physical diversity and thus resiliency for the network to recover from catastrophic outages.

[74] *See, e.g.*, 18 C.F.R. §§ 4.32, 4.81 (establishing information requirements for marine hydrokinetic and other power project permit applications reviewed by FERC).

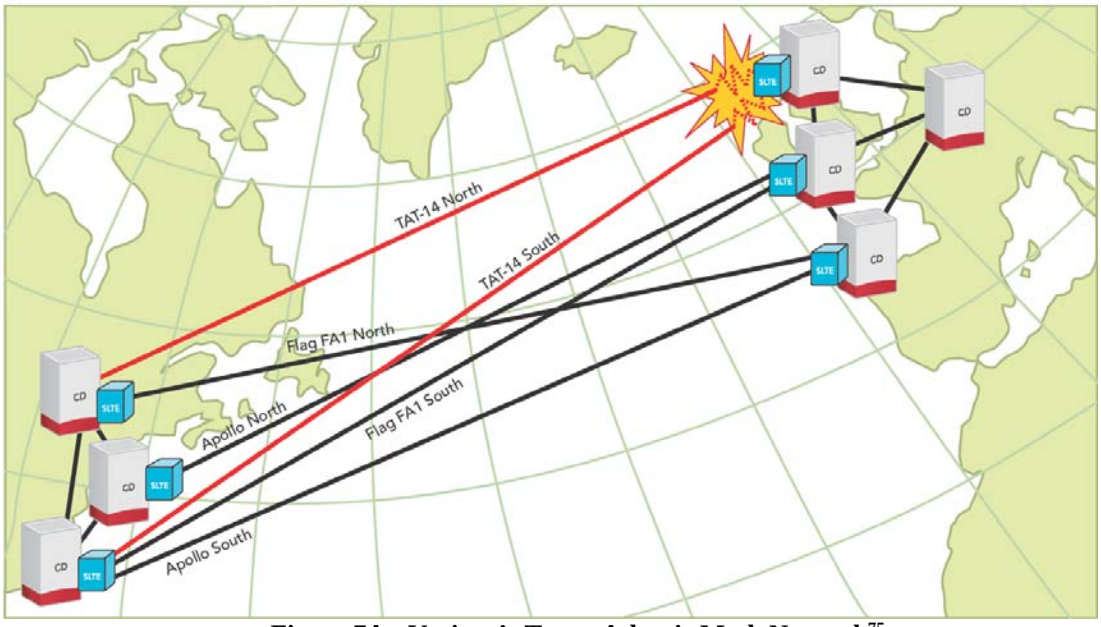

Figure 7A: Verizon's Trans-Atlantic Mesh Network[75]

8 Evaluation and Recommendations

8.1 Evaluation

Existing submarine cable protection mechanisms in the United States are inadequate in absolute terms and fall far short of measures adopted by other developed and developing countries. Although the U.S. Government has identified submarine cables as critical infrastructure, no U.S. federal agency has transposed that finding in practical terms to adopt or enforce cable-protection standards or policies. Moreover, federal agencies often fail to coordinate among themselves and with their state and local counterparts on even an *ad hoc* basis to ensure submarine cable protection, resulting in continuing problems with proposals and licenses for offshore energy installations and dredging projects and beach replenishment projects directly over or adjacent to installed submarine cables. Consequently, this disconnect between the acknowledged importance of submarine cable infrastructure and U.S. Government policies and mechanisms for protecting that infrastructure continues to pose a serious threat to U.S. national security and the U.S. economy. Although the United States leads the world in submarine cable connectivity, its cable protection regime is significantly underdeveloped in comparison to countries such as Australia and New Zealand.

[75] Source: Ciena, *Survivable Submarine Optical Networks*, http://media.ciena.com/documents/Survivable_Submarine_Optical_Networks_WP.pdf.

Due to a lack of awareness of submarine cables, their operational requirements, and their national security and economic significance, federal, state, and local agencies can exacerbate risks to submarine cable infrastructure. The self-help mechanisms traditionally used by submarine cable operators to coordinate with offshore oil and gas and commercial fishing activities have thus far proven wholly inadequate for addressing emerging issues with offshore renewable energy development and increasingly fail to address continuing issues with oil and gas development, dredging, and beach replenishment. To enhance and supplement existing industry efforts, WG8 recommends that the FCC endorse the recommendations set forth below, which consist of a mix of industry and FCC initiatives.

8.2 Recommendations

Early Consultation: The FCC and submarine cable operators should work with other U.S. Government agencies and other stakeholders to consult with and among each other at the earliest possible time to address spatial requirements for submarine cables and their relationship to other proposed marine activities and infrastructure.

Multiple Measures: The FCC and submarine cable operators should promote development and implementation of multiple measures—some existing, some yet to be developed—by government agencies and industry. Submarine cable protection is a complex undertaking that requires more than just a default separation distance from other marine activities, helpful though such a default separation distance can be.

Categorical Exclusion Zones Around Existing Submarine Cables: The FCC should endorse and explore with other federal, state, and local government agencies the creation of exclusion zones around existing submarine cables that would exclude on a categorical basis activities within a defined distance of a submarine cable absent agreement with the submarine cable owner. These zones should reflect well-established spatial requirements for cable installation and maintenance. Technological developments by other marine activities are irrelevant to these minimum spatial requirements, and no amount of consultation will change these minima. Where submarine cables traverse lease blocks for potential energy leases and rights of way for energy infrastructure, energy agencies should either (a) require lessees to maintain specified separation distances between offshore energy facilities and submarine cables or (b) decline to authorize development and installation offshore energy facilities within specified areas of lease blocks containing submarine cables.

Default Separation Distances: In the absence of a specific methodology or separation distances for specific offshore activities in relation to submarine cables, and in the absence of agreement among agencies and stakeholders for particular activities or

particular projects, the FCC should—consistent with ICPC and other industry recommendations and the best practices of other governments—endorse a default separation distance of 500 meters in water depths of less than 75 meters and the greater of 500 meters or two times the depth of water in greater water depths. The FCC should also urge other federal, state, and local government agencies to recognize such default separation distances. Such a default separation distance would not prohibit closer proximity between a submarine cable and another offshore activity, but it would require consultation and agreement between the affected parties.

Endorsement of Existing International and U.K. Standards: The FCC should recognize—and urge other federal, state, and local government agencies to recognize—ICPC, NASCA, and Subsea Cables UK recommendations as standards and best practices regarding submarine cable protection.

Development of New and Updated Standards: The FCC should encourage NASCA, ICPC, and other industry bodies to update existing recommendations and develop new ones to address emerging risks, such as specific developments with renewable energy facilities and activities.

Greater Public Dissemination of Standards: The FCC should encourage ICPC to undertake measures to enhance the public availability and dissemination of its recommendations and model crossing agreement. Historically, many of these documents have been available only on request, a practice that can limit awareness of these critical cable-protection tools.

Recharacterization of ICPC "Recommendations": The FCC should encourage ICPC to consider re-labelling its recommendations as standards, given that other marine activities and regulators often claim that "recommendations" are not authoritative.

ICPC Membership: The FCC should explore whether it or another U.S. Government agency should join ICPC as a member, as ICPC's 2013 change in membership rules means that ICPC now welcomes government participation. Such membership and participation would provide the FCC with more up-to-date information about submarine cable operations and deployments and provide a useful forum for engaging on cable-protection and marine-spatial-planning issues.

Standardize Treatment of Route Position List ("RPL") Data Across Agencies: The FCC should work with submarine cable operators and other U.S. Government agencies to develop a standardized approach to RPL data dissemination—and favor dissemination of such data—in order to promote awareness of installed submarine cables and the spatial requirements for existing and future cables. At present, submarine cable operators receive conflicting requests from various U.S. Government agencies. Some agencies seek to limit distribution of RPL data for security reasons, out of a fear that RPL data will provide terrorists with sensitive information about the location of critical infrastructure.

Other agencies seek to disclose RPL data in full during a permitting process. Consequently, submarine cable operators and NASCA often hesitate to share such data out of a concern that one or more U.S. Government agencies will oppose such sharing.

Mesh Networking: The FCC and submarine cable operators should promote the use of mesh networking as a critical supplement to traditional cable-protection activities, recognizing that such methods may not be possible for all but the largest carriers.

Greater Statutory Penalties for Cable Damage: The FCC should highlight for other U.S. Government agencies and the U.S. Congress the need for legislation substantially increasing the civil and criminal penalties for damage to submarine cable infrastructure. The current penalty levels are far too low to deter activities that might damage installed submarine cables and do not even cover the cost of repair. These penalties do not reflect global best practices.

FCC Rule Modification: The FCC should revoke or revise the standard licensing condition in 47 C.F.R. § 1.767(g)(2), providing that a cable must be moved upon request of the Secretary of the Army. This condition is entirely inconsistent with the status of submarine cables as critical infrastructure, ignores the importance of such infrastructure to U.S. national security and the U.S. economy, and ignores the fact that such relocation or removal would cause severe disruptions in communications and entail significant expense. It also affords undue deference to the Secretary of the Army, as the current requirement is not mandated by the Cable Landing License Act or Executive Order 10,530, both of which post-date the Rivers and Harbors Act of 1899. It also suggests improperly that the continued presence of a submarine cable in a particular area would not be a matter of public interest or national defense, when in fact it is.

APPENDIX A:
EXISTING AND PLANNED SUBMARINE CABLE INFRASTRUCTURE

1. Atlantic-, Gulf of Mexico-, and Caribbean-Region Submarine Cable Systems

The following-in-service submarine cable systems currently connect the Atlantic, Gulf of Mexico, and/or Caribbean coasts of the United States and its territories:

- ***Americas-II***: landing at Hollywood, Florida; Miramar, Puerto Rico; St. Croix, U.S. Virgin Islands; Martinique; Curaçao; Venezuela; Trinidad & Tobago; French Guyana; and Brazil;
- ***AMX-1***: landing at Jacksonville, Florida; Miami, Florida; Puerto Rico; Brazil; the Dominican Republic; Guatemala; and Mexico;
- ***Antillas-1***: landing at Isla Verde and Miramar, Puerto Rico, and the Dominican Republic;
- ***Antilles Crossing***: landing at St. Croix, U.S. Virgin Islands, Barbados, and St. Lucia;
- ***Apollo***: landing at Manasquan, New Jersey; Shirley New York; France, and the United Kingdom;
- ***ARCOS-1***: landing at North Miami Beach, Florida; Isla Verde, Puerto Rico; Bahamas; Belize, Colombia; Costa Rica; Curaçao; Dominican Republic; Guatemala; Honduras; Mexico; Nicaragua; Panama; Turks & Caicos Islands; and Venezuela;
- ***Atlantic Crossing-1***: landing at Brookhaven, New York; Germany; the Netherlands; and the United Kingdom;
- ***Atlantic Crossing-2/Yellow***: landing at Bellport, New York, and the United Kingdom;
- ***Bahamas-II***: landing at Vero Beach, Florida, and the Bahamas;
- ***Bahamas Internet Cable System***: landing at Boca Raton, Florida; Spanish River Park, Florida, and the Bahamas.
- ***Canada-United States-1 (CANUS-1)***: landing at Manasquan, New Jersey, and Canada;
- ***Challenger Bermuda***: landing at Charlestown, Rhode Island, and Bermuda;
- ***CFX-1***: landing at Boca Raton, Florida; Colombia; and Jamaica;
- ***Columbus-III***: landing at Hollywood, Florida; Italy; Portugal; and Spain;
- ***FLAG Atlantic-1***: landing at Island Park and Northport, New York; France; and the United Kingdom;

- ***Gemini Bermuda***: landing at Manasquan, New Jersey, and Bermuda;
- ***Global Caribbean Network***: landing at San Juan, Puerto Rico; St. Croix, U.S. Virgin Islands; Antigua and Barbuda; Barbados; Dominica; Guadeloupe; Martinique; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Trinidad and Tobago;
- ***Globenet***, landing at Tuckerton, New Jersey; Boca Raton, Florida; Bermuda; Brazil; and Venezuela;
- ***Hibernia Atlantic***: landing at Lynn, Massachusetts; Canada; Ireland; and the United Kingdom;
- ***MAYA-1***: landing at Hollywood, Florida; Cayman Islands; Colombia; Costa Rica; Honduras; Mexico; and Panama;
- ***Mid-Atlantic Crossing***: landing at Brookhaven, New York; Hollywood, Florida; and St. Croix, U.S. Virgin Islands;
- ***SAm-1***: landing at Boca Raton, Florida; San Juan, Puerto Rico; Argentina; Brazil; Chile; Colombia; Ecuador; and Peru;
- ***SMPR-1***: landing at Isla Verde, Puerto Rico, and St. Maarten;
- ***Taino-Carib***: landing at Condado and Isla Verde, Puerto Rico, and Magens Bay, St. Thomas, U.S. Virgin Islands;
- ***TAT-14***: landing at Manasquan and Tuckerton, New Jersey; Denmark; France; Germany; the Netherlands; and the United Kingdom; and
- ***TGN Atlantic***: landing at Wall, New Jersey, and the United Kingdom.[76]

The following planned or announced new submarine cable systems connect the Atlantic, Gulf of Mexico, and/or Caribbean coasts of the United States and its territories:

- ***Cable of the Americas ("COTA")***: landing at Boca Raton, Florida, and Brazil;
- ***Emerald Express***: landing at Shirley, New York; Iceland, Ireland, and the United Kingdom; and
- ***Guantanamo-Florida Cable***: landing at Guantanamo Bay Naval Base, Cuba, and South Florida;[77]

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[76] *See* TeleGeography, Submarine Cable Map, www.submarinecablemap.com.

[77] Carol Rosenberg, *Texas Firm Wins $31 million contract to lay fiber-optic cable to Guantanamo*, MIAMI HERALD (May 16, 2014), http://www.miamiherald.com/2014/05/15/4119740/texas-firm-wins-31m-guantanamo.html.

- ***Pacific-Caribbean Cable System***: landing at Jacksonville, Florida, San Juan, Puerto Rico, Aruba, Colombia, Ecuador, Panama, and Venezuela;
- ***Seabras-1***: landing at New York and Brazil;[78] and
- ***Virgin Islands Next Generation Network***: landing at St. Croix and St. Thomas, U.S. Virgin Islands.

2. Pacific-Region Submarine Cable Systems

The following-in-service submarine cable systems currently connect points on the Pacific coasts of the United States (including Alaska and Hawaii) and its territories (including American Samoa, Guam, and the Northern Mariana Islands):

- ***AKORN***: landing at Florence, Oregon, and Anchorage, Homer, and Nikiski, Alaska;
- ***Alaska Northstar***: landing at Nedonna Beach, Oregon, and Lena Point, Valdez, and Whittier, Alaska;
- ***Alaska United East***: landing at Juneau, Valdez, and Whittier, Alaska, and Lynwood, Washington;
- ***Alaska United West***: landing at Seward, Alaska, and Warrenton, Oregon;
- ***American Samoa-Hawaii Cable***: landing at Pago Pago, American Samoa, Keawaula, Hawaii, and Independent Samoa;
- ***Asia-America Gateway***: landing at San Luis Obispo, California; Keawaula, Hawaii; Tanguisson Point, Guam; Brunei; Hong Kong; Malaysia; the Philippines; Singapore; Thailand; and Vietnam;
- ***Australia-Japan Cable***: landing at Tanguisson Point and Tumon Bay, Guam, Australia, and Japan;
- ***BP Gulf of Mexico Fiber Optic Network***: landing at Freeport, Texas, and Pascagoula, Mississippi;
- ***China-U.S.***: landing at Bandon, Oregon; San Luis Obispo, California; Tanguisson Point, Guam; China, Japan; Korea; and Taiwan;
- ***Cook Inlet Segment of TERRA-SW***: landing at Homer and Williamsport, Alaska;
- ***Endeavour***: landing at Keawaula, Hawaii, and Australia;

[78] *See* TeleGeography, Submarine Cable Map, www.submarinecablemap.com.

- ***Guam Okinawa Kyushu Incheon Cable***: landing at Tumon Bay, Guam, and Japan;
- ***HANTRU-1***: landing at Piti, Guam, and the Republic of the Marshall Islands;
- ***Hawaiian Inter-Island Cable System***: landing at Wailua Point, Kauai; Kahe Point, Oahu, Sandy Beach, Oahu, Mokapu, Maui; and Spencer Beach, Hawaii;
- ***Hawaiian Islands Fiber Network***: landing at Wailua Golf Course, Kauai; Keawaula, Makaha, and Sandy Beach, Oahu; Lanai; Molokai; Mokapu, Maui; and Spencer Beach, Hawaii;
- ***Honotua***: landing at Spencer Beach, Hawaii, and Tahiti, French Polynesia;
- ***Japan-U.S.***: landing at Morro Bay, California; Makaha, Hawaii; and Japan;
- ***Kodiak-Kenai Fiber Link***: landing at Anchorage, Homer, Kenai, Kodiak, Narrow Cape, and Seward, Alaska;
- ***Mariana-Guam Cable***: landing at Rota, Saipan, and Tinian, Northern Mariana Islands, and Tanguisson Point, Guam;
- ***Pacific Crossing (PC-1)***: landing at Harbour Pointe, Washington; Grover Beach, California; and Japan;
- ***Pan-American Crossing***: landing at Grover Beach, California; Costa Rica, Mexico; and Panama;
- ***Paniolo***: landing at Hawaii, Maui, Molokai, Oahu, and Kauai, Hawaii;
- ***PPC-1***: landing at Piti, Guam, and Sydney, Australia;
- ***SEAFAST***: landing at Angoon, Hawk Inlet, Juneau, Ketchikan, Petersburg, Sitka, and Wrangell, Alaska; and
- ***Southern Cross***: landing at Hillsboro, Oregon; Morro Bay, California; Kahe Point and Spencer Beach, Hawaii; Australia; Fiji; and New Zealand;
- ***TERRA-SW Cook Inlet Segment***: landing at Homer and Williamsport. Alaska.[79]
- ***TGN Pacific***: landing at Hermosa Beach, California; Hillsboro, Oregon; Piti, Guam; and Japan;
- ***Trans-Pacific Express***: landing at Nedonna Beach, Oregon; China; Japan; Korea; and Taiwan; and
- ***Unity***: landing at Hermosa Beach, California, and Japan.[80]

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[79] *See id.*

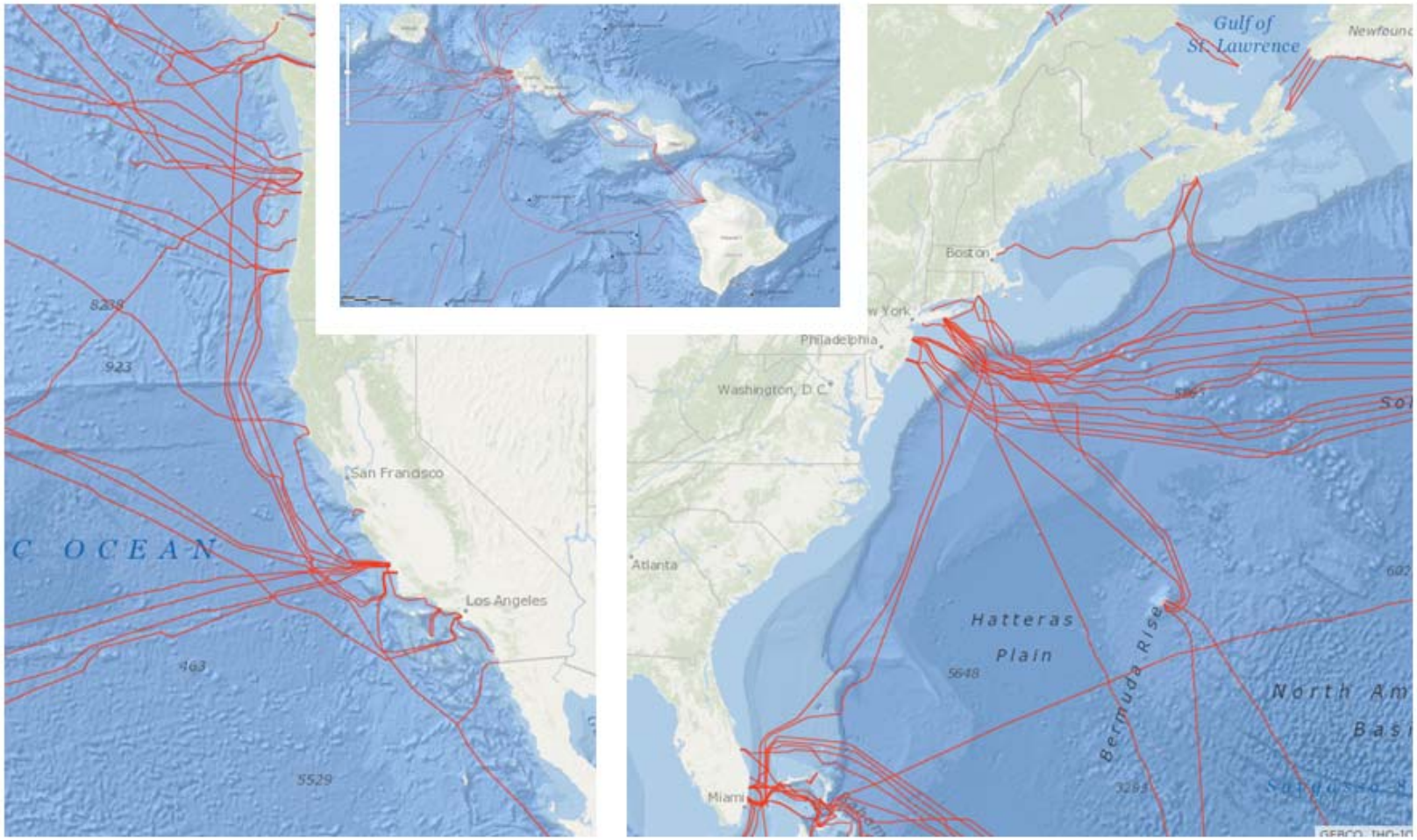
[80] *See id.*

The following planned or announced new submarine cable systems will connect points on the Pacific coasts of the United States (including Alaska and Hawaii) and its territories (including American Samoa, Guam, and the Northern Mariana Islands):

- ***APX-East***: landing at Hermosa Beach, California, and Australia;
- ***Arctic Fibre***: landing at Seattle, Washington; Prudhoe Bay, Alaska; Canada; Ireland; Japan; and the United Kingdom;
- ***FASTER***: landing at Oregon and Japan;
- ***Hawaiki***: landing at Pacific City, Oregon; Oahu, Hawaii; Australia; and New Zealand;
- ***New Cross Pacific Cable ("NCP")***: landing at the West Coast of the United States and China; and
- ***Pacific-Caribbean Cable System***: (described in Section 1 above)
- ***SEA-US***: landing at the West Coast of the United States; Hawaii; Guam; the Philippines; and Indonesia.[81]

[81] *See id.* (showing APX-East, Arctic Fibre, and Hawaiki); Julian Rawle, *How Sustainable Is Asian Growth?*, SUBMARINE CABLE NEWS (Feb. 14, 2014), www.pioneerconsulting.com/site/images/stories/Pioneer_Consulting_Rawle_Article_How_Sustainable_is_Asian_Growth_Feb_2014_Edition_of_SCN.pdf (discussing APX-East, FASTER, Hawaiki, NCP, and SEA-US); NEC Corporation, *A Global Consortium to Build New Trans-Pacific Cable System "FASTER"* (Aug. 11, 2014), http://www.nec.com/en/press/201408/global_20140811_01.html.

APPENDIX B: SUBMARINE CABLES LANDINGS IN THE UNITED STATES



APPENDIX C: STATUS OF STATE AND REGIONAL MARINE SPATIAL PLANNING EFFORTS

1. Atlantic and Gulf Coast Regions

- **Mid-Atlantic Council on the Ocean** ("MARCO") – Includes New York, New Jersey, Delaware, Maryland, and Virginia. MARCO is preparing to launch a regional coastal spatial planning effort using "an ecosystem-based management approach that considers all human uses and ecosystem elements in the Mid-Atlantic." In this planning stage, the specific goals of this project are general and still being defined. As a first step, MARCO developed a data portal demonstrating the varied uses of the ocean floor in the Mid-Atlantic. This mapping tool does not currently identify submarine cables using industry provided cable data, but MARCO is in the process of adding additional data layers and may add this information in the future.

- **Northeast Regional Ocean Council.** NROC **i**ncludes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. NROC established an Ocean Planning Committee to address regional issues related to ocean planning, this committee is gathering information to develop recommendations for the Council. To date, the Committee has briefly considered the submarine cables which could be impacted by the energy sector. NROC has also developed a mapping tool that includes some information about energy transmission lines and is working with NASCA to identify cables in the region.

- **Governors' South Atlantic Alliance.** GSAA includes North Carolina, South Carolina, Georgia, and Florida. GSAA is developing regional coastal spatial planning tools. To date, GSAA is concentrating its efforts on achieving four primary objectives: clean coastal waters, working waterfronts, healthy marine ecosystems, and disaster-resilient communities. GSAA has a limited set of objectives and has not considered any spatial planning efforts relating to conflicting uses of the seabed or to submarine cables specifically. However, the GSAA's Healthy Ecosystems planning group has prioritized gathering data on diverse uses of the seabed to aid multi-use management decisions as a key goal.

- **Gulf of Mexico Alliance.** GMA includes Florida, Alabama, Mississippi, Louisiana, and Texas, the EPA, NOAA, the Department of the Interior, and other federal agencies. GMA is developing a marine spatial plan for the region. GMA considered creating "exclusionary areas" to protect oil & gas platforms and pipelines, but has not considered protecting submarine cables. GMA is focusing its efforts on gathering data about natural resources, protected habitats, and water quality, and has not yet comprehensively addressed the conflicting uses of the seabed.

- **Florida.** Florida considered proposals for defining preferential areas for cable landings and routing but those proposals are now dormant. Specifically, the state proposed imposing more lenient permit conditions and lease fees if cables were placed in geographically specific locations, or "cable corridors." NASCA has raised concerns with this approach.

- **Massachusetts** - Massachusetts developed the Massachusetts Ocean Plan (Plan) to provide a comprehensive approach to ocean management, including balancing current ocean uses with future needs. The Massachusetts Department of Energy and Environmental Affairs ("EEA") is currently convening workgroups and soliciting public comment to update the Plan. The Plan establishes Renewable Energy Areas based on "exclusionary screening criteria," including compatibility with existing uses and avoidance and mitigation of impacts. These factors are categorical and do not outline specific requirements. The Plan also designates a Multi-Use Area, open to all uses, including cables, pipelines, and energy facilities of a certain scale. These uses are managed by siting and performance standards, not spatial designation. The Plan also includes the Massachusetts Ocean Resource Information System ("MORIS"), an interactive data portal. The portal includes data about cables and transmission lines. The map illustrates some overlap between wind energy areas, cable areas, and tidal resource areas.

- **Maryland.** In coordination with MARCO, Maryland has ongoing efforts to develop a wind energy planning area. Maryland's Department of Natural Resources ("DNR") is currently gathering data to reduce conflicting uses, facilitate compatible uses, and diminish the environmental impact that those uses may have on the ocean along Maryland's coast. Maryland is now accepting bids for two proposed offshore wind energy sites that presumably avoid or limit contact with other uses, but Maryland has not provided specific information regarding how these proposed sites were chosen.

- **New Jersey.** New Jersey's efforts to address conflicting uses are channelled through its involvement in MARCO, including contributing data to MARCO's GIS data portal. New Jersey has also begun gathering data to develop a state-specific comprehensive marine spatial plan to manage existing and proposed offshore uses and resources and decrease conflicts. New Jersey is still in the preliminary stages of that inquiry and has not yet developed specific recommendations for the marine spatial plan.

- **New York.** New York has begun work to develop a comprehensive marine spatial plan. At this point, New York has produced a report, in conjunction with NOAA, detailing the impact that new marine uses, such as offshore energy development, have on marine life and habitats. This report is a preliminary step in

a broader effort to develop spatial planning standards to address conflicting uses of the seabed and achieve conservation objectives.

- **Rhode Island.** Rhode Island developed the Ocean Special Area Management Plan (OSAMP), in collaboration with state & federal agencies, and other stakeholders, to provide regulatory standards for ocean management. OSAMP specifically contemplates the impact that offshore renewable energy facilities have on pre-existing cables, and recommends considering pre-existing cables when siting such facilities. OSAMP incorporates the International Cable Protection Committee (ICPC) standards by reference.

2. Pacific Coast Regions

- **West Coast Governors' Alliance on Ocean Health.** WCGA includes California, Oregon, and Washington. WCGA's goal is to "help support rational and orderly decisions regarding future offshore developments and resource management challenges off the West Coast." Beyond that general goal, the WCGA has not specifically addressed conflicting uses of the seabed.

- **California.** California maintains an Ocean Resources Management Program to coordinate the state's response to marine and coastal management issues. Most of California's coastal management efforts are facilitated through its involvement in the WCGA. The state has developed a Coastal Impact Assistance Program ("CIAP") that specifically addresses conflicting uses, including submarine cables. The CIAP includes plans for further research on these issues. California has considered creating a more comprehensive marine spatial plan and is currently collaborating with community leaders and soliciting public comment to begin that process.

- **Hawaii.** Hawaii does not have a marine spatial plan. The Hawaii's Ocean Resources Management Plan contemplates conflicting uses, but limits that inquiry to conflicts between commercial uses and natural resources. Hawaii also briefly considered, but ultimately rejected, cable corridors.

- **Oregon.** As part of its marine spatial planning efforts, Oregon's Land Conservation and Development Commission ("LCDC"), adopted a plan establishing Proprietary Use and Management Areas ("PUMA") that are 1000 meters extending on either side of submarine cables. The Oregon plan provides that applications for marine energy projects proposed within these PUMA areas will not be accepted unless the proposed new use, in addition to being legally permissible, complies with the authorized cable use.

- **Washington State.** Washington law requires that an interagency team, including the Department of Ecology, the Department of Fish and Wildlife, and the Department of Commerce, develop a marine spatial plan to address conflicting uses of the seabed along Washington's Pacific Coast. The statutory requirements for the spatial plan are open-ended and rely heavily on the expertise of the interagency team to develop more specific, enforceable requirements. The interagency team is currently in the process of developing the plan through consultation with environmental groups and other stakeholders. The Washington Department of Ecology is evaluating the potential environmental impact of a marine spatial plan under the State Environmental Policy Act ("SEPA"). Washington also conditions its Shoreline Conditional Use permits on the consideration of and compatibility with existing uses.