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NOIA NATIONAL OCEAN INDUSTRIES ASSOCIATION

July 2, 2012

Mr. Gary D. Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Comments on the Draft PEIS for Atlantic G&G Activities
Via E-mail to GGEIS@BOEM.gov

Dear Mr. Goeke:

The American Petroleum Institute (API), the International Association of Geophysical Contractors (IAGC), and the National Ocean Industries Association (NOIA) offer the following comments on the U.S. Department of Interior Bureau of Ocean Energy Management's (BOEM's) Draft Programmatic Environmental Impact Statement (DPEIS) for Geological and Geophysical (G&G) Exploration on the Atlantic Outer Continental Shelf (OCS). On March 30, 2012, BOEM published the *Notice of Availability* in the *Federal Register* announcing publication of the DPEIS and requesting comments on or before May 30, 2012, a deadline subsequently extended to July 2, 2012. These comments are submitted as a supplement to comments provided during the public hearings held in April 2012.

The API is a national trade association that represents over 490 members involved in all aspects of the oil and natural gas industry, including exploring for and developing oil and natural gas resources in the GOM– a vital part of our nation's economy. The industry supports millions of American jobs and delivers billions of dollars in annual revenue to our government. Last year, it directly contributed more than $470 billion to the U.S. economy in spending, wages and dividends, and it is one of the few industries creating jobs throughout the recession and the ongoing national economic downturn.

The IAGC is the international trade association representing the industry that provides geophysical services (geophysical data acquisition, processing and interpretation, geophysical information ownership and licensing, associated services and product providers) to the oil and natural gas industry. IAGC member companies play an integral role in the successful exploration and development of offshore hydrocarbon resources through the acquisition and processing of geophysical data.

The NOIA, founded in 1972, represents more than 270 companies among all segments of the offshore industry with an interest in the exploration and production of both traditional and renewable energy resources on the nation's outer continental shelf. NOIA's mission is to secure reliable access and a fair regulatory and economic environment for the companies that develop the nation's valuable offshore energy resources in an environmentally responsible manner.

BOEM's DPEIS addresses potential environmental effects of multiple Geological and Geophysical (G&G) activities in the Mid- and South Atlantic Planning Areas of the OCS. These activities include, but are not limited to, seismic surveys, sidescan-sonar surveys, electromagnetic surveys, geological and geochemical sampling, and remote sensing. These activities are critically important and are needed to provide information that will be used to update existing oil and natural gas resource assessments, and should a lease sale be scheduled for the Atlantic OCS, to inform company decisions on areas of interest for future exploration. Therefore, IAGC member companies that actually perform the activities noted above and API member companies that use the data collected during these activities are keenly interested in the DPEIS and the timely completion of the Final PEIS.

Industry has been supportive of the need for oil and gas exploration on the Atlantic OCS. However, it is critical to note that anticipated industry G&G activity will be significantly related to future leasing opportunities. At present no lease sale is scheduled for the Atlantic OCS under the proposed 2012-2017 5-year Leasing Program. It is important to remember that the government does not generate this necessary data; geophysical companies do. And they generally do this on a speculative basis, hoping to sell the data to operators who plan to purchase leases in an area. With no lease sale scheduled in the Atlantic, and thus no potential customers, companies have little incentive to gather new G&G data.

Comment Overview and Structure

In recent months, the Associations have reviewed and provided comment on separate environmental documents/regulatory actions that considered the acoustic effects of seismic surveys and other industry activities. These actions include the BOEM Petition for Incidental Take Authorization for the Gulf of Mexico [*Federal Register, Vol. 76, No. 114. p.34656*] and the DEIS for Effects of Oil and Gas Activities in the Arctic Ocean [*Federal Register, Vol. 77, No. 11, pp. 2513-14*]. Our review of this DPEIS is taken in the context of our comments filed on the Federal Register notices mentioned above. We recognize that while there are unique aspects associated with the Atlantic OCS, there are both technical and policy issues that should be consistent from region to region. The industry has used the following principles to evaluate the documents issued by the BOEM and National Marine Fisheries Service (NMFS):

- The U.S. needs to encourage energy resource development to meet its national economic security interests.
- Development should proceed with reasonable and balanced environmental protection.
- Industry has acknowledged subsistence use, has supported reasonable balance of competing uses and reasonable requirements to satisfy the Marine Mammal Protection Act (MMPA) requirement for no "unmitigable adverse effects" on the subsistence harvests of these species.
- The nature and scope of the conventional energy industry's activities must be accurately described and regulated using the same criteria as applied to other ocean users.
- Assessment of the environmental consequences must use scientifically accepted information and risk characterization/assessment methodologies and identify reasonable probabilities of risk and uncertainty.

- Agency decisions regarding U.S. Atlantic development should be made using clearly stated, legally supported criteria yielding results that can be scientifically replicated.

This transmittal letter provides an overview of our technical comments and comments dealing with the legal aspects of the DPEIS that we feel need to be addressed by BOEM before the issuance of the Final PEIS. Detailed legal comments are included as Appendix 1 and technical comments are included as Appendix 2 to this letter. In addition, we provide a brief examination of the practical impacts of one of the proposed mitigation measures, shutdown requirements, one of several measures that we believe are based on flawed analysis that do not take into account the best available science.

I. Summary of Industry Positions and Technical Comments

A. Geographic Scope:

The DPEIS specifies that the Area of Interest (AOI) includes the Mid- and South Atlantic OCS Planning Areas, as well as adjacent State waters (outside of estuaries) and waters beyond the Exclusive Economic Zone (EEZ) extending to 350 nautical miles (nmi) (648 kilometers [km]) from shore (Figure 1-1). [Page 1-5]. As recommended in our previous comments on the scope of the DPEIS, we believe that the AOI should be expanded to include the North Atlantic Planning Area. Undertaking an environmental assessment of this area now would remove a potential impediment to future exploration and lease sales in an area adjacent to Canadian OCS waters that have yielded successful oil and gas exploration, development and production.

B. Action alternatives

We recommend that BOEM provide another alternative without closure areas prior to issuance of the final PEIS. We strongly encourage that both the range of alternatives analyzed and their evaluation reflect the nature and extent of the known causes of injury and mortality faced by various protected species. In addition, for the reasons explained further in these comments, we oppose as unwarranted several of the mitigation measures proposed as part of Alternative A. Further, we believe that Alternative B is unwarranted for a number of reasons including the finding in the DPEIS that doubling the size of the closure area does not provide additional protection for right whales or marine life generally.

If BOEM does not provide a new alternative that provides no closure areas and reasonable mitigation measures, the Associations believe that Alternative A is the least objectionable of the three alternatives presented in the current DPEIS.

C. Equivalent Use Principal for High Resolution Geophysical (HRG)

The approach to High Resolution Geophysical activities would be improved if the DPEIS recognized that this type of survey equipment is also used by many other sectors not identified in the DPEIS. The DPEIS should explain why a wide range of sectors can use these technologies during certain times and in locations where the oil and natural gas E&P industry could not. Since the environmental consequences of a survey tool's use do not vary by who is using it, there is no apparent basis for this discriminatory treatment, particularly if it shows lack of effect. Industry would note that a wide range of marine users, including scientific researchers, routinely apply one or more of these or similar tools.

The DPEIS also proposes to require unprecedented observation and shut-down zone requirements for HRG but does not provide necessary environmental impact information that would indicate adverse effects of a nature to warrant requiring such zones. The shut-down requirements are in industry's opinion, not warranted, scientifically substantiated nor feasible in many circumstances, including but not limited to, HRG activities conducted by Autonomous Underwater Vehicles (AUVs) that collect data only a few feet above the sea bed.

D. Assessment of Seismic Survey Environmental Effects

Industry appreciates the agency's acknowledgment of the difficulty of assessing acoustic impacts on various species. The DPEIS's selection of sound characterization and propagation model components is more geared toward a portrayal of the size of the sound field rather than the actual impact of that sound. Industry has pointed out in recent months a variety of methodological flaws where the agency's choices in acoustic propagation models, the use of frequency weighting, and acoustic thresholds can result in individual differences in take estimates that vary by several orders of magnitude.

Improving models to better portray 3-D sound fields and animal exposures is a step in the right direction, but nevertheless, these model efforts as utilized in the DPEIS predict unrealistic Level A takes and proportionally greater numbers of Level B takes, using the simplistic 20 dB decrease from 180 dB to 160 dB. Marine Mammal Observer data does not support these model predictions, and in fact, provide no verification of takes the model predicts. Based on both field observations and recent studies, injury or death of marine mammals exposed to airguns seems increasingly unlikely (Richardson et al 2010).

The DPEIS draws conclusions based on model predictions, notably a finding of "moderate" impact, yet fails to provide any basis for an apparent confidence in model results in the face of contradictory observations. The size of the gap between presented estimates of incidental takes and observed few-to-no mortalities/injuries or population level effects undermines the credibility of the assessment. The gap between predictions and the observations provided in IHA observer reports is substantial. [1]This PEIS further highlights the gap between the estimated take numbers and the observational data by presenting large numbers of estimated dolphin takes despite extensive observations of dolphins choosing to bow ride seismic vessels.

The size of the gap between presented estimates of incidental takes based only on exposure and no observation of mortalities/injuries or population level effects undermine the credibility of the assessment. This PEIS notes that injury or death is not an expected or likely outcome yet uses contradictory Level A predictions to support conclusions of impact. The gap between predictions and the observations provided in IHA observer reports is substantial.

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[1] http://www.data.boem.gov/PI/PDFImages/ESPIS/5/5177.pdf

A good example of where exposure does not equal take as defined under the MMPA is in the estimation of dolphin takes. There is extensive documentation of dolphins choosing to bow ride seismic vessels.[2,3] This is a seemingly normal behavioral pattern frequently observed regardless of vessel type, where the animal displays a behavioral response that is not consistent with a response to harassment.

The DPEIS does a better job than some other recent NEPA documents in discussing acoustic impact analysis. However, the PEIS should contain agency explanations of all the steps, choices and assumptions that were made in impact determinations. The effects of these choices are not adequately disclosed nor discussed in the environmental consequences assessment. In the end, industry believes that the DPEIS 1) does not employ the best available science, 2) grossly overestimates the number of Level A and Level B takes, and 3) that these overestimations lead to incorrect choices in the Alternatives presented and the mitigation measures proposed.

These are not new requests. Industry has long requested transparent guidance, for example, on acoustic threshold criteria that uses widely accepted science. The industry's confidence is further eroded by repeated requests from both industry and environmental conservation organizations for clear guidance on how the agencies apply judgment to these estimates of takes to arrive at their "small number of takes" and "negligible impact" determinations. Inconsistencies in agency methods, model components, and inputs from one regulatory action to another do not instill confidence. It appears that the absence of such guidance, for example, allows various agency contractors developing NEPA documents to make choices on behalf of the agency. Variations in methods evaluation criteria, modeling components and data inputs from one agency assessment to the next naturally leads to questions about whether decisions exceed agency discretion.

Technical input on various factors in the calculation of take estimates is offered in Appendix 2.

E. North Atlantic right whale Risk Assessment & Closure Areas.

Industry shares the stated concern regarding the health of the North Atlantic right whale population. The DPEIS properly identifies the long recognized and documented major risks to this species – vessel strikes[4,5] and fishing gear entanglement. In contrast, there are no documented injuries, deaths, or significant disturbances from airguns for one of the most studied

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[2] Moulton, V.D. and Miller, G.W. 2005. Marine mammal monitoring of a seismic survey on the Scotian Slope, 2003. In *Acoustic Monitoring and Marine Mammal Surveys in The Gully and Outer Scotian Shelf before and during Active Seismic Programs*, ed. Lee, K., H. Bain, and G.V. Hurley. Environmental Studies Research Funds Report No. 151, pp. 29-39.

[3] Weir et al. 2011. Cetacean encounters around the island of Montserrat (Caribbean Sea) during 2007 and 2010, including new species state records. *Marine Biodiversity Records*, 4:e42

[4] Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of northern right whales (Eubalaena glacialis) in the western North Atlantic Ocean. J. Cetacean Res. Manage. (Special Issue) 2:193-208.

[5] Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet and M. Podesta. 2001. Collisions between ships and whales. Marine Mammal Science, 17(1):35-75.

whale populations in the world. In the absence of such observed impacts, the basis for the proposed closure areas disappears. The DPEIS would be improved by placing hypothetical seismic survey risks in a context relative to the significant known risks. So doing, for example, would note that the speeds of working seismic survey vessels are less than half of the current regulatory limit of 10 knots. Industry believes that the evaluation of the need for closure areas would be different if this analysis were conducted.

Moreover, the size of the proposed closure areas is premised upon defining areas of habitat critical for life function that includes not only breeding and foraging, but also migration pathways. These three components comprise the totality of activities for these animals rather than critical habitat. The critical habitat designation for North Atlantic right whales determined in 1994 considered but rejected migration routes as inconsistent with the ESA approach to critical habitat. Although there is a petition to revise critical habitat, no decision has been made. BOEM should clearly state on what basis and under what authority it proposes to regulate using migration pathways. Industry does not agree that such regulation is permissible.

Required levels of protection and mitigation standards should be risk based, practicable in implementation and equally applied to all ocean users.

II. Implications of proposed shutdown requirements

If we consider one specific proposed mitigation, the shutdown requirement, to demonstrate just how impactful the incorrect analysis and selection of alternatives and mitigation measures can be, we believe it to be so great as to cast into doubt the very feasibility of conducting seismic activities.

The proposed mitigation measures are designed to respond to and mitigate projected Type A and Type B takes. But because the DPEIS greatly overstates the number of Type A and Type B takes and exclusion zones for potential takes it greatly overstates the risk and extent for reasonable mitigation measures. This is of critical importance, because, based on predictions, some of the proposed mitigation measures would impose potentially high costs, greatly impede or altogether preclude the conduct of seismic surveys and geohazard and cultural resource identification, and deeply frustrate the achievement of the goals of the OCS Lands Act.

The outcome of decision making in the absence of sound science is manifested in the proposed mitigation measure that would: (a) greatly expand the size of the vessel exclusion zone, (b) extend it to include dolphins, and (c) apply discriminately to high resolution geophysical surveys conducted for oil and gas operators only.

Both Alternatives set forth in the DPEIS would substantially expand, by an enormous amount, the spatial area covered by the exclusion zone. This is clearly shown in Table D-21, set forth on p. D-51 of Volume II, which lists the various scenarios examined by BOEM and the resultant exclusion zone. These scenarios establish different exclusion zone radii, based upon the size of the airgun array, the water depth, the bottom type, and the time of year. **Every single scenario would materially expand the exclusion zone beyond the currently allowed 500 meter radius, whenever a large airgun array is being employed.** In some scenarios, the exclusion zone radius would be **over 2,100 meters,** meaning that **the spatial area covered by the**

exclusion zone would be 17 times larger than the current exclusion zone under Joint NTL 2012-G02. New findings of acoustic impacts or a scientific basis for such an increase in regulatory requirements is absent. What recent research does indicate is that thresholds for possible hearing damage (PTS) from an airgun source are above the antiquated 180 dB standard.[6]

That change, plus the expansion of shutdown requirements to include not only whales, as is provided by Joint NTL 2012-G02, but also dolphins, could greatly increase the number of mandatory shutdowns over that experienced under Joint NTL 2012-G02 (and previously under NTL 2007-G02).

The practical consequences of the proposed changes for the conduct of seismic surveying are enormous. We are highly doubtful that seismic survey operations could even be attempted were shutdowns to be required with anything approaching the frequency estimated in the DPEIS.

A more detailed discussion of this topic is found in Appendix 1.

In conclusion, industry has offered specific comments on the DPEIS. However, this input should not distract from higher level issues. Do seismic surveys significantly and adversely affect the marine environment relative to other well known risks? The industry does not believe they do, based on the absence of observed effects and recently released BOEM marine mammal observer data.

To build its case that seismic does have significant adverse effects, BOEM relies on models that have not been validated against field data to create unrealistic estimates of incidental takes. Further, the estimate of the number of takes is only achievable by using acoustic threshold criteria based on 15-year old obsolete data that does not meet the NEPA requirement to use the best available science. In addition, in the face of no observable injury/mortality data and no population level behavioral effect, the DPEIS demands more and more unreasonable mitigation measures, including six-month area closures and the addition of dolphins (who at times intentionally approach seismic vessels) to the list of animals that require operations to shut down. Not only is there little to no basis for these demands, the DPEIS will require the conventional energy industry to comply with operational mitigations that industries having known causes of cetacean mortality do not. In so doing, the agency decision-making is not only impossible to justify but also discriminatory.

We appreciate the work done by BOEM in developing this DPEIS. We request that BOEM review the DPEIS in light of the comments made herein and revise the DPEIS as appropriate prior to issuance of the final PEIS. If you should have any questions on these comments, please contact Andy Radford at 202-682-8584 or radforda@api.org.

[6] Finneran, US Navy Marine Mammal Program at the Acoustical Society of America meeting, October 2011

Sincerely,

Andy Radford, API

Sarah L. Tsoflias, IAGC

Luke Johnson, NOIA

Appendix 1

Legal and Economic Issues

Several key legal principles and economic considerations must guide the preparation of this PEIS.

I. Legal Aspects

A. The DPEIS must be based on best available science

The scientific analysis set forth in the DPEIS, and upon which alternatives and recommendations set forth in the DPEIS are developed, must be based upon the best available science. This obligation stems from two separate legal mandates.

First, NEPA itself requires that an agency "utilize 'high quality' science in preparing EISs." *Sierra Club v. Marita*, 46 F.3d 606, 621 (7th Cir. 1995), citing 40 C.F.R. § 1500.1(b). "Accurate scientific analysis [is] essential to implementing NEPA." *Environmental Defense v. U.S. Army Corps of Engineers*, 515 F. Supp. 2d 69, 78 (D.D.C. 2007).

Second, the use of the best available science is mandated by Presidential Executive Order 13563 (Jan. 18, 2011). Section 1(a) of that Order provides that "[o]ur regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation. It must be based on the best available science."

Accordingly, as one example, BOEM must apply the best available evidence in assessing the sound levels at which Level A or Level B harassments may occur. It is entirely inappropriate for BOEM instead to rely upon historical practice at DOI or any other federal agency. "Accurate scientific evidence remains essential to an Environmental Impact Statement, and…an agency [can]not rely on 'stale' scientific evidence." *City of Carmel–By–the–Sea v. U.S. Dep't of Transportation*, 123 F.3d 1142, 1151 (9^{th} Cir. 1997). BOEM therefore must assess the currently available science, and reach sound conclusions based upon the best available scientific evidence.

As discussed in detail in these comments, the DPEIS does not utilize the best available scientific evidence, and the conclusions reached on critical issues are therefore simply wrong. Specifically, the DPEIS errs when it concludes that exposure to sound levels in excess of 180 dB re: 1 μPa (rms) results in Level A harassment, and that exposure to sound levels in excess of 160 dB re: 1 μPa (rms) results in Level B harassment. Nor is an adequate scientific basis provided for the proposed expansion of shutdown requirements to include delphinids, the proposed expansion of the shutdown zones, or the proposed separation requirement for seismic vessels conducting simultaneous operations.

Further to this, industry does not believe the principle of equating received sound levels to takes has been subjected to public comment or peer review as is required for rulemaking. In addition, this interpretive application of exposure as a proxy for incidental take is not supported by the MMPA, which requires that harassment must take place. 16 U.S.C. 1362(18)(A). In the case of Level B Harassment, the disturbance must be related to a disruption in behavioral patterns, not just behavioral change. 16 U.S.C. 1362(18)(A)(ii), 1362(18)(D). Bow-riding by dolphins is an excellent example of a normal behavioral pattern and should not therefore be assessed as a take based on received sound levels, using any metric. Finally, there is no jurisdictional precedent defining whether sound occurring at a certain level constitutes take. It is simply not enough for an animal to be exposed to a sound. For there to be a "take" based on harassment, there must be "disruption" of a "pattern" of behavior and it must be caused by an act of pursuit, torment or annoyance. 16 U.S.C. 1362(18)(A).

B. The DPEIS must reflect programmatic needs and goals

Congress has been quite explicit in its programmatic goals under the OCS Lands Act. The OCS Lands Act's organizing principle is the "*expedited exploration* and development of the Outer Continental Shelf in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade." 43 U.S.C. § 1802(1) (emphasis added); *see also* 43 U.S.C. § 1332(3) (the OCS "should be made available for *expeditious and orderly development*, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs" (emphasis added)).

Congress mandated these programmatic goals when it substantially amended the OCS Lands Act in 1978 for the express purpose of "promot[ing] the *swift*, *orderly and efficient* exploitation of our almost untapped domestic oil and gas resources in the Outer Continental Shelf." H.R. Rep. No. 95-590, at 8 (1977), *reprinted in* 1978 U.S.C.C.A.N. 1450, 1460 (emphasis added). As the D.C. Circuit observed soon thereafter, "the Act has an objective — the expeditious development of OCS resources." *California v. Watt*, 668 F.2d 1290, 1316 (D.C. Cir. 1981).

Despite these clear statements of Congressional intentions and programmatic goals, the PEIS lacks any analysis of the Congressional purpose enshrined in the OCS Lands Act; the manner in which the seismic surveying at issue in the DPEIS advances those goals; and the question whether Alternative A versus Alternative B, or the proposed mitigation measures contained in both Alternative A and Alternative B would have a materially negative impact upon the accomplishment of those goals. This is a fundamental flaw in the DPEIS, and one that leads to the inclusion of inappropriate proposed mitigation measures.

"NEPA itself does not mandate particular results, but simply prescribes the necessary process." *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989); accord *Winter v. Natural Resources Defense Council, Inc*., 555 U.S. 7, 48 (2008); *accord Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 350 (1989). Furthermore, while an agency must consider mitigation measures as part of its assessment of alternatives, NEPA neither "require[s] agencies to discuss any particular mitigation plans that they might put in place," nor … require[s] agencies—or third parties—to effect any." *Theodore Roosevelt Conservation Partnership v. Salazar*, 616 F.3d 497, 503 (D.C. Cir. 2010). Moreover, "[i]f the adverse environmental effects of the proposed action are adequately identified and evaluated, the agency is not constrained by NEPA from deciding that other values outweigh the environmental costs." *Robertson*, 490 U.S. at 350.

In conducting a NEPA environmental evaluation, an agency is *not* required to consider alternatives "inconsistent with the [government's] policy objective" in undertaking the program that is under NEPA review. *Kootenai Tribe of Idaho v. Veneman*, 313 F.3d 1094, 1121 (9th Cir. 2002) (Forest Service "not required under NEPA to consider alternatives in the DEIS and FEIS that were inconsistent with its basic policy objectives.").

The courts have been adamant on this point: an agency's only NEPA obligation is to evaluate "reasonable alternatives," 40 C.F.R. 1502.14(a), and a '"proposed alternative is reasonable only if it will bring about the ends of the federal action' measured by whether it achieves the goals the agency sets out to achieve." *National Resources Defense Council, Inc. v. Pena*, 972 F. Supp. 9, 17 (D.D.C. 1997), *quoting Citizens Against Burlington, Inc. v. Busey,* 938 F.2d 190, 195 (D.C. Cir. 1991).

What is a "reasonable alternative" is evaluated in light of the "purpose and need of the project." *Audubon Naturalist Society of the Central Atlantic States, Inc. v. U.S. Dep't of Transportation*, 524 F. Supp. 2d 642, 671 (D. Md. 2007), citing *City of Alexandria v. Slater,* 198 F.3d 862, 868 (D.C. Cir. 1999). "Alternatives addressing different purposes and goals are inherently unreasonable or infeasible." *Id.* at 671 n. 26. A federal agency may therefore eliminate alternatives and mitigation measures that do not meet the purposes and needs of the project. *Biodiversity Conservation Alliance v. BLM*, 608 F.3d 709, 715 (10th Cir. 2010); *accord City of Richfield, Minn. v. F.A.A.,* 152 F.3d 905, 907 (8th Cir.1998) ("Under NEPA, an EIS must examine 'reasonable alternatives' to a project.... An alternative is unreasonable if it does not fulfill the purpose of the project.").

Furthermore, in determining programmatic goals, and hence what proposed alternatives are "reasonable," an "agency's *evaluation of its objectives is heavily influenced by the agency's consideration of "the views of Congress, expressed*, to the extent that the agency can determine them, in the agency's statutory authorization to act, as well as in other congressional directives." *Pena*, 972 F. Supp. at 18 (emphasis added).

C. The DPEIS must focus upon reasonably likely effects, not merely potential effects

BOEM's only obligation is to assess reasonably likely environmental impacts, *South Fork Band Council of Western Shoshone of Nevada v. DOI*, 588 F.3d 718, 727 (9th Cir. 2009), not impacts that are simply a mere possibility. "An EIS need not discuss…conjectural consequences," *Sierra Club v. Hodel*, 544 F.2d 1036, 1039 (9th Cir. 1976), and alternatives and mitigation measures therefore cannot be imposed to counteract purported effects for which there exists no credible scientific proof. The Draft PEIS violates these precepts in, for example, its establishment of exclusions zones based upon conjectural impacts of exposure to arbitrarily selected sound thresholds.

III. Economic Considerations

A. The DPEIS must assess economic effects

An associated but separate requirement is that an agency appropriately "consider alternatives in a manner that is consistent with the economic goals of a project's sponsor." *Weiss v. Kempthorne*, 683 F. Supp. 2d 549, 567 (W.D. Mich. 2010) *aff'd in part and vacated in part on other grounds*, 2012 WL 204494 (6th Cir. Jan. 25, 2012). Indeed, "the consideration of alternatives may accord substantial weight to the preferences of the applicant and/or sponsor in the . . .design of the project." *Id*. at 568 (citations omitted); *see also Citizens' Comm. to Save Our Canyons v. U.S. Forest Serv.*, 297 F.3d 1012, 1030 (10th Cir. 2002) (where a private party's proposal triggers a project, the agency may "give substantial weight to the goals and objectives of that private actor").

Thus, in considering alternatives and possible mitigation measures, the agency "may legitimately consider such facts as cost to the applicant and logistics." *Sylvester v. U.S. Army Corps of Engineers*, 882 F.2d 407 (9th Cir. 1989). Indeed, the agency "has a *duty* to take into account the objectives of the applicant's project," and the effect of proposed alternatives on the achievement of those objectives. *Id*., quoting *Louisiana Wildlife Fed'n, Inc. v. York,* 761 F.2d 1044, 1048 (5th Cir.1985) (per curiam). This includes consideration whether possible alternatives would allow the project to remain "economically advantageous." *Id*.

Here, private parties are proposing to engage in seismic surveying in order to determine the presence of commercially recoverable hydrocarbons, with the intent that the leasing, exploration and production of such hydrocarbons may be fostered. "[I]t is appropriate for the agency to give substantial weight to the goals and objectives of [such] private actor[s]" when considering which alternatives are to be evaluated in the EIS and conducting that evaluation. *Fuel Safe Washington v. FERC,* 389 F.3d 1313, 1324 (10th Cir. 2004). Yet the DPEIS contains no discussion of the effect of the proposed alternatives and mitigation measures upon project economics.

B. The DPEIS must contain a cost-benefit analysis

The required consideration of economic costs must include a cost-benefit analysis. Section 1(b) of Executive Order 13563 explicitly mandates that "to the extent permitted by law, each agency must…propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs…" Section 1(c) of the Order further dictates that the agency "use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible."

Nothing in the law prohibits BOEM's inclusion of a cost benefit analysis in the DPEIS, *see also Cape May Greene, Inc. v. Warren*, 698 F.2d 179, 187 (3rd Cir. 1993) ("[T]he National Environmental Policy Act requires a balancing between environmental costs and economic and technical benefits."). Thus, under the Executive Order, the PEIS should contain a cost-benefit analysis but the DPEIS does not.

C. Operational and economic implications of the proposed shutdown requirements

Industry discusses the proposed mitigations in detail in the attached technical analysis. We focus here on one specific proposed mitigation, the shutdown requirement, to demonstrate just how impactful the incorrect analysis and selection of alternatives and mitigation measures can be.

These impacts can be so great as to cast into doubt the very feasibility of conducting seismic activities.

The proposed mitigation measures are designed to respond to and mitigate projected Type A and Type B takes. But because the DPEIS greatly overstates the number of Type A and Type B takes using a flawed sound exposure equals take argument it greatly overstates the need for mitigation measures. Put another way, because the environmental impact of G&G activities is based on inaccurate science (for example, does not utilize Southall et al. 2007) and greatly overstated, the need for mitigation measures is also greatly overstated.

This is of critical importance, because some of the proposed mitigation measures would impose potentially high costs, greatly impede or altogether preclude the conduct of seismic surveys and geohazard and cultural resource identification, and deeply frustrate the achievement of the goals of the OCS Lands Act. This is antithetical to core legal principles discussed in II.B above, which require that the DPEIS, and the alternatives and proposed mitigation measures, be consonant with the programmatic goals established by Congress under the OCSLA. Fostering the expedited exploration and development of OCS resources is at the core of those goals.

The outcome of decision making in the absence of sound science that leads to decisions that are not aligned with the intent of the law is manifested in the proposed mitigation measure that would: (a) greatly expand the size of the vessel exclusion zone, (b) extend it to include dolphins, and (c) discriminately include high resolution geophysical surveys for oil and gas operators only.

Under current Joint Notice to Lessees ("NTL") 2012-G02, as well as under its predecessor notice, NTL 2007-G02, a seismic survey operator must shut down seismic operations whenever a marine mammal (except delphinids and manatees) or a sea turtle sighted within a 500 meter radius "exclusion zone," measured from the center of the airgun array and the area within the immediate vicinity of the survey vessel. The operator cannot recommence seismic operations for 30 minutes, or until the animal is no longer sighted within the 500 meter radius, whichever takes longer.

Both Alternatives set forth in the DPEIS would substantially expand, by an enormous amount, the spatial area covered by the exclusion zone. This is clearly shown in Table D-21, set forth on p. D-51 of Volume II, which lists the various scenarios examined by BOEM and the resultant exclusion zone. Additional details about these scenarios are set forth in Table D-19 on p. D-42 of Volume II, and in Vol. II, pp. D-58 through D-67.

These scenarios establish different exclusion zone radii, based upon the size of the airgun array, the water depth, the bottom type, and the time of year. **Every single scenario would materially expand the exclusion zone beyond the currently allowed 500 meter radius, whenever a large airgun array is being employed.** In some scenarios, the exclusion zone radius would be **over 2,100 meters,** meaning that **the spatial area covered by the exclusion zone would be 17 times larger** than the current exclusion zone under Joint NTL 2012-G02.

That change, plus the expansion of shutdown requirements to include not only whales, as is provided by Joint NTL 2012-G02, but also dolphins, could lead to at least a 450-fold increase in the number of mandatory shutdowns over what that experienced under Joint NTL 2012-G02 (and previously under NTL 2007-G02).[7] **The differences are not supported by the evidence.** In recent Supplemental Environmental Assessments associated with the permitting of seismic surveying in the Gulf of Mexico, BOEM has stated that there have been a total of approximately **55** required shutdowns in a typical year, due to a whale being within the 500 meter radius shutdown zone.

By contrast, BOEM in the DPEIS has estimated that there will be literally thousands of occasions a year in which a marine mammal will come within the proposed expanded exclusion zone radius surrounding an active seismic vessel and its arrays, thus triggering a shutdown of at least 30 minutes and possibly longer. Specifically, Table 4-10, found in Volume II, page Tables-32, shows that there would be **over 26,000** such shutdown events in 2016, as contrasted with the roughly **55** such events per year under current NTL requirements.[8] These estimates reflect the Government's modeling of Atlantic survey activities and marine mammal movement patterns, and are likely overstated based on the assumptions that went into that modeling. Nonetheless, the estimates do indicate the enormous effect of the proposed changes to the size of the exclusion zone and the hypothetical number of marine mammals subject to the shutdown requirement.

The fact that dolphins engaged in bow riding would not trigger a shutdown requirement, as stated in the draft PEIS at, *e.g.*, Volume II, p. C-11, does not significantly ameliorate the problem. BOEM has stated in its recent SEAs that approximately 33% of dolphins within 500 meters of a survey vessel were exhibiting bow-riding behavior.[9] Thus, the bow riding exception would at most apply approximately one-third of the time, and probably less, given that the ability to determine that a dolphin is exhibiting bow riding behavior is arguably diminished if the exclusion zone is expanded beyond the 500 meters radius, and that determination must therefore be made when the dolphin is at a considerably greater distance from the survey vessel. Further, the illogical contradiction that dolphins that do not happen to bow ride require a different mitigation strategy makes no sense. The fact that they do bow ride during seismic surveys has been observed for decades as a behavioral indicator that the surveys do not in fact cause them harm. There is no empirical evidence to the contrary.

The practical consequences of the proposed changes for the conduct of seismic surveying are enormous. We are highly doubtful that seismic survey operations could even be attempted were shutdowns to be required with anything approaching the frequency estimated in the DPEIS.

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[7] Table 4-10, Volume II, page Tables-32, indicates over 26,000 such shutdown events in 2016 versus approximately 55 such events reported under current BOEM NTL requirements.

[8] Table 4-10 sets forth "Annual Level A Take Estimates," using (incorrectly for the reasons stated in these comments) an exposure to sound at a decibel level greater than 180 dB as establishing a Level A take. And, the proposed exclusion zone radius is set at the distance from the array at which sound levels are thought to drop to 180 dB. Therefore, in setting forth the projected number of Level A Takes (using the 180 dB criteria), Table 4-10 is simultaneously setting forth the number of projected occasions a year on which a marine mammal is expected to come within the exclusion zone, and trigger a shutdown requirement.

[9] *Site-Specific Environmental Assessment of G&G Survey Application No. L11-023* (Jan. 26, 2012), at 7.

Appendix 2
Detailed Technical Discussion

I. Industry activity

Given the lack of active leases and planned lease sales, the DPEIS greatly overstates the anticipated level of industry seismic activity. The projected activity estimates submitted in May 2010 are no longer endorsed by the geophysical industry and should not be used in the development of the DPEIS.

Table 3-3 projects the acquisition of 321,600 line-kilometers and 141,700 line-kilometers of 2D seismic for the mid and south Atlantic planning areas respectively, for the first 5 years of the 9-year period covering 2012-2020. By comparison, submitted industry (IAGC) estimates were significantly less – by 36% (298,200 line-kilometers).

Accordingly, regardless of when seismic acquisition begins, the DPEIS has overstated the amount of 2D seismic that will be acquired. Although E&P companies continue to have interest in exploring the Atlantic OCS, their level of interest will likely not manifest itself into supporting and licensing (buying) non-exclusive seismic data since these areas are not included in the proposed 5-year leasing plan (2012-2017).

The industry estimates also assumed that the DPEIS would be completed in a timely manner (April 2012) with G&G permits approved in 2012 and each of the subsequent years through 2016 in support of future lease sales. Notwithstanding Secretary Salazar's statement at the time the PEIS was released that the DPEIS would be final by the end of this year, it is highly unlikely that the MMPA rulemaking and ESA section 7 consultation will be completed – pushing back the start of any geophysical activity (if any) well beyond 2012. At best, assuming Atlantic acreage is included in a 5-year leasing plan for 2017-2022, geophysical activity may commence in 2015 or 2016.

The proposed 5-year leasing plan (2012-2017) does not propose any lease sales in the mid- and south Atlantic OCS. Additionally, although the oil and gas industry believes that there are hydrocarbon resources underlying these areas and that new geophysical seismic data will illuminate those resources, lacking a commitment from the Federal Government to hold lease sales in the future (2017 and beyond), as well as support from the coastal states (Delaware, Maryland, Virginia, North Carolina, South Carolina) for lease sales and exploration and production, it is unrealistic to expect significant, if any, geophysical activity within this timeframe.

Several geophysical companies have submitted G&G permit applications to the former MMS in response to the then (2010) high level of interest expressed by E&P companies. The permit applications remain in the "queue" at BOEM. However, BOEM should not interpret this to mean that because none of the permit applications have been withdrawn that there remains a high level of interest in acquiring seismic data in the mid- and south Atlantic OCS planning areas. If a geophysical company with a permit application covering these areas were asked if they want to withdraw their application, the response would be “no”. The geophysical company has already paid the cost of submitting a permit application to BOEM and there is no additional cost for it to remain with BOEM pending review. Furthermore, unless and until E&P companies clearly indicate an interest in licensing seismic data, survey activities allowed under any issued the permit would not be conducted.

II. Environmental Benefits of Geological & Geophysical Technologies

The accuracy of the DPEIS would be enhanced by more fully characterizing the important role that geophysical imaging technologies offer E&P operations toward increasing safety and reducing environmental risks in E&P operations, particularly during drilling operations. At present, there are no commercially available and viable alternatives to current geophysical imaging technologies, which have been employed and continuously refined over the last six decades to be more efficient and emit less sound energy.

Geophysical imaging technologies such as 2D and 3D seismic surveys, near surface / shallow hazard surveys and electromagnetic surveys help reduce the safety and environmental risks of future exploration activities. Vast improvements in these technologies in recent years now afford the E&P industry significant precision in subsurface imaging, resulting in significant environmental benefits. Over the E&P lifecycle, these benefits include: siting wells, facilities and pipelines at safe locations on the seafloor; the need for fewer wells and fewer facilities due to improved drilling success; the ability to predict hazardous over-pressurized zones, and thus to be able to better design wells that manage the associated risks; and improved overall safety of operations.

As a result, wells are drilled at safe locations, platforms and other facilities are placed in safe locations, and operators can route pipelines safely and around archeologically sensitive areas.

Today, conventional oil and gas companies are able to predict the pore pressures of rocks through which a well is drilled, and the predictions are improved when able to combine attributes provided by geophysical imaging technologies with subsurface information.

III. The Alternatives

The DPEIS notes the requirement for reasonable alternatives:

> *These regulations (40 CFR 1500-1508) provide for the use of the NEPA process to identify and assess reasonable alternatives to a proposed action that avoid or mitigate adverse effects of a given action upon the quality of the human environment. [Page 1-11]*

The range of alternatives should include one without the closure areas for the North Atlantic right whales. This would address the agency’s NEPA requirements to include a reasonable range of alternatives. In addition, for the reasons explained in Industry’s cover letter and in these comments, the proposed mitigation measures should not expand the seismic airgun survey protocol beyond what already appears in NTL 2012-G02.

Of the alternatives presented, industry favors Alternative A as the most reasonable but would note that the Alternative proposes a range of protective measures that, in some cases, exceed those required for the Gulf of Mexico. [Page 2-3].

Alternative A includes the following mitigation measures developed specifically for this Draft Programmatic EIS (Table 2-1):

- *a time-area closure for North Atlantic right whales;*
- *a seismic airgun survey protocol;*
- *an HRG survey protocol (for renewable energy and marine minerals sites);*
- *guidance for vessel strike avoidance;*
- *guidance for marine debris awareness;*
- *avoidance and reporting of historic and prehistoric sites;*
- *avoidance of sensitive benthic communities;*
- *guidance for activities in or near National Marine Sanctuaries (NMSs);*
- *guidance for military and National Aeronautics and Space Administration (NASA) coordination.*

BOEM notes in the DPEIS that the range of alternatives and their evaluation was significantly influenced by concern over protected species particularly the North Atlantic right whale. Industry supports this sensitivity but would encourage the BOEM to ensure a comparative risk assessment reflecting the nature and extent of the known causes of injury and mortality faced and placing the risk of industry activities within this context. The primary reason for establishing the North Atlantic right whale Seasonal Management Areas was to reduce ship strikes on this highly endangered species. The conditions that make them highly vulnerable to ships traveling greater than 10 knots – i.e., slow movements, time spent at the surface, and time spent near the coast – makes it easier for an observer to see these whales and avoid them during seismic operations. Based upon the DPEIS evaluation of the relative risks, industry does not believe that Alternative B is warranted. Industry comments will address the proposal for closure areas in greater detail later in this Appendix.

IV. DPEIS Scope, Utility and Regulatory Consistency

It is a fundamental tenet of NEPA law that an EIS is not a decisional document – such that it requires an agency to take a specific action. NEPA analyses are intended to look at the consequences of proposed actions and suggest a reasonable range of feasible alternatives. NEPA analyses are intended to inform subsequent agency decisions. The DPEIS scoping must reflect the range of decisions that may be brought forward and the DPEIS itself must be informed by and consistent with regulatory standards and the requirements of <u>all</u> Federal statutes under which the agencies make their decisions. The Atlantic DPEIS does identify and reference the Outer Continental Shelf Lands Act, the Marine Mammal Protection Act and the Endangered Species Act but industry suggests a more clear statement of the requirement to balance the three statutes and guidance to resource managers on how to achieve that balance.

There are no regulations defining the term "potential effects". The DPEIS analysis provides extensive attention to potential effects, many of which are questionable due the lack of scientific certainty, and in some critical areas – the virtual absence of knowledge. Furthermore, the DPEIS in several key respects fails to utilize the best scientific evidence that does exist. Moreover, it gives too little attention to the probability of impact. Next, the DPEIS provides little attention to the potential severity of effects. The DPEIS provides an improvement over other recent seismic survey evaluations such as the Arctic DEIS. However, more work needs to be done to avoid a situation in which the DPEIS presents an extensive list of "potential effects" as if they are likelihoods or even certainties and then demands they be mitigated. This makes it impossible for the DPEIS to inform, guide or instruct agency managers on how to differentiate between activities that have no effect, minor or major effect to a few animals, or to an entire population.

The different purposes and considerations of MMPA/ESA/OCSLA require balancing judgments by multi-agency decision-makers. The accuracy of the underlying environmental consequences analysis is critical to this proper balancing. The DPEIS provides extensive information regarding potential impacts of industry activities on marine life. Industry would continue to encourage much greater and appropriate attention in the DPEIS to the impacts the alternatives and mitigation measures would have on development of OCS resources and whether they are warranted. This should include information on lost opportunity costs and the effect of time and area closures, which under various alternatives could amount to six months per year of important areas in the AOI. The same analysis is needed with respect to mitigation measures.

V. The Environmental Consequences Methodology

A. Overview: The characterization of risk is highly subjective and is not based on sound science. This results in overstatement of impact from the industry operations and proposed mitigation measures that inappropriately allocate resources and are in conflict with the historical reality of no meaningful effect.

The comments in the cover letter identified a number of shortcomings in the gap between the assessments of environmental consequences, including the estimate of takes. These problems to a significant degree are not merely disputes over specific data issues or modeling approaches, although this itself is certainly an area in which improvements are needed. Rather they are related to a flawed environmental consequence analysis.

The DPEIS itself validates industry's concern over the modeled overestimate of takes, the ability to create representative model information and the inconsistency with actual observable effects.

> "Ultimately, the accuracy of the task relies less on the accuracy of the models and more on the accuracy of the modeler's ability to estimate these representative or average conditions. To date, probably the best measurement of this need to estimate representative or average conditions is the annually reported level of impacts for any given year of operations; as compared to that year's take authorization number. To the best of our knowledge, this has not been done officially, but anecdotal information and experience with years of annual reports has shown that typically the number of animals observed at sea is less than predicted, and their potential impacts appear lower since they are seldom observed near the sources." (DPEIS at E-69)

The DPEIS presents an environmental consequences analysis that incorrectly assesses the environmental effects of seismic operations on both an absolute basis and equally importantly on a comparative basis with other known sources of risk to individual animals and populations.

The analysis appears to give equivalent weight to potential risks, which are not equivalent – Level A (mortality/injury) and Level B (behavioral effect many of which are likely short-term and transitory). These low behavioral effect levels are then labeled as a greater risk ("Moderate") than non-industry activities such as vessel strikes and fishing gear entanglements involving mortality to marine mammals of concern, which are labeled as "Minor" environmental effects.[10]

Conflicting standards in the environmental consequence yields an internally contradicted DPEIS assessment of risks regarding a multitude of activities. Minor and short-term behavioral effects associated with seismic surveys appear to be judged more consequential than known causes of animal mortality, such as ship strikes.

B. Methodology

The DPEIS does properly concede the difficulty in evaluating acoustic risk to marine mammals and thus should require the agency to be especially vigilant and attentive in characterizing and calculating risk. The methodology outlined is inadequate and suffers from multiple problems. Industry would encourage BOEM risk assessors to consider other ecological risk assessment experiences and approaches conducted by NOAA, EPA, OMB and other agencies that are able to inform development of an improved methodology.

An improved DPEIS would better explain in the Environmental Consequence analysis how the inaccurate proxy of the incidental takes estimates progresses from assertions of single-animal effects to the population-level effect. It is not clear how this

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[10] NMFS reported 272 vessel strikes from 1972-2002, with recognition that total number of vessel strikes is unknown and only a small fraction of ship strikes reported and verified. Jensen, A.S. and G.K. Silber. 2003. Large Whale Ship Strike Database. NOAA Technical Memorandum, U.S. Department of Commerce. NMFS-OPR. 37 pp.

determination is made, (e.g., whether the analysis is premised on a deterministic approach, a probabilistic approach, or some other method).

i. The Mechanics of Assessment

The EIS describes "potential" impacts of the alternatives. Definitions of Individual Effect Criteria – the "criteria" for characterizing impact are not clear and do not adequately differentiate between "minor" and "moderate" and "moderate and "severe". To some degree they appear to be distinctions without a difference.

Moreover, the criteria used to assess acoustic effects vary from NEPA document to NEPA document, creating additional confusion. See the table below for a comparison of the criteria used on the 2012 Arctic DEIS and the 2012 Atlantic G&G DPEIS.

	Atlantic DPEIS (3/30/12)	Arctic DEIS (12/22/11)
Negligible	Little or no measurable / detectable impact	Impacts are generally extremely low in intensity (often they cannot be measured or observed), are temporary, localized, and do not affect unique resources.
Minor	Impacts are detectable, short-term, extensive or localized, but less than severe	Impacts tend to be low in intensity, of short duration, and limited extent, although common resources may experience more intense, longer-term impacts
Moderate	Impacts are detectable, short-term, extensive and severe; or impacts are detectable, short-term or long-lasting, localized and severe; or impacts are detectable, long-lasting, extensive or localized, but less than severe	Impacts can be of any intensity or duration, although common resources may be affected by higher intensity, longer-term, or broader extent impacts while unique resources may be affected by medium or low intensity, shorter duration, local or regional impacts.
Severe	Impacts are detectable, long-lasting, extensive, and severe	Impacts are generally medium or high intensity, long-term, or permanent in duration, a regional or state-wide extent, and affect important or unique resources

Thus, there is no objective or reproducible scientific basis for agency personnel to make decisions. The DPEIS process would inherently require agency decision makers to make **arbitrary** decisions not based upon objective boundaries. There needs to be consistency between the BOEM regions and NMFS on how the effects criteria are defined and how the impacts are analyzed.

ii. <u>Characterization of Aggregated Effect</u>

The second step in the assessment process provides for a relative judgment about Intensity versus Duration versus Extent versus Context. The same problem outlined above becomes an order of magnitude worse since there is no reproducible scientific process.

The net result is an assessment with a wide potential range of outcomes. Based upon this system, the DPEIS asserts that the effect of industry seismic activity is "Moderate" on marine mammals. If the effect of seismic is moderate, what is the assessment of risks from vessel strikes or a host of other activities? Industry would like to see the comparative assessment. These identified problems in the risk assessment make it virtually impossible to meet the NEPA requirements and guidelines requiring objective decision-making procedures. More importantly, it would yield inconsistent assessments from reviewer to reviewer. No matter how conscientious a decision maker is, there are no objective boundaries for making determinations. A minimum test is whether decisions are 1) internally consistent and 2) consistent from decision to decision. On both counts this decision making process would exceed agency discretion – in violation of both NEPA and the Administrative Procedures Act requirements.

The characterizations of risk are highly subjective and appear to be dependent upon the selection of the evaluator, who would be authorized to use his/her own, individual scientific understanding, views and biases. Thus, the assessments do not appear able to be replicated.

The DPEIS itself seems to acknowledge the inconsistency from assessment to assessment. This creates a situation in which the DPEIS determines that otherwise minor effects from industry operations (ranging from non-detectable to short-term behavioral effects with no demonstrated population-level effects) are judged to be a higher-rated risk to the species than known causes of mortality such as vessel strikes and entanglements. Thus, the projection of acoustic risk is inconsistent with reality of effect.

iii. <u>Use of data that is not best available science.</u>

The DPEIS acknowledges the requirement to utilize best available science and assert the agencies have met this requirement. Industry does not share that assessment.

With respect to marine mammal noise exposure criteria, industry and many scientists believe that the best available science is Southall et al. 2007, which proposes thresholds above the 160/180 dB levels for assessing Level B and Level A takes, for pulsed-sound sources such as airguns. The NMFS-initiated expert panel likewise substantially argued that the 190/180/160 dB re: 1 μPa (rms) criteria are inadequate and improved criteria are needed. Additional new information since 2007 further shows the inadequacy of the present thresholds and should contribute to a revised acoustic criteria. Historical precedent is an entirely inadequate justification for continuing to apply these thresholds because they fail to reflect the best available science. Industry is pleased that the DPEIS did include one table for estimated takes based upon Southall et al. 2007. However, other approaches are also reflected and it is not clear which approach BOEM and NMFS will ultimately utilize. The mitigation measures incorporated into the proposed alternatives do not reflect the Southall et al. 2007 conclusions.

The NMFS acoustic threshold of 180 dB re: 1 μPa (rms) for Level A takes is a dated initial criterion long overdue for revision. Again, the expert panel created by NMFS clearly provides more recent science on acoustic criteria (Southall et al 2007) and recommends a Level A sound pressure level threshold of 230 dB re: 1 μPa (peak) (flat) (or sound exposure level of 198 dB re: 1 μPa2-s) for a pulsed sound source. However, the question of sound pressure level or sound energy level as the more accurate predictor of potential injury is also discussed. The use of 160 dB re: 1 μPa (rms) as a threshold for Level B takes is a NMFS guideline. For potential disruption of behavioral patterns, the question of a dose-response versus a context-response is very much in question.

More important to the concept of take and marine mammal well being, is the question, "What responses actually represent a biologically significant impact?" Richardson et al. (2011) provides a review of potential impacts on marine mammals that concludes injury (i.e., permanent hearing damage) from airguns is extremely unlikely and behavioral responses are both highly variable and short-term. In a NMFS October 5, 2006 notice to Lamont-Doherty Earth Observatory (LDEO), the agency stated in the Disturbance Reactions section that "Simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean "in a manner that might have deleterious effects to the well-being of individual marine mammals or their populations". [11] The DPEIS reverts to dated acoustic thresholds and ignores significant and more recent recommendations on improving criteria. The agency should not use outdated criteria, but should in the final PEIS utilize this more recent and far more reliable information.

iv. Probabilities of Effect Ignored

[11] 71 Fed. Reg. at 58790

The environmental consequences analyses are burdened by increasing attention given to more and more speculative “potential” effects without adequate consideration to probability of occurrence or applying the required “reasonable likelihood” standard or utilizing standard “weight of the evidence” tests.

v. Uncertainty & Use of Conservative Factors

The discussion of acoustics and acoustic effects suggests – but does not explicitly say --that “precautionary factors” were injected at various points in its consideration of noise criteria and acoustic effects to offset the absence of adequate information.

The Associations urge NMFS/BOEM to examine this process to handle uncertainty and to include in a revised DPEIS the assumptions and precautionary factors applied that are associated with each step of this process such as: 1) estimates of seismic activity, 2) source sizes and characterizations, 3) underwater sound propagation, 4) population estimates and densities of marine mammals, 5) noise exposure criteria, 6) marine mammal behavior, including the context of a behavioral reaction. Until the agencies document and communicate these underlying decisions in a transparent fashion neither the industry nor agency resource managers can know and understand how such decisions are made and therefore the range and rate of error. The DPEIS as presently written presents an “on the one hand; on the other” approach which does not inform the issue for agency resource managers.

The use of precautionary principles that are not reflected in actual scientific knowledge is particularly inappropriate given their fundamental inconsistency with the programmatic goals of encouraging the expeditious exploration of the OCS.

vi. Socio-Economic Considerations

The Environmental Consequences analysis must more fully consider essential economic factors, to properly evaluate and to give appropriate consideration to socio-economic impacts as required by NEPA and necessary for subsequent regulatory decisions under OCSLA. The DPEIS should, for example, discuss economic effects that would result from leasing and successful exploration that leads to production. The positive economic experiences in more mature areas such as the Gulf of Mexico should be included.

The environmental consequences analysis as noted earlier does not properly address the relative evaluation of effects (biological, physical, socio-economic). For example, the evaluation system suggests that a “Minor” biological effect and a “Minor” Socio-Economic effect would be equivalent. Industry would assert that the analysis not only does not appear to arrive at this conclusion but the DPEIS analysis does not provide a basis for assessing the relative costs and benefits of the alternatives.

As Industry observed in its cover letter to these comments, under Executive Order 13563 and controlling case law, the PEIS should include a cost benefit analysis, must take into account programmatic goals, and must also take into account the goals sought to be achieved by the private parties that will be conducting the seismic surveys. None of these are reflected in the draft PEIS.

VI. Acoustics

A. Acoustic Issues Overview

After increasing public attention to the potential impact of marine sound, the Marine Mammal Noise Exposure Criteria Work Group (the Southall Work Group) (Southall et al. 2007) was formed in the early 2000's to review the body of scientific evidence and recommend thresholds that regulators could employ. The Southall Work Group examined the prior work by the High Energy Seismic Survey (HESS) team, (HESS, 1999) and determined that those levels were "precautionary estimates" below which physical injury was considered unlikely (Southall et al. 2007). After reviewing all the available research, the Southall Work Group proposed a sound pressure level threshold for Level A injury of 230 dB re: 1 μPa (peak) (flat) (or 198 dB re 1 μPa^2-s, sound exposure level). The Southall Work Group also repeatedly stated that precaution factors had also been applied in creating its own new proposed criteria.

This represents the best scientific evidence on this question, and it should form the starting point for assessing alternatives and mitigation measures.

As previously noted the issue of acoustic-related incidental takes has suffered from the absence of a clear risk characterization and assessment. At a minimum, it is necessary for the DPEIS to clearly define what constitutes a take and why and what thresholds will be utilized in the rulemaking. If for example, there is a reason for differing thresholds (e.g. for commercial or military vessels versus seismic survey vessels), those differences should be clearly communicated and their rationale thoroughly explained.

B. Industry recommends that the DPEIS:

- Clearly differentiate the difference between the sound field, the animals exposed to sound and injury or behavioral exposure.

- Adopt the Southall Criteria (Southall, et al. 2007), which would establish the following thresholds: Level A at 198 dB re: 1 μPa2-s with M-weighting embedded in calculated RL's SEL (Sound Exposure Level); Level B at the lowest level of TTS-onset as a proxy until better data is developed.

The DPEIS does not clearly establish and communicate this information. In fact NMFS has been unable to clearly communicate that sound exposure does not equal a take although that position is often inferred. Instead, the DPEIS often uses, in our opinion, significantly inflated model predictions of takes to justify concern. This has been an issue for more than a decade. NMFS has also been unable to make a decision about utilizing Southall et al. (2007) – which has been published in a peer reviewed journal, peer reviewed by other panels and under consideration by BOEM and NMFS officials for four years. Industry believes that these are the first necessary steps in addressing the acoustics/incidental take issue. We encourage BOEM to use Southall et al. 2007 in estimating takes in the Atlantic DPEIS as it represents the best available science and not rely on the outdated, historically used 180 and 160 dB re: 1 μPa (rms) criteria.

C. Estimates of Potential Level A and B "Takes"

i. Level A: The growing scientific consensus is that seismic sources pose little risk of Level A takes (Southall et al., 2010; Richardson et al. 2011)[12]. Southall et al. (2010) and Richardson et al. (2011) recommend a Level A threshold, 230 dB re: 1 μPa (peak) (flat) (or 198 dB re 1 μPa2-s, sound exposure level). The National Research Council's expert panel assessment (NRC 2005) and further review, as discussed by Richardson et al., (2011) also support the Associations' position that this be the level adopted.

Utilizing the Southall approach greatly reduces the estimated number of Level A takes, as shown in Table 4-9 of Volume II of the DPEIS. This correction properly eliminates the proposed revisions to the established and effective shutdown requirements now set forth in NTL 2012-G02.

ii. Level B: The level of sound exposure that will induce behavioral responses may not directly equate to biologically significant disturbance; therefore additional consideration must be directed at response and significance (NRC 2005; Richardson et al. 2011; Ellison et al., 2011) [13]. To further complicate a determination of an acoustic Level B take, the animals' surroundings and/or the activity (feeding, migrating, etc.) being conducted at the time they receive the sound rather than solely intensity levels may be as important for behavioral responses (Richardson et al., 2011).

The Southall Work Group also questioned the relevance of the 160 dB re: 1 μPa disturbance criterion noting that thresholds for odontocetes and pinnipeds exposed to pulsed sounds is not at all well-established …" (Southall et al. 2007, Page 417).

Further, the Southall Work Group recognized that a difference existed between "a significant behavioral response from [and] an insignificant, momentary alteration in behavior." (See also Richardson et al., 2011). The Southall Work Group went on to

[12] Southall 2010 is a further extension of the work undertaken by Southall 2007
[13] W.T. Ellison, B.L. Southall, C.W. Clark, and A.S. Frankel. 2011. A new context-based approach to assess marine mammal behavioral response to anthropogenic sounds. *Conservation Biology*.

propose that "[c]onsequently, upon exposure to a single pulse, the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (i.e., TTS-onset). We recognize that this is not a behavioral effect per se, but we use this auditory effect as a de facto behavioral threshold until better measures are identified."

D. Factors Impacting Thresholds

Other considerations should be recognized in establishing thresholds:

The biological significance of sound may also depend more so on how long the sound persists (Richardson et al. 2011). The DPEIS fails to allow for the fact that 3D seismic surveys are typically acquired in a racetrack pattern resulting in lower chances of an individual animal being exposed to loud sounds for extended periods of time. In other words, given that the seismic vessel is moving in and out of a localized area and the fact that animals are believed to avoid vessel traffic and seismic sounds, cumulative sound exposure is again likely being overestimated in the DPEIS. The acoustic integration model (AIM©) further does not address avoidance and, for purposes of the model limitations, does not allow animals (animats) to move out of the area. Seismic operations are most often in timescales of weeks to months which reduces the possibility of significant displacement since they do not persist in an area for an extended period of time. However, little evidence of area-wide displacement exists or has been demonstrated. For typical scales of habitat displacement studies, seismic surveys are short-term and impacts are localized.

The DPEIS analysis does not adequately consider the fact that many animals avoid vessels regardless of whether they are emitting loud sounds and may increase that avoidance distance during seismic operations (Richardson et al. 2011). Therefore, it should be a reasonable assumption that natural avoidance serves to provide another level of protection to the animals.

While crude dive profiles are included in AIM© exposure modeling, the profiling does not incorporate any animal response to the 3D sound field predicted exposures. Yet observations clearly indicate that another likely behavioral response (if the animal does not simply depart) is a change in diving behavior. Changing water depth, orientation to the source, and even an increasingly better understood mechanism of "built-in ear plugs" (stapedial reflex) all amount to significant loud noise responses (or reflexes) that reduce exposure risks.

As previously noted, the DPEIS is unclear about what constitutes an incidental taking. The MMPA defines Level B takes in the context of behavioral change, not in the context of sound exposure levels, or RMS Sound Pressure Levels. It is debatable whether behavioral changes are dose-responses or context-responses. There are also indications that some animals change their behavior in the presence of RMS Sound Pressure Levels of 160 dB re: 1 μPa (rms) or lower. In other cases of exposure to sounds of 160 dB (and higher), there is no evidence of behavioral change. It is neither logical nor reasonable to assume that every exposure to 160 dB re: 1 μPa (rms) or higher results in a behavioral change of biologically significant impact equating to a Level B take (Southall et al., 2007; Ellison et al, 2012).

There is also mounting scientific evidence that behavioral reactions are dependent upon the species and often the individual animal (Stone and Tasker, 2006) and can vary due to biological and environmental context (Wartzok et al., 2004; Frost et al., 1984; Finley et al., 1990; Richardson et al., 2011; Miller et al., 2005; Richardson et al., 1999). Most behavioral studies conducted to date have not recorded the received sound pressure levels nor is it clear that sound pressure level (rms) is the best measurement to use for behavioral studies (Southall et al. 2007). In other words, there is not enough scientific evidence to provide a convincing argument that 160 dB re: 1 μPa (rms) should be used as behavioral "take" criteria. In the base case, it is highly likely, just as the case where 180 dB re: 1 μPa (rms) was previously used, that 160 dB re: 1 μPa (rms) is overly cautious and results in an exceedingly high number of "takes".

In other rulemakings, NMFS has asserted that animals within calculated isopleths of sound above 160 dB re: 1 μPA (rms) are considered a take[14]. This basic rationale (independent of uncertainties in numbers) also likely overestimates actual take numbers and therefore should be rejected (exposure of an animal to a sound is not necessarily equivalent to the animal being taken).

Southall et al (2007) went to great effort to define functional groups in terms of sound sources and the specialized hearing characteristics of marine mammal species. Industry remains concerned with the use of the antiquated 160 dB re: 1 μPa (rms) guideline for Level B take estimation and, to a great extent, the inability to define a more reasoned criterion, which rests with an inability to document and quantify marine mammal responses to known sound levels and, more so, what response constitutes a biologically significant effect (NRC 2005). The Associations strongly encourage BOEM in the DPEIS analysis to consider the frequency component, nature of the sound source, cetacean hearing sensitivities, and biological significance when determining what constitutes a Level B incidental take.

E. <u>Using and Explaining The Appropriate Acoustic Units of Measure</u>

To foster meaningful dialogue and avoid confusion and poor decisions regarding industry acoustics issues, the DPEIS should adequately and accurately describe acoustic source levels.

Evaluation of acoustic effects should include both the cumulative energy criterion in Southall et al., (2007) as well as proposed cumulative energy criterion. Southall et al. indicates that, for impulse sounds, any cetacean exposed to either a peak pressure ≥230 dB re 1 μPa or a cumulative sound exposure level (energy) of 198 dB re 1 μPa2 -sec might incur auditory injury. The DPEIS should explicitly note the SEL criteria, which

[14] Federal Register/Vol. 75, No. 95/Tuesday, May 18, 2010 at Page 27712

is the one that will almost always (if not always) be the determining factor. The document in several places relies on Root Mean Square (RMS) Sound Pressure Level criteria for acoustic impacts. The most recent research has questioned the adequacy of these criteria.[15] Instead, they should be replaced by a combination of Sound Exposure Level limits and Peak (not RMS) Sound Pressure Levels or other metric being considered.

Seismic source levels are regularly quoted but they require explanation in order for the reader to have a clear understanding of what the numbers mean. Failure to do so can lead many unfamiliar with acoustics to make inaccurate judgments about the effect of seismic surveys (for example by taking 255 dB minus 180 dB as an indicator of the risk). That approach is flawed but left unexplained, the DPEIS would contribute to presentation of inaccurate information and discussion. The emitted sound pressure level close to the source array is lower than that calculated using the 'far field' calculation.

These source levels are the back-calculated, modeled sound pressure values and are not actually realized at any point in the water column. In virtually all cases they are derived from modeling and are an over-estimate of the true source sound level (sound output from a seismic source array at 1 meter distance from the array). This is an extremely significant point and we suggest BOEM add the following text or similar and a graphic to further expand upon this important point:

> *"It is difficult to measure the actual sound pressure level close to a full source array that is being activated, due to the physical environment surrounding an active seismic array. Therefore assumptions are made that enable the response of a given source array to be modeled."*

The far field assumption suggests that at some distance away from a source array, which is much greater than the dimensions of the source array, the peak energy pulses from the various individual source elements (near field signature) arrive at the same time and add together constructively to form the far field response of the source. This response is corrected or back-projected to one meter from the source array to produce the far field signature of the source at one meter, which is a standard modeled measure of a source array output. It is well known that the peak energy pulses from individual source elements no longer align at locations close to the seismic source array (in the near field) as a seismic source array is a distributed, rather than a point source.

F. Frequency Weighting

The PEIS should incorporate frequency weighting in development of incidental take estimates. Hearing (frequency) varies from species to species and among the cetaceans discussed in the DPEIS. Not all the frequencies used by industry fall within an animal's functional hearing range. In assessing the effects of noise, the M-weighted curve is

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[15] Ellison et. al 2011; Madsen, P.T., Marine Mammals and Noise: Problems with Root Mean Square Sound Pressure Levels for Transients; Acoustical Society of America, 2005

applied to correct the sound-level measurement for the frequency-dependent hearing function. (Southall et al., 2007)

Without these frequency-weighted hearing curves, “extremely low- and high-frequency sound sources that are detected poorly, if at all, might be subject to unrealistic criteria.” (Southall et al., 2007, pg.413)

The primary application of the M-weighting curve is for predicting auditory damage or a dose-response situation. It should be noted that the M-weighting functions are “quite precautionary” but nevertheless are superior to flat weighting to estimate dose-response exposure.

The DPEIS should make clear whether frequency weighting to account for the hearing ranges of the species was applied in the Environmental Consequences analysis. We understand NMFS has not yet publicly accepted that M- (or similar) weighting should be applied when estimating takes during seismic surveys. At an absolute minimum, BOEM should provide examples of the potential effects of M-weighting on dose response (Level A) takes and a rationale for excluding this significant factor should have been provided.

Aggregating all frequencies for the purpose of calculating exclusion zone (safety radii) for baleen whales which are believed to have hearing sensitivity in the lower frequencies is scientifically supportable. However, it is not supportable with respect to dolphins and other odontocetes known to be mid-frequency hearing specialists. If BOEM ignores this and proceeds to require shutdowns for these species, no more than a 500 meter exclusion zone should be used which is conservative and precautionary.

VII. Biology Issues

Dolphins

The Atlantic DPEIS highlights the issue of dolphins and exclusions zones. From a biology standpoint dolphins are important in the discussion of Mid and South Atlantic G&G activities. The DPEIS notes that there are several strategic stocks of dolphins. There are large numbers of these animals. They comprise a very large percentage of the modeled estimate of Level A and Level B incidental takes.

The biology of dolphin hearing mechanisms should be considered in the DPEIS. It is well known in the Gulf of Mexico and other regions that dolphins frequently enter the seismic exclusion zone to bow ride seismic vessels.

It has also been long recognized that often cetaceans emit sounds as they echolocate that are well above the regulatory protective levels of 180/160 dB re: 1 μPa (rms). Repeated dolphin clicks have been measured up to 230dB (Au, et al 1978).

Alexander Supin and Paul Nachtigall developed a way of measuring the hearing of cetaceans during echolocation by examining the brain wave patterns of the animals to both the outgoing echolocation signal and the echo that returned from that signal (Supin et al, 2003; Nachtigall and Supin 2008).

Research into harbor porpoise (Linnenschmidt et al, 2012), and the bottlenose dolphin (Li et al, 2011, 2012) suggest hearing control may apply to a number of different species of echo locating whales and dolphins.

The DPEIS should consider this new research regarding animal sound tolerance. An example of this is the recent work conducted by Jim Finneran and his colleagues that investigated the auditory effects of multiple underwater impulses produced by a seismic airgun. The pre- and post-exposure hearing thresholds in exposed dolphins were compared to determine the amount of temporary hearing loss, called a temporary threshold shift (TTS), as a function of exposure level and the number of impulses. The research shows that dolphins exposed to airguns up to 186 dB dB re 1 μPa2 -sec (SEL) show ZERO temporary threshold shift (Finneran, US Navy Marine Mammal Program at the Acoustical Society of America meeting, October 2011). The DPEIS would be improved by a discussion of research specifically exploring the hearing control of dolphins and cetaceans. There are indications that animals naturally reduce their hearing sensitivity and therefore the estimates of incidental takes should be reduced. These results would further explain why dolphins may bow ride seismic vessels with no injury.

As mentioned previously, the PEIS should incorporate frequency weighting. It is well documented that dolphins are mid-frequency hearing specialists. Failure to incorporate frequency weighting likely results in overestimating dolphin incidental takes by at least a factor of two.

VIII. Mitigation Measures

The DPEIS proposes to require standard mitigation measures for all action alternatives. It also then proposes consideration of future optional mitigation measures.

Consideration of mitigating measures cannot be disassociated from the risks they are intended to mitigate and requirements that they be effective. In fact, a Council on Environmental Quality memorandum notes that if agencies cannot determine if mitigation was implemented or effective, mitigation requirements fail to advance NEPA objectives of informed and transparent decision-making. [CEQ 2011] Decisions regarding mitigation come through a variety of channels as the DPEIS notes and decisions about mitigation measures should be respectful of the procedures and jurisdictions that have historically evaluated and implemented mitigation requirements.

A. <u>Considering Mitigation Effects</u>

The DPEIS spends considerable time talking about the need for mitigation and the effects of observation zones and shut-down requirements. The DPEIS explicitly notes that it does not do so. Industry requests that BOEM consider the effects of standard required mitigation measures and reduce its takes estimates accordingly.

The Level A incidental takes predicted by the AIM© modeling do not take into account the operational mitigation measures included in the seismic airgun survey protocol to ensure that marine mammals are not present within the 180-dB exclusion zone. Although these measures are not expected to be 100 percent effective, they are expected to significantly reduce the risk of Level A harassment to marine mammals. The exclusion zone could extend up to 2.1 km (1.3 mi) from a large airgun array (5,400 in3) and up to 186 m (610 ft) from a small airgun array (90 in3). If the operational mitigation measures were100 percent successful, then all Level A harassment of marine mammals would be avoided. [Page 2-13]

B. Adaptive Management Considerations

The DPEIS mentions adaptive management on page ES-34 and elsewhere. The implication is that mitigation requirements could be altered over time. Industry has supported the application of adaptive management in a number of contexts. However, in the DPEIS the term is positioned toward the use of adaptive management to further restrict activities and it does not leave room for adaptive management to reduce restrictions. Adaptive management should also be applied to the need for corrections, if new science alters existing understandings. If monitoring shows undetectable or limited impacts, an adaptive management strategy should allow for decreased restrictions on oil and gas exploration. The conditions under which decreased restrictions will occur should be plainly stated in the discussion of adaptive management.

C. Right Whale Closure Area Proposal

The DPEIS proposes a six-month right whale closure area for Alternative A. An expanded closure area is proposed for Alternative B. The proposals are shown below:

Alternative A:

> *The total closure area under Alternative A would be 7,589,594 acres (ac) (30,714 square kilometers [km2]), or approximately 4 percent of the AOI. No G&G surveys using airguns would be authorized within the right whale critical habitat area from November 15 through April 15 nor within the Mid-Atlantic and Southeast U.S. Seasonal Management Areas (SMAs) during the times when vessel speed restrictions are in effect under the Right Whale Ship Strike Reduction Rule (50 CFR 224.105).* [Page 2-4]

Alternative B:

> *Alternative B includes one additional mitigation measure developed specifically to reduce impacts on marine mammals: an expanded time-area closure for North Atlantic right whales. The time-area closure would be expanded to a continuous 37-km (20-nmi) wide zone extending from Delaware Bay to the southern limit of*

the AOI (Figure 2-3). No G&G surveys using airguns would be authorized within the designated Right Whale critical habitat area from November 15 through to April 15, nor within the Mid-Atlantic and Southeast U.S. SMAs or the additional 37-km (20-nmi) closure areas during the times when vessel speed restrictions are in effect under 50 CFR 224.105.

The DPEIS explains the rationale for the Alternative A closure below. This logic would of course also extend to the expanded closure of Alternative B.

> *Alternative A includes a time-area closure intended to avoid most impacts from vessel strikes* ***or ensonification of the water column [emphasis added]*** *on North Atlantic right whales. It is estimated that this closure would avoid about two-thirds of the incidental takes of North Atlantic right whales by active acoustic sound sources over the period of the Draft Programmatic EIS.* [Page 2-4]

The DPEIS observes that seismic vessels travel at notionally 5 knots/hour (or half the mandatory vessel speed limit under the right whale ship strike reduction rule) and the seismic vessels are required to have onboard dedicated marine mammal observers. The proposal raises the obvious questions:

- Does BOEM believe that seismic vessels should be held to a standard even more restrictive than one that is twice as restrictive as every other vessel operating in these management zones along the Mid- and South Atlantic?

- If the proposal is based not on vessel strike risks but rather acoustic effects, should the agencies revise the many risk assessments that include vessel strikes and fishing gear entanglements to include acoustic noise as an equivalent level threat before applying a six-month no-activity requirement?

The proposal to establish a six-month no-seismic activity zone is a significant step. BOEM should initiate rulemaking to enable sufficient study and public comment before requiring it. Such a proposal would need to consider other sound producers. Assuming that such a proposal is warranted, would such a restriction apply for example to all NOAA vessels or do the agencies propose selectively enforcing such a requirement only on one set of vessels?

The Alternative B proposal is largely based upon attention to migration routes. At present, the Critical Habitat Designation for North Atlantic Right Whales does not include these areas. Establishing migration pathways as opposed to aggregation areas for critical life functions of feeding, calving, etc. is a significant step. What basis does BOEM have in proposing such a step and has it considered rulemaking to ensure there is adequate consideration of all the factors before implementing such a regime?

D. <u>Seismic Airgun Survey Protocol</u>

The DPEIS proposes a Seismic Airgun Survey Protocol [Page 2-5 and Appendix C]. This and associated proposals in the DPEIS would require important changes in the historic operation of observation and shut-down zones including (a) shut-down zone dimensions larger than 500-meters; (b) use of the zones in waters under 200-meters, and (c) extending the use of zones from whales to dolphins. Each warrants discussion and further consideration regarding the need for such protective measures and their practicability.

E. Exclusion zone size

The DPEIS proposes that: *The radius of the exclusion zone would be calculated on a survey-specific basis but would not be less than 500 m (1,640 ft). Based on calculations in Appendix D, the 180-dB zone for a large airgun array (5,400 in3) ranges from 799 to 2,109 m (2,622 to 6,920 ft), with a mean of 1,086 m (3,563 ft).* [Page 2-5 and Appendix C]

If sound source modeling is to be required and be used to increase the size of the exclusion zone – then it should also be available to reduce the size of the exclusion zone. The DPEIS should also be more specific as to how sound measurements are to be conducted. In addition, the proposal does not explain how long such a requirement would be in place. Experience in other areas including the U.S. Arctic have shown that after a few such field source verification tests the size of such zones are well established and there is adequate knowledge of them. Requiring verification tests after such a point brings no new knowledge and is not warranted.

Finally, the DPEIS notes the size of the zone, particularly for Level B effects, may be large and impractical to visually monitor.

F. Separation between simultaneous airgun surveys

Alternative B would establish a 40-km (25-mi) separation distance between simultaneously operating seismic airgun surveys. This is in contrast to Alternative A, which does not require any geographic separation of concurrent seismic surveys. However, in practice, operators typically maintain a separation of about 17.5 km (9.5 nmi) between concurrent surveys to avoid interference (i.e., overlapping reflections received from multiple source arrays). The separation distance under Alternative B was created by rounding up this typical "operational" separation distance to 20 km (10.8 nmi), then doubling it. The purpose of this measure is to limit ensonification of large areas of the AOI at the same time by specifying a conservative separation distance between simultaneous surveys. The largest exposure radii estimated for the 160-dB threshold for a large airgun array is approximately 15 km …" [Page 29]

The need for such a requirement and the manner in which it was calculated are questionable. A separation requirement for seismic surveys should therefore not be established at this time.

NMFS has noted that "[i]n general, NMFS expects the masking effects of seismic pulses to be minor, given the normally intermittent nature of seismic pulses." 76 Fed. Reg. at 6438

The DPEIS notes that seismic survey vessels already maintain separation distances of more than 15 kilometers, which limit overlapping ensonified areas. It is noted there is a desire is to establish a "conservative separation distance". Beyond whether there is a need are questions about what standards are used to establish the need for that additional distance. The DPEIS acoustics risk assessments do not adequately address the issue of overlapping sound fields. The stated procedure of "rounding up to 20 and then doubling" does not convey a well thought out approach.

By comparison, the Final Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys resulted in standard seismic-survey G&G stipulations providing that "operators must maintain a minimum spacing of 15 miles [24 kilometers] between the seismic-source vessels for separate operations." [16]. Thus, the DPEIS proposes a separation distance two and one-half times greater than that required in the Arctic – even though conditions in the Atlantic OCS would be expected to result in shorter sound propagation distances.

G. Dolphins Shut-down Factors

Use of observation/shut-down zones have historically been applied to cetaceans, excluding dolphins. BOEM's existing requirements are documented in NTL 2012-G02 and were premised upon a 2002 NMFS Biological Opinion.

BOEM has itself previously recognized that extending the shutdown requirement to delphinids is unwarranted. In its recent Supplemental Environmental Assessment for a specific seismic survey permit in the Gulf of Mexico, BOEM concluded that "From a biological standpoint, the best available information suggests that delphinids are considered mid-frequency specialists (i.e., auditory bandwith of 150 Hz to 160 kHz) (Southall et al., 2007). Low frequency seismic arrays, such as the ones considered for use under this proposed action, generally operate in the frequency range of 20 Hz to 20 kHz (Goold and Fish, 1998) and may extend well into the ultrasonic range up to 50 kHz (Sodal, 1999). Therefore, while the majority of the seismic noise occurs at frequencies below that of delphinids, there are some components that may enter into the hearing range of delphinids (Goold and Fish, 1998). These higher frequency components would be at lower intensity levels (i.e., not as loud). It is unclear, though, from a scientific standpoint whether any of the seismic noise that might be heard by delphinids is in fact disruptive."

[16] Minerals Management Service, Final Programmatic Environmental Assessment, Arctic Ocean Outer Continental Shelf Seismic Surveys - 2006 (OCS EIS/EA MMS 2006-038), at p. 235.

BOEM also noted the disruptive effect of a shutdown requirement on seismic operations: "Unlike other sound producing activities (e.g., sonar), seismic surveys occur on specified tracklines that need to be followed in order to meet the data quality objectives of the survey. In other words, seismic vessels in operation cannot simply divert away from nearby marine mammals without a loss in data quality." Site-Specific Environmental Assessment of G&G Survey Application No. L11-020 (Jan. 23, 2012), at 7-8. *See also* Site-Specific Environmental Assessment of G&G Survey Application No. L11-023 (Jan. 26, 2012), at 6-7; Site-Specific Environmental Assessment of G&G Survey Application No. L11-007 (Sept. 16, 2011), at 7-8; Site-Specific Environmental Assessment of G&G Survey Application No. L10-048 (Sept. 16, 2011), at 7-8.

While BOEM in these Supplemental SEISs left open the possibility of examining the issue further in a PEIS, the fact is that none of the scientific data presented in the draft PEIS for the Atlantic OCS calls into question the conclusions reached in these Supplemental SEISs.

The DPEIS nonetheless proposes adding dolphins to the shut-down requirement. It is not clear on what basis BOEM proposes such a change. The DPEIS should include a biological assessment indicating that the acoustic risks to dolphins warrant such a change.

It has been commonly observed, in fact, that dolphins seek to "bow ride" seismic and other vessels, challenging assertions of harm to the animals. The fact that various marine mammals want to approach and enter the ensonified area raises serious questions about the basic validity of a regulatory approach that rigidly established proximity to sound as its basis.

As discussed more fully in the Biology Factors section of this Appendix, recent science on the stapedial reflex is providing insight into why various animals in ensonified zones may not be adversely affected.

The DPEIS recognizes this issue of forcing shut-downs for animals that want to be in the exclusion zone: *However, shutdown would not be required for dolphins approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. If a dolphin voluntarily moves into the exclusion zone after the airguns are operating, it is reasoned that the sound pressure level is not negatively affecting that particular animal*. [Appendix C-11]

Industry suggests that rather than adding dolphins to the survey protocol, BOEM should provide similar provisions to not shut-down when cetaceans are voluntarily in the observation zone.

H. Whale Shut Down Factors

On page C-16, section 3.4, *Guidance for Vessel Strike Avoidance,* key element number 6 states:

> *"Whales may surface in unpredictable locations or approach slowly moving vessels. When animals are sighted in the vessel's path or in close proximity to a moving vessel, the vessel must reduce speed and shift the engine to neutral. The engines must not be engaged until the animals are clear of the area"*

As the motion of the vessel is required to provide the hydrodynamic force to keep the streamer cables in position, putting the engines in neutral for more than a moment, will result in a potential streamer cable tangle. These are very serious incidents. One recent one in French Guiana resulted in about one month of downtime and dozens of small boat sorties to untangle. The Association recommends the wording should be changed to "steer the vessel away from the whale." With the streamers in the water, a seismic vessel is traveling at 4 to 5 knots and is not at high speed.

I. Passive Acoustic Monitoring (PAM) and Protected Species Observers

Though there are limitations to current PAM technology, there are also limitations to visual observations. PAM offers another tool, in addition to visual observers, for use in monitoring. We support the use of PAM as a monitoring tool during certain conditions.

The capability of any PAM system to detect vocalizing marine mammals is dependent on various factors including level of background noise levels, animal vocalization source levels relative to background noise conditions and the experience of personnel operating the PAM system. PAM is useful under certain conditions and for certain species which have somewhat regular vocalization patterns. However, at this time, standard PAM systems are not able to reliably and accurately determine the location of the vocalizing animal automatically. In addition, the species identification capability of the PAM systems varies. The PAM system may not correctly differentiate between species of concern and other marine mammals. Current PAM systems are not able to determine if the vocalizing animal is a calf. A significant amount of research and effort is underway to improve the localization and species classification capabilities of PAM systems.

We recommend that basic training criteria, such as that specified by many countries for marine mammal observers (MMOs), be developed and required for PAM operators. In addition, minimum requirements for PAM equipment (including capabilities of software and hardware) should also be considered.

A period of confidence in the current PAM capabilities, understanding of limitations, and experienced operator capacity-building is needed before government agencies consider requiring PAM as a mandatory monitoring tool during seismic operations.

On page C-11 of Appendix C, it suggests there would be up to three PSOs plus a PAM operator on a shift together. With a typical limit of four hours per shift with a two hour break, this implies a large number of PSOs on board. With bunk space limits on vessels – usually stipulated by the USCG or other regulatory agencies – this may be an infeasible requirement.

May 28, 2012

Mr. Gary D. Goeke,
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard,
New Orleans, Louisiana 70123–2394
(*also submitted via email to GGEIS@boem.gov*)

Re: SUBMITTAL OF WRITTEN COMMENTS ON THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR THE ATLANTIC OUTER CONTINENTAL SHELF PROPOSED GEOLOGICAL AND GEOPHYSICAL ACTIVITIES

Dear Mr. Goeke:

Enclosed, please find one (1) hardcopy of Coastal Planning & Engineering's (CPE) written comments on the Draft Programmatic Environmental Impact Statement for the Atlantic Outer Continental Shelf Proposed Geological and Geophysical Activities

CPE appreciates the opportunity to review and comment on the DPEIS. If you should have any questions or comments, please feel free to contact me.

Sincerely,

COASTAL PLANNING & ENGINEERING, INC.

Beau C. Suthard, P.G.
Director, Tampa Bay Regional Office

cc: Jeffrey Andrews, VP, PSM, CH, CPE
Melany Larenas, PG, CPE
Kenneth Willson, CPE
Christopher Dougherty, CPE

WRITTEN TECHNICAL COMMENTS ON THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR THE ATLANTIC OUTER CONTINENTAL SHELF PROPOSED GEOLOGICAL AND GEOPHYSICAL ACTIVITIES

COASTAL PLANNING AND ENGINEERING, INC.
A SHAW GROUP COMPANY

MAY 28, 2012

As noted in the Draft Programmatic Environmental Impact Statement (DPEIS), development of new oil and gas resources requires significant exploration involving marine seismic surveys that include the use of multi-ship air gun arrays. These types of surveys may pose a risk to marine mammals, particularly whales, as the acoustics involved in the firing of the air guns may physically injure or disrupt normal behavioral patterns.

Since the mid-1990's the National Marine Fisheries Service (NMFS) has used a two tiered system to classify acoustic impacts on marine mammal populations. Level A "take" is considered to be when physical injury or harassment has taken place and occurs at 180 dB re 1 μPa RMS for Cetaceans and 190 dB re 1 μPa RMS for Pinnipeds. Level B "take" is considered to be when a behavioral disturbance has been caused and occurs at 160 dB re 1 μPa RMS for both Cetaceans and Pinnipeds. While air guns operate in these acoustic ranges and are the industry standard for oil and gas exploration, other sectors – such as renewable energy infrastructure site surveys, oil and gas infrastructure site surveys, and sand and gravel mineral exploration – utilize high resolution geophysical equipment that have far less impacts than those of air guns.

On January 21, 2009 the Bureau of Ocean Energy Management (BOEM) published a notice of intent (NOI) to prepare a Draft Programmatic Environmental Impact Statement (DPEIS) in the Federal Register. The purpose of this DPEIS is to evaluate potential environmental effects of multiple Geological and Geophysical (G&G) activities in the Mid- and South-Atlantic Planning Areas of the Outer Continental Shelf (OCS). This effort will provide framework for BOEM to ensure that G&G data are obtained in a technically safe and environmentally sound manner as directed by the Outer Continental Shelf Lands Act (OCSLA) pursuant to the Energy Policy Act (EPAct) of 2005 and to ensure compliance with the National Environmental Policy Act (NEPA) and other laws such as the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

Included in this DPEIS are two alternatives for consideration that, among other things, limit the time of year and geographic location that geophysical surveys can take place in the North Atlantic. The time-area closure currently recommended in Alternative A is from November 15 through April 15 and affects all areas in the right whale critical habitat areas. Alternative B would follow this protocol and add an additional closure offshore of Brevard County, Florida from May 1 to October 31 during sea turtle nesting season and the area of impact for avoidance of North Atlantic right whales would be expanded from the Delaware Bay entrance to the southern limit of the area of interest (AOI) and further offshore. While this closure may be appropriate for offshore oil and gas surveys utilizing air gun technologies, industries such as renewable energy site surveys, oil and gas site surveys, and sand and gravel mineral exploration that use far less impactful High Resolution Geophysical (HRG) systems, like chirp sub-bottom profilers, would be unfairly impacted under this policy.

Marine sand and gravel mineral explorations utilize high-resolution, high-frequency geophysical equipment such as chirp sub-bottom profilers, sidescan sonars, and single- and multi-beam sonars. These small, high-frequency sonar systems are far less invasive than air-gun arrays and are designed to penetrate shallow depths under the ocean floor. Unlike air-guns, chirp sub-bottom profilers are a focused sound source and sound levels high enough to be considered Level A take are only met when an animal is within 30 meters (often far less) directly below the sound source in the focused beam of sound energy (along the primary axis of the sound source). Peripheral sound levels adjacent to HRG systems dissipate below take levels very rapidly, unlike air-gun systems. By electing to describe the HRG system impacts in terms of their Source Level (sound energy level at the face of the transmitter) as opposed to their Transmit Level (which takes into account the transmission direction, distance from source, and energy level integration across the full signal bandwidth) the DPEIS unfairly overestimates the potential impact of HRG systems.

Furthermore, to increase resolution, these HRG systems are typically towed close to the seafloor. The result is that, for HRG systems, sound energy approaching take levels is focused in a small cone from the sound source, directed downward along the primary sonar axis into the seafloor immediately below the sound source. The likelihood of impacts to marine mammals in this configuration is greatly reduced during HRG surveys based on the reality of how the sound is transmitted and how the systems are deployed. These issued are not addressed in the DPEIS, and without a detailed discussion, true impacts caused by HRG systems cannot be understood in terms of the Proposed Action.

It is also important to note that, due to the shorter distances and areas where potential Level A take may be found in the vicinity of HRG systems (often less than 30 meters from the sound source as described above), the proposed mitigation of using Protect Species Observers (PSO) will reduce – and likely fully eliminate – any potential take of marine mammals related to HRG surveys. This mitigation technique is currently used for HRG surveys in the Gulf of Mexico and has proven to be very effective, especially in regards to HRG surveys. Since the systems are often towed in close proximity to the survey vessel, close to the seafloor, and with Level A impact levels limited to 30 meters or less, the area required for monitoring by the PSO's is greatly reduced, allowing for the PSO to focus their energy and effort on the areas of immediate potential take (as well as the overall monitoring area required by the G&G authorization.) With the proposed PSO, ramp-up, and shut-down mitigation measures in the DPEIS, potential HRG take is greatly reduced if not eliminated, and therefore, HRG systems should be exempt from the time-area closures included in this DPEIS.

In section 2.1.2.1 the DPEIS states:

> *"…high resolution geophysical (HRG) surveys proposed in critical habitat areas and SMAs may be considered on a case-by-case basis only if: (1) they are proposed for renewable energy or marine minerals* ***operations****; and (2) they use acoustic sources other than air guns." (Emphasis added.)*

This statement is vague as the interpretation of the term "operations" is unclear and is never defined within the DPEIS. Further in section 2.1.2.1 the DPEIS states:

> *"Exceptions for proposed HRG surveying in the right whale time-area closure could occur if a survey was needed to serve important operational or monitoring requirements for a particular project."*

If the definition of "operations" means any survey or operation in support of marine mineral exploration regardless of project status than Coastal Planning and Engineering Inc. (CPE) has no issue with the DPEIS as outlined. If "operations" is taken to mean in support of a specific dredge or construction activity currently underway (and its associated monitoring) with no other considerations for mineral exploration or other HRG surveys, than CPE is against this proposition as this could adversely affect the public by negatively impacting shore protection programs.

As stated above, while HRG "operations" surveys are clearly exempted from the time-area closures in the DPEIS, the term "operations" is never defined within the DPEIS. In addition, differing definitions of the term "operations" have been verbally expressed by BOEM staff at the DPEIS Public Meetings (sometimes differing between the separate Public Meetings) and during informational telephone calls regarding the DPEIS. "Operations" have been verbally described by BOEM staff to CPE as ranging from active dredging operations and their associated regulatory required monitoring **only** – which would bound HRG sand and gravel mineral exploration to the restrictive time-area closures; to meaning anything HRG survey related to sand and gravel mineral exploration and/or operations – which would exempt HRG sand and gravel mineral exploration from the restrictive time-area closures. This lack of a clear definition of "operations" leaves the DPEIS Alternative Descriptions in terms of HRG survey ambiguous and prevents the users and commenting Agencies from having a full and accurate understanding of each Alternative. At a minimum, a Supplemental DPEIS needs to be completed with descriptions of the Alternatives that include a clear definition of what "Operations" means and what, if any, time-area closures apply to HRG for each Alternative. Furthermore, due to the reduced impacts and focused lower sound energy levels of the HRG systems as compared to the air-gun systems, CPE feels strongly that all HRG systems, including chirp sub-bottom, sidescan sonar, and single- and multi-beam sonars should be exempted from the time-area closures in all HRG survey cases.

Shore protection projects, and their associated offshore sand resources, are important economically and are instrumental in the defense of the public and coastal communities against storms and erosion. Unlike large-scale, multi-year, federally-funded projects designed and carried out by the United States Army Corps of Engineers (USACE), many projects throughout the Gulf and East coasts of the United States are funded with local and/or State funds and built for the public benefit. These projects are built using local tax dollars, and as a result, are often done as efficiently as possible, taking advantage of weather and offshore operational windows; contractor, vessel, and equipment availability; contracting and funding availability; and other factors, which often result in short, rigid timescales for project design, permitting, exploration, and construction in very short time frames. Due to the nature of these types of publicly funded local and state projects, limiting HRG marine mineral exploration to 6 months out of the year would be detrimental, and in some cases, potentially dangerous to coastal communities with critical erosions issues working with reduced tax funding and short project planning windows to construct their shore protection projects.

Furthermore, focusing HRG mineral explorations into one 6 month window each year would result in cumulative impacts to other downstream, project-required tasks. Specifically, as all HRG mineral exploration will be focused into one 6 month window, all related project design, permitting, and regulatory approval would be focused into the following 6 month window. Project designs and permit applications cannot be completed until the offshore sand explorations have been concluded and the sand resource identified. Since this window for these HRG exploration surveys will be cut in half (from 12 months to 6 months), the current HRG mineral exploration operators will be forced to do their offshore mineral exploration in the AOI in the summer and fall (at the height of hurricane season.) As a result, the regulatory agencies will see a spike in project permit applications and consultation requests at the close of the HRG survey windows for the time-area exclusions. This will focus all of the regulatory review for these critical shoreline protection windows into a 6 month window during the time-area closures, further taxing an already inundated regulatory review and approval process.

CPE also takes issue with the scientific research exemption as outlined in section 3.4.1. The DPEIS specifically states that

> *"…reconnaissance G&G surveys are performed to map and characterize OCS sand resources and/or identify any sensitive environmental resources that could be affected by surveys. The G&G surveys may also be performed in support of regional or strategic sediment management planning without a particular end use or user in mind. The G&G surveys may be performed by other Federal agencies, State or Local governments, contractors working on behalf of a government, and/or academia… Scientific research only requires notification and is not authorized by BOEM."*

This exemption could lead to direct competition between publicly funded academic institutions/government agencies and private industry. Academic institutions and government agencies would unfairly be free to conduct year round marine mineral exploration for hire under the auspices of scientific research. This would result in unfair competitive advantages to academic institutions and federal, state, and local agencies, negatively impacting the ability of private professional organizations to compete in a free-market system. Furthermore, academic institutions often conduct this work without the supervision of licensed professionals found in the private sector, and as a result are not bound by the same industry standards or professional liability as the private professional market. This can lead to potentially significant quality control and quality assurance issues for shore protection projects.

While the intent of the DPEIS is well founded and rooted in scientific research, there are issues that need to be resolved prior to final publication. In summary, BOEM should develop a Supplemental DPEIS to address the following points:

1) If HRG surveys are going to be exempt from the time-area closures for "operations" only, than "operations" must be clearly defined in detail within a Supplemental DPEIS in order for the reader and commenting Agencies to fully understand the Alternatives and the Proposed Action and their potential impacts.

2) By electing to describe the HRG system impacts in terms of their Source Level (sound energy level at the face of the transmitter) as opposed to their Transmit Level (which takes into account the transmit direction, distance from source, and energy level integration across the full signal bandwidth) the DPEIS unfairly overestimates the impact of HRG systems. The transmit levels of HRG systems must be evaluated and described within a Supplemental DPEIS, and if small enough, should justify an HRG mineral exploration exemption from the time-area closures.

3) HRG systems have reduced potential for marine mammal impacts due to their focused axial sound energy, reduced transmit levels, and towing configurations close to the seafloor. These facts must be addressed within a Supplemental DPEIS in order to accurately quantify the true potential for HRG impacts to marine mammals and if small enough, should justify an HRG mineral exploration exemption from the time-area closures.

4) With the proposed PSO, ramp-up, and shut-down mitigation measures in the DPEIS, potential HRG take is greatly reduced – if not totally eliminated – and therefore, HRG systems should be exempt from the time-area closures included in this DPEIS. These facts must be addressed within a Supplemental DPEIS in order to accurately quantify the true potential for HRG impacts (together with the proposed mitigation measures) to

marine mammals and if small enough, should justify an HRG mineral exploration exemption from the time-area closures.

5) HRG mineral exploration is most often conducted using public funds for the public benefit. The impact of reducing HRG mineral exploration to a single 6 month window – during hurricane season – to the public entities funding and constructing the shore protection projects must be evaluated within a Supplemental DPEIS from a socioeconomic standpoint, and if large enough, should justify an HRG mineral exploration exemption from the time-area closures.

6) Cumulative impacts to regulatory agencies due to the focusing of project design, permitting, and regulatory approvals to coincide with the time-area closures after HRG mineral exploration has occurred need to be fully evaluated within a Supplemental DPEIS, and if large enough, should justify an HRG mineral exploration exemption from the time-area closures.

7) The exemption afforded for "Scientific Research" creates a barrier to competition for these projects, unfairly biasing the market towards academic and federal, state, and local agencies, negatively impacting the free-market system, and potentially resulting in impacts to quality control and quality assurance safeguards. This negative impact is large enough to either invalidate the need for a Scientific Research exemption, or more appropriately, justify an across-the-board HRG mineral exploration exemption from the time-area closures.

CPE asserts that the time-area closures in the North Atlantic are far too restrictive for HRG surveys in support of marine mineral exploration for shore protection projects conducted with public funds for the greater public good, and exemptions should be made for all HRG surveys conducted in the AOI. CPE also believes that if a time-area closure is mandated for all HRG surveys, that this mandate should be enforced across the board to include Scientific Research. Allowing unlicensed professionals free reign to conduct offshore mineral exploration normally conducted under the industry standard of care under, the auspices of Scientific Research, will create quality control issues and squeeze private companies out of the free market.

Lockheed Martin MS2
2221 Niagara Falls Blvd., Niagara Falls, NY 14304
Telephone 716 · 297 · 1000 Facsimile 716 · 298 · 6981

May 30, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section, Office of Environment (MS 5410)
Bureau of Ocean Energy Management, Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123–2394

RE: Comments on the Draft PEIS for Atlantic G&G Activities

VIA EMAIL

Dear Mr. Goeke:

Lockheed Martin is the manufacturer of the mobile gravity gradiometry systems mentioned in Section 3.2.2.6.2 of the Draft PEIS for Atlantic Geological and Geophysical (G&G) Activities. Developed by Lockheed Martin heritage corporation Bell Aerospace Textron for the U.S. Navy in the 1970's and 1980's for submarine navigation and ballistic missile launch systems, the technology has been available commercially for oil, gas and mineral exploration since 1998. The technology is considered a "breakthrough" that dramatically reduces the cost of oil and gas exploration.[1] By providing rapid, high-resolution data acquisition on a basin-wide scale, gravity gradiometry complements seismic methods, and allows for more targeted seismic surveys. This has proven to be cost-effective for the oil and gas industry; yet, gravity gradiometry also provides an environmental benefit. By focusing higher-impact seismic surveys on areas with better prospects, areas with poorer prospects can be avoided, minimizing the impact on marine mammals and other wildlife. An article in an industry trade journal concludes:

> As frontier exploration moves into increasingly environmentally sensitive areas, such as the Arctic and the US Eastern Seaboard, it is clear that noninvasive techniques that can provide valuable geological information to aid the screening of such areas with next to no environmental impact will form the backbone of future exploration efforts. GGI [gravity gradiometry imaging] is one such example – a noninvasive technology that can complement more traditional methods…[2]

Thank you for the opportunity to submit these comments.

Sincerely,

S. Bruce Kohrn
Manager, Geoscience Applications
716.298.6992
Bruce.kohrn@lmco.com

[1] Bamford, David, "Breakthrough technologies – that reduce costs," in *Digital Energy Journal*, June 2011, Issue 31.
[2] Jackson, David, "An integrated approach to frontier exploration," in *E&P*, June 2010 (www.EPmag.com)

PABC
Palmetto AgriBusiness Council

602 Meeting St.
Suite B
W. Columbia, SC 29169
(803) 926-3462
(803) 926-3462 Fax

April 20, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Dear Mr. Goeke:

I am writing on behalf of Palmetto Agribusiness Council (PABC) in support of exploring the possibility of offshore drilling for energy sources off the coast of South Carolina. PABC represents some of the largest agribusiness employers in SC with a mission to sustain the economic viability of our state's largest industry.

Being located in a state that boundaries our great Atlantic Ocean provides our region of the United States an opportunity to be a contributor to our nation's fuel supply stability. Safe off-shore exploration of additional fuel supplies could also have the ability to capture untapped natural resources that could assist in reducing the price of our much needed fuel supply.

It is our belief that there is not a single silver bullet that will reduce fuel prices, maintain stability and totally remove our dependency on fuel oil…..but we do, however, ascertain that it will take a variety of alternatives and renewables to help our nation move forward in making positive energy strides. Best practices in wind, solar, geothermal, biomass and traditional production are ALL very much needed.

Food harvesting, production and transportation are heavily dependent on energy. Exploration of many fuel alternatives can serve to assist us in finding ways to reduce the cost of food to consumers and discourage the importing of foods that are not as tightly regulated and therefore as safe as what we can produce here in our own back yards.

We are requesting an opportunity…..an opportunity to update, through new survey techniques, decades of old data that could result in providing our nation another source of a much needed energy supply. The first step to develop our offshore resources is approval of seismic surveys in the Atlantic Outer Continental Shelf (OCS). The knowledge gained would help support leasing, drilling and development that could mean creating thousands of jobs and billions in revenue. In fact, studies show that developing our own energy resources in offshore waters and other federally controlled areas could create 530,000 new jobs. All businesses and consumers would benefit from a greater supply of domestically produced fuel strengthening America's energy security and keeping energy costs under control.

In South Carolina, we have just now begun to develop strategies to increase the economic impact of agribusiness, which contributes $34 billion to the state's economy and provides 200,000 jobs. If we are to sustain and expand our industry, we must find solutions to surging energy costs that have the potential of putting us out of business at the expense of consumers.

Thank you for your consideration of our request.

Sincerely,

Cathy B. Novinger
Executive Director

/sb

AIF Draft 8 PUBLIC MEETINGS – JAX 1ST ONE

PUBLIC STATEMENT

Draft Programmatic Environmental Impact Statement (PEIS) for Geological and Geophysical (Seismic) studies in the Mid- and South Atlantic OCS areas

Good afternoon. My name is Chris Verlander and I am Vice President of Corporate Development for the Associated Industries of Florida. AIF, established in 1920, is a voluntary association of diversified businesses, created to foster an economic climate in Florida conducive to the growth, development, and welfare of industry and business and the people of the state. A not-for-profit association, AIF is owned by its members, which hail from every corner of the state and represent every segment of Florida's private sector. Thank you for the opportunity to speak today about this PEIS, which will support the issuance of permits to conduct geological and geophysical study activities on the Atlantic Outer Continental Shelf (OCS).

The AIF supports the generation of seismic data that will allow for more accurate estimates of the potential and location for oil and natural gas development in this area. We can create more jobs and generate more revenue if allowed to responsibly develop and produce – here in the United States – more of the oil and natural gas we need.

Ultimately, Atlantic OCS leasing and development would help the nation and its economy, and it would also have a significant positive effect on our state's economy. It would bring much needed jobs in a variety of industries. According to a recent Wood Mackenzie study, opening up Atlantic offshore areas and the Eastern Gulf of Mexico that are currently unavailable could bring 161,332 jobs to Florida.

Jax 1 pm

These are not limited to jobs directly associated with oil and natural gas development, but jobs created indirectly by those companies that supply equipment and other support services – both offshore and onshore – as well as construct the infrastructure required to drill offshore.

In addition, offshore development can generate much-needed revenue to fund critical services, including roads, environmental conservation and education. According to a Wood Mackenzie study, $24 billion dollars in revenue could be generated for Florida from 2012 to 2030 if offshore development (including the Eastern Gulf of Mexico) were allowed to take place in areas that are currently off-limits from development.

Energy security and affordability remain key aspects to successful long-term economic recovery and growth in Florida, and the nation in general. Recent technological advances in exploration and production have led to tremendous potential in meeting future energy demand with domestic resources allowing the United States to better manage risks in the global energy markets. Development of domestic energy resources will lead to more energy security, more jobs, and more government revenues. We appreciate the opportunity to offer supportive comments on this PEIS for geological and geophysical studies in the Atlantic OCS.

SOUTH CAROLINA FARM BUREAU

South Carolina Farm Bureau Federation
PO Box 754 • Columbia, SC • 29202.0754
803.796.6700 • Fax 803.936.4496
www.scfb.org

April 19, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Dear Mr. Goeke:

The South Carolina Farm Bureau, the state's largest general farm organization, supports the Bureau of Ocean Energy Management's permitting geological and geophysical activities for oil and gas exploration and development in the Mid and South Atlantic Planning Areas. Increasing access to and promoting production of domestic energy sources not only strengthens America's energy security, but promotes economic development as well.

We applaud a recent announcement by the current Administration to begin the process of obtaining updated seismic data. With the continued increase in gas prices, farmers are suffering, and the U.S. government should assess every opportunity to produce domestic energy safely. Natural gas is a critical recourse to nearly every farm in America, from fertilizer, to crop protection chemicals, many farms rely heavily on products based on natural gas. Updated data is very important for the Atlantic Outer Continental Shelf (OCS), given that current estimates are based on old data and have not benefited from the technological advances in seismic surveying and computer modeling in use by the industry today.

Our economy depends on the millions of jobs off-shore production generates. Millions of jobs rely on oil and natural gas as a vital and necessary part of their core function – from aviation to trucking to chemical manufacturing to iron and steel production, and certainly to agriculture. While Atlantic OCS leasing and development would help the nation and its economy, it would also have a significant positive effect on our state's economy.

The South Carolina Farm Bureau supports efforts by the Bureau of Ocean Management in beginning the process of opening the Atlantic OCS to drilling for oil and gas resources, increasing American's energy security and reducing the price of oil and gas for America's farmers. Thank you for consideration of our comments on this important issue.

Sincerely,

David M. Winkles
President

DW/bss

PUBLIC STATEMENT

Draft Programmatic Environmental Impact Statement (PEIS) for Geological and Geophysical (Seismic) studies in the Mid- and South Atlantic OCS areas

Good afternoon. My name is Eric Hamilton and I am Associate Director of the Florida Petroleum Council. Thank you for the opportunity to speak today about this PEIS, which will support the issuance of permits to conduct geological and geophysical study activities on the Atlantic Outer Continental Shelf (OCS).

The oil and natural gas industry has a long history of working with the Department of the Interior to develop this country's natural resources to the benefit of the U.S. economy and all Americans. Our industry stands ready to invest in exploration off the Atlantic OCS, and this PEIS is a needed first step to begin the process of generating the data that will allow for more accurate estimates of the potential for oil and natural gas development in this area. Generating new data is very important for the Atlantic OCS, given that current estimates are based on decades-old data and have not benefited from the technological advances in seismic surveying and computer modeling in use by the industry today. Although it is difficult to accurately estimate the amount of resources without the benefit of drilling, current estimates are likely to be conservative, given that history has shown that active exploration and development often leads to increased resource estimates.

However, the belief that moving forward with this decision can quickly lead to filling the information gaps on potential Atlantic OCS oil and gas resources is misguided. This effort falls

Jax 1pm

short in initiating forward-thinking, comprehensive energy policy. In fact, the data-collection activities envisioned by the administration will not likely happen unless companies are convinced the prospects for leasing in the Atlantic OCS in the near future are real. As we all know, current OCS policy does not allow for a lease sale in the Atlantic until 2017 at the earliest.

It is important to remember that the government does not generate this data; seismic companies do. And they generally do this on a speculative basis, hoping to sell the data to operators who are looking to purchase leases in an area. With no lease sale scheduled in the Atlantic, and thus no potential customers, seismic companies have little incentive to gather new data.

Excluding the North Atlantic Planning Area in this PEIS is yet another short-sighted policy decision. There is a great deal of interest in surveying and eventually developing this area. Oil and natural gas companies need geological and geophysical data that they can use to compare with geologic features in other offshore areas where there is current oil and natural gas production. Without this new data, a significant data gap will remain.

We can create more jobs and generate more revenue if allowed to responsibly develop and produce – here in the United States – more of the oil and natural gas we need. But more development – especially on public lands and federally controlled waters – requires that industry and government share a vision of the potential benefits and act as partners to fully realize them. The oil and natural gas industry already supports 9.2 million U.S. jobs and 7.7

percent of the U.S. economy, delivers more than $86 million a day in revenue to our government, and, since 2000, has invested more than $2 trillion in U.S. capital projects to advance all forms of energy, including alternatives.

A Wood Mackenzie study shows that developing the offshore areas that had been subject to congressional moratoria until recently, as well as the resources in Alaska's Arctic National Wildlife Refuge and a small portion of currently unavailable federal lands in the Rockies, would:

- Lift U.S. crude oil production by as much as 2.8 million barrels per day in 2025, equivalent to 30 percent of the nation's current imports;
- Increase natural gas production by 6.5 billion cubic feet per day in 2025;
- Create 530,000 new jobs; and
- Add $206 billion in cumulative government revenue by 2025. $196 billion from the OCS alone.

While Atlantic OCS leasing and development would help the nation and its economy, it would also have a significant positive effect on our state's economy. It would bring much needed jobs in a variety of industries. According to a recent Wood Mackenzie study, opening up Atlantic offshore areas and the Eastern Gulf of Mexico that are currently unavailable could bring 161,332 jobs to Florida.

These are not limited to jobs directly associated with oil and natural gas development, but jobs created indirectly by those companies that supply equipment and other support services – both offshore and onshore – as well as construct the infrastructure required to drill offshore.

In addition, offshore development can generate much-needed revenue to fund critical services, including roads, environmental conservation and education. According to a Wood Mackenzie study, $24 billion dollars in revenue could be generated for Florida from 2012 to 2030 if offshore development (including the Eastern Gulf of Mexico) were allowed to take place in areas that are currently off-limits from development.

We appreciate the opportunity to comment on this PEIS for geological and geophysical studies in the Atlantic OCS and the oil and natural gas industry stands ready to invest in safe exploration and development of the OCS should administration policies change to take full advantage of the opportunities that are present.

Statoil

July 2, 2012

U.S. Department of the Interior
Attention: Mr. Gary D Goeke
Chief, Environmental Assessment Section
Leasing and Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Re: Comments on the Draft PEIS for Atlantic G&G Activities

Dear Mr. Goeken:

Statoil USA E&P Inc. ("Statoil") appreciates this opportunity to provide the following comments on the U.S. Department of the Interior Bureau of Ocean Energy Management's Draft PEIS for Atlantic G&G Activities. On March 30, 2012, BOEM published the Notice of Availability in the *Federal Register* announcing publication of the DPEIS and requesting comments on or before May 30, 2012. The comment period was extended to July 2, 2012.

Statoil and its affiliates comprise an international energy enterprise with operations in 40 countries. We have more than 35 years of experience in oil and gas production on the Norwegian continental shelf where we operate 80% of the production. Statoil is the largest offshore operator in the world in waters deeper than 100 meters, and we are committed to accommodating the world's energy needs in a responsible manner, applying technology and creating innovative business solutions. Statoil's parent company, Statoil ASA, is headquartered in Norway with 31,000 employees worldwide, and is listed on the New York and Oslo stock exchanges. Statoil ASA has a market capitalization of nearly $85 billion and produced approximately 1.85 million barrels of oil equivalent per day in 2011. We are the operator of 40 producing fields worldwide and have a resource base of about 23 billion barrels of oil equivalent (5.5 billion barrels of booked reserves). We are one of the world's largest net sellers of crude oil. Statoil is committed to safe operations and protecting the environment, and remains dedicated to working with the respective regulatory bodies to ensure those goals.

Statoil is one of the largest leaseholders in deepwater Gulf of Mexico and holds significant positions in the Alaska Chukchi Sea. Our companyl has a keen interest in BOEM's Outer Continental Shelf Oil and Gas Leasing Program. At BOEM's most recent lease sale, Central Gulf of Mexico Sale 210/222, Statoil submitted 32 bids for over $400 million and was the successful bidder on 26 new leases for a total of over $333 million.

Statoil favors Alternative A, but we recommend that BOEM analyze another alternative without closure areas prior to issuance of the DPEIS. We strongly encourage that both the range of alternatives analyzed and their evaluation reflect the nature and extent of the known causes of injury and mortality faced by various protected species. Further, we believe that Alternative B is unwarranted based upon the assessment in the DPEIS that doubling the size of the closure area/time does not provide additional protection for right whales or marine life generally.

Additionally, Statoil concurs with and supports the comments submitted to BOEM on the Draft PEIS for Atlantic G&G Activites by the American Petroleum Institute (API) and the International Association of Geophysical Contractors (IAGC). We respectfully request that BOEM consider these comments in addition to our specific comments contained within this letter. A copy of the API/IAGC comments is attached for your review and consideration.

Furthermore, Statoil supports the Proposed Action for the 2012-2017 5-year lease sale program but believes that it represents a missed opportunity to expand OCS exploration and development in the Eastern Gulf of Mexico and the U.S. East Coast. The inclusion of these additional areas in the leasing program would encourage new investment in G&G activities for offshore exploration and development, especially – an investment that would create new jobs, generate billions of dollars in economic activity, ultimately delivering much-needed energy to American consumers and reduce U.S. dependence on foreign energy resources. We encourage BOEM to continue to look for opportunities to bring these potentially promising areas into the leasing program.

Statoil is readily available for further dialogue, and looks forward to contributing to future OCS planning processes in a constructive way.

Thank you for consideration of our comments.

Very truly yours,

James R. Meek,
Vice President, Commercial & Negotiations
Statoil USA E&P Inc.

Attachment

GEORGIACHAMBER

April 18, 2012

Mr. Gary D. Goeke
Chief - Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management, Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

RE: Comments on the Draft PEIS for Atlantic G&G Activities'

Dear Mr. Goeke:

My name is Jeff Hamling and I'm the Vice President of Federal Affairs with the Georgia Chamber of Commerce. Thank you for the opportunity to speak today. I am here to represent the membership of Georgia's business community and voice support for the Bureau of Ocean Energy Management's decision to allow seismic studies of the Atlantic Outer Continental Shelf (OCS). We believe these studies are important because they will determine the potential resources of oil and natural gas available for domestic production.

Georgia Chamber members employ nearly 1 million Georgians. Our companies span almost every major industry that drives the U.S. economy, including agriculture, manufacturing, transportation, technology and healthcare. We have members which are Fortune 500 companies as well as small businesses that are just starting up.

I am here because Georgia businesses understand the value of oil and natural gas and the need to produce more of this energy domestically. Our member companies are similar to the millions of businesses throughout the country that are reliant on oil and natural gas for

Edward S. Heys, Jr.
2012 Chair

Chris Clark
President and CEO

www.gachamber.com

233 Peachtree Street NE, Suite 2000 Atlanta, Georgia 30303-1564 Phone: 404.223.2264 Fax: 404.223.2290

powering factories and offices; transporting goods to market; or using the products created by these rich resources.

Producing more oil and natural gas domestically would provide a steady, reliable source of energy, helping to keep input costs stable. Studies show that developing oil and natural gas reserves in offshore waters and other federally controlled areas could create thousands of new jobs and generate hundreds of billions of dollars in new revenue for government programs. In Georgia alone, a Wood Mackenzie study concluded that thousands of jobs and over $285 million in state revenue between 2012 and 2030 could be generated if the area off the Atlantic OCS is developed.

But, we need to begin now. Our Chamber believes that government policies should be based on sound science and data. With this in mind, we fully support the government's decision to conduct seismic analyses. The data available regarding the offshore Atlantic area is over 20 years old and new seismic survey technologies would give producers a clearer, more detailed accounting of OCS resources as they make business decisions regarding exploration.

The federal government indicated leasing in the Atlantic will not be possible until we have more data on potential resources. Without leasing, the companies will not be able to explore for offshore oil and natural gas; and without exploration there can be no development of those resources -- and thus no potential for the additional energy, jobs and revenue that offshore oil and natural gas development can bring.

Our organization understands the important balance between environmental impact and economic opportunity. Therefore, it is reassuring that the seismic survey techniques will be carefully managed by the operator to avoid impacting marine mammals. And as there have been significant strides from both the government and industry to improve offshore drilling safety, we appreciate the continued efforts to safely develop offshore resources.

Thank you again for the opportunity to comment, and in conclusion, we ask that the government allow these seismic studies to move forward and to allow the oil and natural gas companies to begin leasing land for development.

Regards,

Jeff Hamling
Vice President, Federal Affairs
Georgia Chamber of Commerce

LUND'S FISHERIES INCORPORATED
Phone: (609) 884 - 7600 Fax: (609) 884 - 0664 lundsfish@lundsfish.com
997 Ocean Drive, Cape May, New Jersey 08204, U.S.A.
Email to: jreichle@lundsfish.com

May 29, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394
By email: GGEIS@boem.gov

Re: Comments on the Draft Atlantic G&G Programmatic EIS

Dear Mr. Goeke:

On behalf of the 150 employees of our family-owned business, Lund's Fisheries, Inc., and the independent fishermen who also supply fisheries products to our processing facility in Cape May, New Jersey, we thank you for the opportunity to comment on the Draft EIS. I am writing in the strongest possible opposition to your proposal, based primarily on the potential number of lethal takes of marine mammals in the region – some 138,489 – from "Seismic Airgun Sources". As commercial fish processors and harvesters, our industry's interaction with marine mammals is tightly regulated with 10s or hundreds of lethal marine mammal takes being sufficient to close our commercial fisheries.

I am also the President of the Garden State Seafood Association and would like my comments to also represent GSSA's position on this matter. One of our members, Mr. Jim Lovgren, a Point Pleasant-based commercial fisherman, was able to attend the Atlantic City hearing on April 27. We appreciate his taking the time to learn of the hearing and participate in it. Unfortunately, the hearing was not widely publicized and we are fortunate that Jim was able to attend in order to express our concerns.

There is no question that energy independence is important to our country but drilling off the New Jersey shore and endangering more than a hundred thousand marine mammals during the exploratory process, in addition to the potential to jeopardize our important commercial fisheries resources through oil spills, is not an option that we can support. Please consider drilling in ANWR or completing the gas pipeline from Canada as potentially viable alternatives for our nation.

Sincerely

Jeff Reichle

Jeffrey B. Reichle
President

Cc: NJ Congressional Delegation
Governor Christie

CHARLESTON METRO
CHAMBER OF COMMERCE

P.O.Box 975
Charleston, SC 29402-0975
843.577.2510
843.723.4853 fax
www.charlestonchamber.net

May 22, 2012

Mr. Michael R. Bromwich
Bureau of Ocean Energy Management
1849 C Street, NW
Washington, D.C. 20240

Dear Mr. Bromwich:

The Charleston Metro Chamber of Commerce supports the Bureau of Ocean Energy Management's permitting of geological and geophysical activities for oil and gas exploration and development in the Mid and South Atlantic Planning Areas.

The Chamber strongly supports development of a comprehensive energy strategy for our nation and our state to help lesson our dependence on foreign oil. Exploration of energy sources within the United States is a logical part of that strategy. By developing our own resources, we are helping to create jobs and strengthen our nation's national defense at the same time.

By approving the seismic study of offshore drilling on the Atlantic Outer Continental Shelf, the U.S. government would be taking a solid first step in this process. In a recovering economy such as ours, it is important that we assess all opportunities that would spur economic development. Hundreds of thousands of jobs would be created by opening the Atlantic Outer Continental Shelf. This would also give our regional business community a competitive advantage over our international counterparts.

The Charleston Metro Chamber of Commerce supports the efforts by the Bureau of Ocean Management in beginning the process of studying the Atlantic Outer Continental Shelf for oil and gas resources.

Sincerely,

Mary Graham

Mary Graham, CCR, IOM, CCE
Senior Vice President
Business Advocacy

May 30, 2012

VIA E-MAIL TO GGEIS@BOEM.GOV

Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Re: **Comments on the Draft Atlantic G&G Programmatic EIS**

Dear Mr. Goeke:

The Bureau of Ocean Energy Management (BOEM) of the U.S. Department of the Interior (DOI) announced on March 30, 2012 in the Federal Register that it has published and made available a "Draft Programmatic Environmental Impact Statement (PEIS) to evaluate potential environmental effects of multiple Geological and Geophysical (G&G) activities in the Mid- and South Atlantic Planning Areas of the OCS [Outer Continental Shelf]." These activities include "seismic surveys, sidescan-sonar surveys, geochemical sampling, and remote sensing" across "three program areas managed by BOEM: (1) Oil and gas exploration and development; (2) renewable energy; and (3) marine minerals" [77 Fed. Reg. 19,321 (March 30, 2012)].

The Offshore Wind Development Coalition (OffshoreWindDC) and the American Wind Energy Association (AWEA) respectfully submit these comments on the offshore wind renewable energy aspects of this PEIS and assert that *all* impacts associated with offshore wind renewable energy G&G activities would be "negligible" or "minor." While the subject Draft PEIS looks at "[d]eep penetration seismic airgun surveys . . . occur[ing] almost exclusively in support of oil and gas exploration and development" accounting for 79 percent of the PEIS Area of Interest (AOI)[1] (p. viii) and concludes that "most impacts" would be "negligible to minor" and none would be "major" (p. xxiv), BOEM's earlier *Final Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities in the Mid-Atlantic States of New Jersey, Delaware, Maryland, and Virginia* (hereinafter "Mid-Atlantic EA"), issued in January 2012, found insignificant impacts from those activities, which include G&G surveys.

[1] The AOI levels for renewable energy and marine minerals are 15 percent and nine percent respectively.

OffshoreWindDC represents offshore wind developers and supply chain business, including wind turbine manufacturers, offshore construction companies, environmental consultants, law firms, and other service providers. AWEA is a national trade association representing a broad range of entities with a common interest in encouraging the deployment and expansion of wind energy resources in the U.S. AWEA's members include wind turbine manufacturers, component suppliers, project developers, project owners and operators, financiers, researchers, renewable energy supporters, utilities, marketers, customers, and their advocates.

After describing the potential of offshore wind to contribute to U.S. energy goals, we examine the scope of offshore wind renewable energy G&G activities found in the Draft PEIS and argue that no more than "minor" impacts should be assigned to these activities. We accomplish the latter through a comparison with the Final Mid-Atlantic EA; additional analysis on the potential effects of offshore wind G&G activities on marine mammals, in particular the north Atlantic right whale; and an examination of the Draft PEIS' "moderate" rating assigned to fuel spill impacts to coastal and marine birds.

Offshore wind and America's energy future

The development of offshore wind resources can play a vital role in the nation's effort to restructure the electricity sector in a manner that increases employment, improves national security, reduces price volatility, and combats climate change. At the end of 2011, the European Union had 53 operational offshore wind farms accounting for 3,813 megawatts (MWs) of generating capacity, with nine utility-scale projects of 2,375 MWs of additional capacity under construction (European Wind Energy Association (EWEA), www.EWEA.org). It is clear that offshore wind projects in U.S. waters can also produce clean electricity at stable prices from projects located close to coastal demand centers. These projects can create thousands of jobs and billions of dollars of economic development, reduce the need for long-distance transmission lines, and help coastal States meet their renewable electricity standards. A 2008 study by the U.S. Department of Energy (DOE), entitled *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, found that the U.S. could obtain 20 percent of its electricity from wind by 2030, and that 15 percent of that wind power could come from offshore projects with a total of 54,000 MWs of generating capacity.[2]

President Obama has made renewable energy a priority of his administration. In his 2011 State of the Union speech, he said:

> Clean energy breakthroughs will only translate into clean energy jobs if businesses know there will be a market for what they're selling. So tonight, I challenge you to join me in setting a new goal: By 2035, 80 percent of America's electricity will come from clean energy sources.

And this past January, during his 2012 State of the Union address, the President said:

> . . . I will not walk away from the promise of clean energy . . . I will not cede the wind or solar or battery industry to China or Germany because we refuse to make the same commitment here . . .

[2] U.S. Department of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply* (July 2008) *available at* http://www.20percentwind.org/20percent_wind_energy_report_revOct08.pdf.

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> It's time to end the taxpayer giveaways to an [oil] industry that's rarely been more profitable, and double-down on a clean energy industry that's never been more promising.

The Administration's *Blueprint for a Secure Energy Future* released in March 2011 reiterated this goal, stating in the chapter "Innovate Our Way to a Clean Energy Future" that this electricity will come from a "diverse set of clean energy sources – including renewable energy sources . . ."[3] An offshore wind farm is pictured on the first page of this chapter. Additionally, a February 2011 joint report from the Departments of Energy and the Interior called *A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States* lays out a path for reaching the 54,000 MW offshore wind goal DOE set in 2008.[4]

Wind-generated electricity helps combat the threat of climate change, which the U.N. Intergovernmental Panel on Climate Change expects will contribute to the extinction of 20-30 percent of existing wildlife species by 2030.[5] Additionally, as DOE recognized in 2008, wind power produces other significant environmental benefits. Electricity generation from an offshore wind farm is accompanied by virtually no conventional air pollution, water pollution, or hazardous waste, or impacts from mining, transporting, or refining fossil fuels. The DOE report found that wind power could: (1) keep electric sector emissions from increasing despite dramatic increases in electricity demand; (2) displace 50 percent of electricity generated from natural gas and 18 percent of that from coal, avoiding more than 80 gigawatts (GWs) of new coal capacity (and mitigate electricity price increases by reducing demand for fossil fuels); and (3) diminish cumulative water consumption in the electric sector by eight percent, or four trillion gallons, by 2030.[6]

At present, there are about fifteen offshore wind projects at various stages of development in the U.S. Eleven of these projects are planned for sites on the East Coast for which leases from Interior's Bureau of Ocean Management (BOEM) will be required. The others have been proposed for sites on state submerged lands, lakebed in the Great Lakes, or state coastal waters. The first BOEM lease, awarded to the Cape Wind project in Nantucket Sound, was signed in October 2010.

Scope of offshore wind G&G activities

We would like to make a few comments about the type and scope of offshore wind G&G activities analyzed in this Draft PEIS.

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[3] Office of the President of the United States, *Blueprint for a Secure Energy Future* at 32 (March 11, 2011), *available at* http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf.

[4] The 2011 Report sets out a path to "54 gigawatts (GWs) of deployed offshore wind generating capacity by 2030." The Report finds that meeting this goal will require policy-makers to achieve "two critical objectives: reduce the cost of offshore wind energy and reduce the timeline for deploying offshore wind energy." U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, and U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, *A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States* at 8 (Feb. 7, 2011), *available at* http://www1.eere.energy.gov/windandhydro/pdfs/national_offshore_wind_strategy.pdf.

[5] Intergovernmental Panel on Climate Change (IPCC), *Fourth Assessment Report: Climate Change 2007*, Working Group II: Impacts, Adaptation and Vulnerability *available at* http://www.ipcc.ch/publications_and_data/ar4/wg2/en/spmsspm-c-2-ecosystems.html

[6] DOE Report, *available at* http://www.20percentwind.org/20percent_wind_energy_report_revOct08.pdf. *See also* AWEA comments, p. 12.

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1. Turbine spacing within wind farms. The Draft PEIS assumes, in Section 3.3.3.2, page 2-30, that between 14 and 45 turbines will be placed within each three-by-three nautical mile (nm) OCS block. This upper bound, though, assumes relatively tight turbine spacing of approximately one-half nm apart while the lower uses more generous spacing of about one nm. The document also assumes 3.6 MW and 5.0 MW turbines with rotor diameters of 110 and 130 meters respectively. European experience to date suggests that turbines selected for projects are increasing in size, resulting in fewer turbines per project with more space between the machines than ever before – in other words, moving away from 0.5 nm and closer to 1.0. This would mean many fewer geotechnical surveys per OCS block than the upper-bound 45 now in the Draft PEIS (see Table 3-6).

2. Economically viable water depth. Page 3-14 of the Draft PEIS states, "The distance from shore for a wind facility is generally defined at the outward limit of its economic viability, currently about 46 km (25 nmi [nautical miles]) from shore of 100 m (328 ft) water depth." While a single demonstration floating wind turbine is operating in 200 m of water off the southwest coast of Norway[7], EWEA reports that 22.8 m was the average depth for commercial projects (all fixed foundation) built last year and nearly every project under construction or online is in water shallower than or equal to 40 m deep.[8] Furthermore, the eastern edge of the Mid-Atlantic WEAs exists at a water depth of approximately 30 m. Therefore, 100 m is currently not an economically, that is to say, commercially, viable water depth.

3. Size and type of vessels for geotechnical studies. Page 3-17 and Table 3-9 indicate that a "small barge or a ship approximately 20 m (65 ft) in length" (p. 3-17) would be used to conduct offshore wind geotechnical studies, but we believe that for *open-ocean drilling*, ships, not barges, of at least 60 m will most likely be the vessels that are used.

4. Meteorological equipment. In Section 3.3.2.3, page 3-18, the Draft PEIS assumes that meteorological (met) buoys, but not met towers, will be used on offshore wind projects. It says that while the renewable energy G&G surveys scenario "does not preclude the use of meteorological towers," Table 3-6 shows, exclusively, between seven and 38 "bottom-founded monitoring buoys" as part of the Draft PEIS "Projected Levels of G&G Activities for Renewable Energy Site Characterization and Assessment." While the advantages of met buoys, especially those with LiDAR technology, are clear, traditional offshore wind met towers are still being deployed in Europe and the Final Mid-Atlantic EA assumed the installation of up to 12 met towers, along with 25 met buoys (p. vii).

   Furthermore, as we have written in submissions in other BOEM dockets, buoys and towers can be viewed as both alternatives and complements to each another. A developer may seek to use both a tower and a buoy (or two) on a single project. In the case where a met tower has also been commissioned, it may be desirable to first deploy the buoy adjacent to the met tower for a limited test period (e.g., one month) in order to establish some wind measurement correlations and comparisons, and then to redeploy the buoy elsewhere within the project area. It may also

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[7] This is Statoil's Hywind project. More information is at http://www.statoil.com/en/TechnologyInnovation/NewEnergy/RenewablePowerProduction/Offshore/Hywind/Pages/HywindPuttingWindPowerToTheTest.aspx.
[8] EWEA, *The European offshore wind industry key 2011 trends and statistics*, January 2012, *available at*: http://www.ewea.org/fileadmin/ewea_documents/documents/publications/statistics/EWEA_stats_offshore_2011_02.pdf

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be desirable near the end of the monitoring campaign to bring the buoy back to the vicinity of the tower for another limited data collection period. The purpose of this second test period would be to verify the stability of the correlations and comparisons established during the first test period. The Final PEIS should acknowledge that met buoys and towers are not mutually exclusive.

5. Survey methodologies. The description in the Draft PEIS of the offshore wind G&G activities is reasonable, however, the document should specifically address the benefits – environmental and economic, for instance – of allowing flexibility in the G&G protocols. The assumption of only a single mobilization, for example, may not hold for developers pursuing staged surveys. We therefore believe that the Final PEIS should allow for survey flexibility so that the value of this PEIS can be more fully realized with respect to offshore renewable energy.

Offshore wind G&G activities – most impacts less than "minor"

On page xxiv, the Draft PEIS concludes: "Most impacts under all three alternatives [studied in this Draft PEIS] would be **negligible** or **minor**, and no **major** impacts were identified." It lists four impacts determined to be "moderate" – only one of which can result from offshore wind G&G activity, as the other three are the effect of "airguns" used almost exclusively in oil and gas exploration. It is extremely difficult, if not impossible, to tease out the impacts due only to offshore wind G&G study.

Below we make the case that not only are the impacts from offshore wind G&G far less than "major," they are also significantly less than "moderate" and in nearly all subject areas less than "minor." But we begin by stating our strong support for the overarching objective of the PEIS, that is to establish a "framework for subsequent environmental documents for site-specific action":

> while identifying and analyzing appropriate mitigation measures to be used during future G&G activities. The impacts of future site-specific actions will be addressed in subsequent NEPA [National Environmental Policy Act of 1969] evaluations, per CEQ [Council on Environmental Quality] regulations (40 CFR 1502.20) by tiering from this programmatic evaluation (pp. 1-5).

Those regulations instruct agencies "to relate broad and narrow actions and to avoid duplication and delay" (40 C.F.R. 1502.4(d)) and allow these agencies to "tier" environmental reviews to avoid "repetitive discussion of the same issues and to focus on the actual issues ripe for decision at each level of environmental review" (40 C.F.R. 1502.20). Additionally, we are encouraged that the Draft PEIS cites numerous previous environmental reviews of offshore wind G&G activities, most notably, the 2007 PEIS on alternative energy and alternate use of OCS facilities, 2009 EA of met tower leasing, and 2011 Draft Mid-Atlantic EA. We strongly encourage BOEM to produce a Final PEIS reflecting the *Final* Mid-Atlantic EA, issued in January, since it is the most relevant and up-to-date document on the offshore wind issues in this subject PEIS.

In that Final EA, BOEM makes a "Finding of No Significant Impact" (FONSI) with respect to the potential effects of offshore wind leasing and site assessment and characterization activities in the Wind Energy Areas (WEAs) off the coasts of New Jersey, Delaware, Maryland, and Virginia. BOEM's Chief Environmental Officer, Alan D. Thornhill, concludes on page xiv:

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> It is my determination that there are no substantial questions regarding the reasonably foreseeable impacts of the proposed action or alternatives, and that no reasonably foreseeable significant impacts are expected to occur as the result of the preferred alternative or any of the alternatives contemplated in the EA. It is therefore my determination that implementing the proposed action or any of the alternatives would not constitute a major federal action significantly affecting the quality of the human environment under Section 102(2)(C) of the National Environmental Policy Act of 1969.

Furthermore, the Final Mid-Atlantic EA anticipates no significant impacts in *any* of the 17 subject areas ("environmental and socioeconomic conditions") constituting the EA. The two highest ratings are to water quality ("minor") and air quality ("minor if detectable"). The impact assessments for most of the other areas (e.g., birds, coastal habitats, sea turtles, archaeological resources, fish and fish habitat) are "none," "negligible," or "minimal."

Although the Draft PEIS concludes that impacts to marine mammals from high-resolution geophysical (HRG) and geotechnical activities for offshore wind "are expected to be" "negligible" or "minor" (p. xv) and the Final Mid-Atlantic EA finds marine mammal impacts to be "minimal" (p. viii), we want to explore further the potential effects on these important biological resources, especially the endangered north Atlantic right whale.

Marine mammals and the north Atlantic right whale

The National Oceanographic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) has jurisdiction over right whales under the Endangered Species Act (ESA) and the National Marine Mammals Protection Act (MMPA). Under the 1994 Amendments to the MMPA, the MMPA prohibits the "take" of marine mammals, which is defined as the harassment, hunting, or capturing of marine mammals, or the attempt thereof. "Harassment" is further defined as any act of pursuit, annoyance, or torment, such as a vessel collision, and is classified as Level A (potentially injurious to a marine mammal or marine mammal stock in the wild), and Level B (potentially disturbing a marine mammal or marine mammal stock in the wild by causing disruption to behavioral patterns). Projects with the potential to cause noise levels exceeding NOAA's criteria levels, resulting in incidental harassment, are permitted to apply for an incidental harassment authorization (IHA), where authorizations can be issued in 120 days, following a public comment process that is published in the Federal Register. Project proponents can request Level B take based on estimated numbers of marine mammals that may be ensonified during project activities and NMFS will determine if proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat.

The Draft PEIS and Final Mid-Atlantic EA both contain a number of mitigation measures for marine mammals currently employed in various projects along the East Coast. These measures have been vetted through the existing permitting process at NMFS. This process is well established and has been successfully employed to provide appropriate protection at each specific development site. NMFS' conservative noise criterion guidelines are designed to protect all marine species from high sound levels at any point in the frequency spectrum. Furthermore, project developers, such as, interim policy lessees, are currently required to abide by NMFS dynamic area management and seasonal area management measures already in place to reduce the chances of ship strike.

In addition, mitigation methods have been developed and successfully employed that enable marine activities producing noise levels that exceed NOAA's criteria levels to occur year-round and during nighttime hours. For some of these projects, actual harassment levels have been significantly below initially calculated levels or altogether non-existent. In the case of geophysical survey activities, noise levels produced by seismic reflection survey sound sources (SRSSS), such as, "boomers," are significantly less than those from major marine construction and industrial projects that take place in the vicinity of marine mammals at all hours of the day. Take calculations can be, and have been, tailored to site-specific conditions and mitigated and monitored successfully, even during nighttime activities. For example, during construction and subsequent operation of the Northeast Gateway Deepwater Port and the Neptune Deepwater Port, both of which are located in Massachusetts Bay in north Atlantic right whale habitat, a combination of vessel personnel and marine mammal monitors were trained using NOAA-approved methods to monitor marine mammal activity at distances up to two miles from the noise source. Methods approved as part of the NMFS IHA enabled marine mammal monitoring to occur during nighttime construction activities through the use of night-vision optics and underwater acoustic monitoring. Additionally, operational deepwater port activities occur on an around-the-clock basis and use vessel personnel, trained using NOAA-approved methods, to monitor for marine mammal activity. To date, no incidental take has occurred from these activities.[9]

NMFS also issued an IHA in June 2011 to the U.S. Geological Survey (USGS) for a marine geophysical study in the central Gulf of Alaska deploying an array of 36 airguns that were operated 24 hours per day over the survey period.[10] These particular airguns produce noise levels propagating out to approximately 3,850 m to the 160 dB isopleth – the distance from the source where the noise level dissipates to 160 dB. Mitigation techniques include a combination of protected-species observers, use of night vision equipment, and passive acoustic monitoring during nighttime actives. Such mitigation methods, coupled with a 500 m monitoring area as suggested by the EA, can successfully mitigate the use of the significantly quieter "boomers" and other SRSSS during nighttime hours.

Survey activities, including geophysical, avian and bat surveys, will be required by BOEM under the new regulations, and some must take place year-round. Potential platforms for survey activities of this nature will require service by associated vessels. Measures such as exclusion zones and marine mammal monitoring, as recommended by NMFS, particularly during migration periods for mammals such as the north Atlantic right whale, would effectively minimize potential impacts to marine mammals.

There is no evidence that the existing processes provide inadequate protection for marine mammals under the governing statutes and regulations. Furthermore, after analyzing the likely impacts under the preferred Alternative A of the Final Mid-Atlantic EA, BOEM concluded the alternative "is not anticipated to result in any significant or population-level effects to marine mammals . . . Specifically, harassment from sound and slight increases in the risk of vessel collisions are the primary potential

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[9] See also Reiser, Craig, Dale Funk, Robert Rodrigues, and David Hannay of LGL Alaska Research Associates, Inc. and JASCO Research Ltd. for Shell Offshore Inc., NMFS, and US FWS, *Marine Mammal Monitoring and Mitigation During Marine Geophysical Surveys by Shell Offshore Inc. in the Alaskan Chukchi and Beaufort Seas*, July-October 2010: 90-day Report (January 2011) *at* http://www.nmfs.noaa.gov/pr/pdfs/permits/shell_90day_report_appendices.pdf. The report found no evidence of harassment or take during the four-month survey, which included operations after dusk.
[10] Federal Register Vol. 76, No. 111, June 9, 2011. *Available at* http://www.nmfs.noaa.gov/pr/pdfs/fr/fr76-33705.pdf.

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impacts to marine mammals associated with Alternative A, but these impacts, if any, are expected to be minimal" (p. 97).

Bird impacts from fuel spills – much less than "moderate" for offshore wind

The one area of the Draft PEIS relevant to offshore wind receiving an impact rating higher than "minor" (i.e., "moderate") is the "impacts of accidental fuel spills on coastal and marine birds" (p. xxiv). (The Draft PEIS identifies three other "moderate" impacts, all of which result from the use of "airguns" used almost exclusively for oil and gas surveys.) The document explains:

> If the accidental fuel spill occurred in offshore waters, there is the potential for some oceanic and pelagic seabirds to be directly and indirectly affected by spilled diesel fuel. Direct impacts would include oiling of plumage and ingestion (resulting from preening). Indirect impacts could include oiling of foraging habitats and displacement to secondary locations. Impacts are expected to be negligible to minor for most bird species, but potentially negligible to *moderate* for listed species such as piping plover, roseate tern, red knot, and Bermuda petrel [emphasis added] (p. xviii).

While it is extremely difficult, if not impossible, to tease out the impacts due only to offshore wind G&G activities, it is straightforward to determine that these potential impacts should be considered insignificant. First, the vessels performing the offshore wind HRG and geotechnical surveys would be "small" – less than 98 feet in length (Draft PEIS, pp. 3-16, 3-17) [11] – carrying just "several thousand gallons" of fuel, 2-3 orders of magnitude less than the quantity on "large seismic survey vessel[s]" (p. 3-35). Second, the likelihood of a spill during offshore wind G&G surveys is remote; the Draft PEIS points out that a recorded oil/fuel spill "has never been recorded" in more than 54,000 nautical miles (100,000 km) of seismic surveys funded by the National Science Foundation (NSF) (p. 3-36). Third, the Final Mid-Atlantic EA rated the reasonably foreseeable impacts on water quality to be "minor," the risk of a spill "small," and the impacts "in the unlikely event of a spill" "minimal . . . since the spill would very likely be small, and would dissipate and biodegrade within a short time" (p. viii). The Final Mid-Atlantic EA also found "no threat of significant impacts" and "negligible" impacts to birds from a variety of sources, including "accidental fuel releases" (p. ix).

Conclusion

OffshoreWindDC and AWEA appreciate this opportunity to comment on the Draft Atlantic G&G Programmatic EIS and respectfully request that BOEM consider this document in its analysis of the environmental significance of offshore wind G&G activities in the Mid- and South Atlantic Planning Areas. We look forward to future opportunities to discuss these points with you and to present the best available evidence that these activities will not result in significant impacts.

Please feel free to contact us with any questions regarding our comments.

[11] Notwithstanding our earlier comments concerning the size of offshore wind geotechnical vessels.

OffshoreWind Development Coalition
1130 Connecticut Avenue, NW, Suite 300 Washington, DC 20036 ● Phone: 202.688.1424 ● www.OffshoreWindDC.org

Sincerely yours,

Jim Lanard
President
Offshore Wind Development Coalition

Tom Vinson
Senior Director of Federal Regulatory Affairs
American Wind Energy Association

Before the
BUREAU OF OCEAN ENERGY MANAGEMENT
U.S. DEPARTMENT OF THE INTERIOR
Washington, D.C.

In the Matter of Atlantic OCS Proposed Geological And Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement	OCS EIS/EA BOEM 2012-005

COMMENTS OF THE
NORTH AMERICAN SUBMARINE CABLE ASSOCIATION

Kent D. Bressie
Madeleine V. Findley
Kristine Laudadio Devine
WILTSHIRE & GRANNIS LLP
1200 18th Street, N.W., Suite 1200
Washington, D.C. 20036-2516
+1 202 730 1337 tel

Counsel for the
North American Submarine Cable Association
.

30 May 2012

EXECUTIVE SUMMARY

To ensure compliance with the National Environmental Policy Act ("NEPA") and other legal obligations and to achieve effective coordination and protection of potentially competing marine activities on the outer Continental Shelf ("OCS"), the North American Submarine Cable Association ("NASCA") urges the Bureau of Ocean Energy Management ("BOEM") to revise its Draft Programmatic Environmental Impact Statement ("DPEIS") in this proceeding to account for the extensive presence, critical importance, and unique legal status of undersea fiber-optic telecommunications cables. Although the potential for conflict between undersea telecommunications cables and energy-related activities on the OCS—including those in the Mid- and South Atlantic Planning Areas—continues to grow, the DPEIS makes no mention whatsoever of undersea telecommunications cables, much less the unique rights and protections due to such cables, the federal laws and agencies governing such cables, or any of the threats to undersea cables posed by energy-related activities in the OCS absent awareness and coordination.

Undersea cables carry more than 95 percent of the international voice, data, and Internet traffic of the United States, a percentage that is expected to continue to increase. Without undersea cable infrastructure, the global Internet would not function. Currently, there is significant deployment of undersea cables in the Mid- and South Atlantic Planning Areas, and additional cables are either under construction or in the planning stage.

Various international treaties to which the United States is a party and customary international law (as observed by the United States) grant to undersea cables unique rights and freedoms not granted to any other activities in the marine environment. The DPEIS, however, makes no mention of these rights and freedoms or their implications for other marine activities, including energy-related ones. In the United States, undersea cables are licensed and permitted principally by the Federal Communications Commission ("FCC"), the U.S. Army Corps of Engineers ("ACOE"), and the group of national-security and law-enforcement agencies known as "Team Telecom," pursuant to various federal statutes and regulations. But the DPEIS does not even identify the FCC or Team Telecom (much less designate them as coordinating agencies" under NEPA) or describe these other statutes and regulations (including civil and criminal penalties for undersea cable damage), even though regulatory activity pursuant to those statutes and regulations could have a variety of impacts on energy-related activities on the OCS.

Energy-related activities—including oil and gas exploration and exploitation, deep-sea mining, and alternative energy activities (wind, wave, and current)—pose numerous threats to undersea cables. All three categories of energy-related activities threaten to impede access for undersea cable installation and maintenance, whether on the ocean surface or seafloor, and the risk of damage due to increased vessel activity. Oil and gas-related activities also pose threats from pipeline crossings. Deep-sea mining poses additional threats from direct disturbance and seafloor erosion and abrasion. Alternative energy activities also pose additional threats, particularly from bottom-scouring from wind turbine towers and crossings by power cables of undersea telecommunications cables. None of these is discussed in the DPEIS.

The failure to address these threats, potential conflicts, and other legal-regulatory regimes is inconsistent with both NEPA and Congress's directive to conduct a PEIS for the Atlantic OCS, as that directive was not limited to consideration of energy matters only. With respect to NEPA, undersea cable activity is "reasonably foreseeable" and should therefore be addressed by BOEM as such in revisions to Alternatives A and B. BOEM should add conclusions that vessel traffic, grab-and-core sampling, buoy founding and anchoring, and well drilling, and any other activities under Alternatives A and B that may have an impact on undersea cables would be “moderate” or “major” absent further modifications. BOEM should also describe the other laws, regulations, treaties, and agencies relating to undersea cables, given the potential for conflict with undersea-cable and energy-related activities, if left uncoordinated. Finally, BOEM should consider designating the FCC and the Team Telecom agencies as “coordinating agencies” for NEPA purposes.

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BUREAU OF OCEAN ENERGY MANAGEMENT
U.S. DEPARTMENT OF THE INTERIOR
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In the Matter of Atlantic OCS Proposed Geological And Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas Draft Programmatic Environmental Impact Statement	OCS EIS/EA BOEM 2012-005

COMMENTS OF THE
NORTH AMERICAN SUBMARINE CABLE ASSOCIATION

To ensure compliance with the National Environmental Policy Act ("NEPA") and other legal obligations and to achieve effective coordination and protection of potentially competing marine activities on the Outer Continental Shelf ("OCS"), the North American Submarine Cable Association ("NASCA") urges the Bureau of Ocean Energy Management ("BOEM") to revise its Draft Programmatic Environmental Impact Statement in this proceeding to account for the extensive presence, critical importance, and unique legal status of undersea fiber-optic telecommunications cables.[1] Undersea cables[2] carry more than 95 percent of the international

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1 *See Department of the Interior, Bureau of Ocean Energy Management, Geological and Geophysical Exploration on the Atlantic Outer Continental Shelf, Notice of Availability of a Draft Programmatic Environmental Impact Statement*, 77 Fed Reg. 19,321 (Mar. 30, 2012); Atlantic OCS, Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Draft Programmatic Environmental Impact Statement ("DPEIS"), www.boem.gov/BOEM-Newsroom/Library/Publications/2012/BOEM-2012-005-vol1-pdf.aspx (vol. I, chaps. 1-8), http://www.boem.gov/BOEM-Newsroom/Library/

voice, data, and Internet traffic of the United States, a percentage that is expected to continue to increase. Without undersea cable infrastructure, the global Internet would not function. Customary international law and various international treaties grant to undersea cables unique rights and freedoms not granted to any other activities in the marine environment. Moreover, undersea cable operators have developed a set of private coordination and cooperation mechanisms permitting shared—and sometimes cooperative—use of important coastal and marine regions, to the mutual benefit of all parties.

Although the potential for conflict between undersea telecommunications cables and energy-related activities on the OCS—including those in the Mid- and South Atlantic Planning Areas—continues to grow, the DPEIS makes no mention whatsoever of undersea telecommunications cables, much less of the unique rights and protections due to such cables, the federal laws and agencies governing such cables, or any of the threats to undersea cables posed by energy-related activities in the OCS absent awareness and coordination. NASCA would like to work with BOEM to remedy these issues, starting with the filing of these comments. As the issues and concerns raised in these comments are not unique to the Mid- and South Atlantic Planning Areas, NASCA also seeks to have BOEM address them in future project-specific and programmatic environmental impact statements.

NASCA is a nonprofit association of the principal undersea cable owners, undersea cable maintenance authorities, and prime contractors for undersea cable systems operating in North America. NASCA members' cables land in fifteen (15) U.S. states and territories, with

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Publications/2012/BOEM-2012-005-vol2-pdf.aspx (vol. II, figures, tables, appendices, and key word index).

2 The terms "undersea cables" and "submarine 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."

thousands of kilometers of installed cable traversing the OCS of the United States (including both the Mid- and South Atlantic Planning Areas) and many more under construction or in the planning stage. NASCA seeks to protect the interests of the undersea cable industry by educating government decision makers and the public, coordinating with other marine activities, and ensuring efficient government regulation of cable installation and maintenance activities in accordance with applicable law and treaty obligations. For decades, NASCA's members have worked with federal, state, and local government agencies, as well as other concerned parties—such as commercial fishermen, offshore energy companies, and private environmental organizations—to ensure these ends.

These comments are divided into four parts. *First*, NASCA provides background on undersea cables, explaining their presence in marine areas, their critical economic and national-security importance, their unique legal-regulatory status, and existing mechanisms used by undersea cable operators, suppliers, and maintenance providers to coordinate with other marine activities, and the unique threats posed to undersea cable systems by energy-related programs. *Second*, NASCA details the potential threats posed to undersea cables by uncoordinated oil and gas, deep-sea mining, and alternative energy (wind, wave, and current) activities. *Third*, NASCA explains that BOEM's DPEIS analysis fails to comply with NEPA and demonstrates a continuing need for better coordination and consultation with other federal agencies involved in reviewing and authorizing undersea cable projects. *Fourth*, NASCA proposes specific revisions to BOEM's DPEIS that would address crucial undersea cable system issues relating to the Geological and Geophysical Activities ("G&G Activities") discussed in the DPEIS.

I. BACKGROUND ON UNDERSEA CABLES

A. Undersea Cables Are Critically Important to the U.S. Economy and U.S. National Security

Contrary to popular perception, most U.S. international voice, data, and Internet traffic travels by undersea cable—a percentage that continues to increase over time.[3] Undersea cables provide higher-quality, more reliable and secure, and less expensive communications than do communications satellites.[4] Undersea cables also provide the principal connectivity between the contiguous United States and Alaska, Hawaii, American Samoa, Guam, Puerto Rico, and the U.S. Virgin Islands, and also significant connectivity within Alaska, Hawaii, and the U.S. Virgin Islands.[5]

Undersea cables play a critical role both in ensuring that the United States can communicate with itself and the world, and in supporting the commercial and national security endeavors of the United States and its citizens. Undersea 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, as evidenced by international bandwidth build-out.[6] They also carry the

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[3] *See Submarine Cables and the Oceans – Connecting the World*, UNEP-WCMC Biodiversity Series No. 31 (UNEP-WCMC and ICPC, 2009) at 8, *available at* www.iscpc.org/publications/ICPC-UNEP_Report.pdf (noting that more than 95 percent of the world's telecommunications and Internet traffic is routed via submarine cable) ("UNEP-WCMC-ICPC Report") (attached as Appendix 1).

[4] *Id*. at 15-16.

[5] *Cf. id.* at 16; *see also* TeleGeography, Submarine Cable Map, http://www.submarinecablemap.com/ (last visited May 30, 2012).

[6] *See, e.g.*, Press Release, Google, Inc., Global Consortium to Construct New Cable System Linking US and Japan to Meet Increasing Bandwidth Demands, Feb. 26, 2008, *available at* http://www.google.com/intl/en/press/pressrel/20080225_newcablesystem.html,

vast majority of civilian and military U.S. Government traffic, as the U.S. Government does not generally own and operate its own undersea cable systems for communications purposes.[7]

Undersea cables—which typically have the diameter of a garden hose—are laid 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 merchant mariners, submersible engineers, and cable operations staff. These ships use a variety of remotely operated vehicles ("ROVs"), sea plows, lines, and grapnels for manipulating cable and repeaters beyond the ship, whether in the water column or on the seabed.

Cable maintenance providers contract with individual owners of undersea cable systems and with regional maintenance authorities for the provision of long-term maintenance services. They also occasionally contract with system owners for one-off maintenance operations. Cable and repeaters for repairs are typically manufactured on a system-specific basis and kept on hand for immediate use by the maintenance provider.

Although damage to undersea cables is rare, it most often is caused by human activities such as commercial fishing (in which nets and clam dredges ensnare cables), vessel anchors, dredging related to sand and mineral extraction, petroleum extraction, and pipeline construction.[8]

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[7] *See, e.g.*, John Cummings, *Contract Awarded for Kwajalein Cable System*, U.S. Army News, June 13, 2008, *available at* www.army.mil/-news/2008/06/13/9972-contract-awarded-for-kwajaleincable-system-kcs/ (describing Defense Information Systems Agency's contract for service on the privately-owned HANTRU1 system, which will connect Guam with the U.S. Army Kwajalein Atoll/Reagan Test Site in the Republic of the Marshall Islands); Naval Facilities Engineering Command, Capabilities, *available at* https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_che_pp/navfac_che_ocean/tab4000467.

[8] *See* UNEP-WCMC-ICPC Report at 43-48; International Cable Protection Committee, *Fishing and Cables: Working Together* (2d ed. 2009), *available at* www.iscpc.org/information/Openly%20Published%20Members%20Area%20Items/ICPC_Fishing_Booklet_Rev_2.pdf; International Cable Protection Committee, *Loss Prevention*

Undersea cables are also at risk from natural hazards such as hurricanes, underwater landslides, and seismic events such as earthquakes and tsunamis resulting therefrom.[9] Timely repairs are critical given the economic and national-security significance of traffic carried by these cables. Consequently, maintenance providers and cable ships must be prepared to respond rapidly, with continuously-qualified personnel, vessels on stand-by, and appropriate equipment. Recent damage to undersea cables in east Africa in 2012, in the Pacific following the Tohoku earthquake in 2011, and in east Asia, south Asia, and western Africa in July and August of 2009, only underscores the importance of such maintenance operations.[10]

B. Significant Undersea Cable Infrastructure Already Exists in the Mid- and South Atlantic Planning Regions, and More Is Planned

Although often viewed a region largely devoid of undersea cables, the Mid- and South Atlantic Planning Regions contain significant existing and planned undersea cable infrastructure. At present, two in-service undersea cable systems traverse the Mid- and South Atlantic Planning Areas:

Bulletin: Damage to Submarine Cables Caused by Anchors (Mar. 18, 2009), www.iscpc.org/publications/Loss_Prevention_Bulletin_Anchor_Damage.pdf; International Cable Protection Committee, *About Submarine Telecommunications Cables* (presentation), Oct. 2011, *available at* www.iscpc.org/publications/About_SubTel_Cables_2011.pdf ("About Submarine Telecommunications Cables") (attached as Appendix 2).

9 *See* About Submarine Telecommunications Cables at 37.

10 David Smith, *East Africa internet access slows to a crawl after anchor snags cable*, The Guardian (UK) (Feb. 28, 2012), *available at* 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.

- ***Globenet***: This system lands in Tuckerton, New Jersey; Boca Raton, Florida; St. David's, Bermuda; Fortaleza and Rio de Janeiro, Brazil; and Maiquetia, Venezuela.[11] Globenet Segment 1, between Tuckerton and Boca Raton (which was originally part of a system known as Atlantica-1), traverses both the Mid- and South Atlantic Planning Areas. The system is owned and operated by Globenet, Inc., a subsidiary of the Brazilian telecommunications company Oi S.A.

- ***Mid-Atlantic Crossing***: This system lands in Brookhaven, New York; Hollywood, Florida; and St. Croix, U.S. Virgin Islands.[12] The segment between Brookhaven and Hollywood traverses both the Mid- and South Atlantic Planning Areas. The segment between Brookhaven and St. Croix traverses the Mid-Atlantic Planning Area. The system is owned and operated by subsidiaries of Level 3 Communications, Inc.

These in-service systems are shown in the map attached as Appendix 3. Of course, there are also numerous out-of-service telecommunications and telegraph cables traversing both the Mid- and South Atlantic Planning Regions.

At least two new undersea cable systems are currently planned for the Mid- and South Atlantic Planning Areas:

- ***AMX1***: This system will land in Jacksonville, Florida; Miami, Florida; Puerto Rico; Brazil; the Dominican Republic; Guatemala; and Mexico.[13] The system will be owned

11 *Atlantica USA LLC*, Cable Landing License, 14 FCC Rcd. 20,787 (Int'l Bur. 1999); FCC File No. SCL-LIC-19990602-00010, http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SCLLIC1999060200010&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number.

12 *MAC Landing Corp.*, Cable Landing License, 14 FCC Rcd. 3981 (Int'l Bur. 1999); FCC File No. SCL-LIC-19981030-00023, http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SCLLIC1998103000023&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number.

13 Application for a License to Construct, Land and Operate an Undersea Cable System Linking the Continental United States, the Dominican Republic, Puerto Rico, Brazil, Colombia, Guatemala, and Mexico, the América Móvil Submarine Cable System, (filed Mar. 30, 2012) ("AMX1 Application"); FCC File No. SCL-LIC-20120330-00002 http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SCLLIC2012033000002&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number. For an AMX1 route map, *see* TeleGeography,

and operated by subsidiaries of América Móvil S.A.B. de C.V. This system is already under construction, with completion expected in August 2013.[14]

- ***WASACE***: This recently announced system is planned to land in Virginia Beach, Virginia; Miami, Florida; Cartagena, Colombia; Colón, Panama, Fortaleza, Rio de Janeiro, and Sao Paolo, Brazil; Cape Town, South Africa; Luanda, Angola; Lagos and Bonny Island, Nigeria; and San Sebastian, Spain.[15] It is currently scheduled to enter into commercial service in the second quarter of 2014.

NASCA expects to see additional cables traversing the Mid- and South Atlantic Planning Regions in the near future.

The planned commercial lifespan of these and other undersea cable systems is 25 years.[16] Nevertheless, the commercial lifespan of undersea cable systems can extend well beyond 25 years, particular where the systems have been ungraded or redeployed. Consistent with these characteristics, the Federal Communications Commission ("FCC") grants cable landing licenses for a term of 25 years from commencement of commercial service, subject to renewal.[17]

C. Undersea 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

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Submarine Cable Map, www.submarinecablemap.com (click on link for América Móvil system).

14 AMX1 Application at 2.

15 WASACE Cable Company, www.wasace.com. For a route map of WASACE, *see* www.wasace.com/network-map.

16 UNEP-WCMC-ICPC Report at 33.

17 47 C.F.R. § 1.767(g)(14) (providing that "[t]he cable landing license shall expire twenty-five (25) years from the in-service date, unless renewed or extended upon proper application."). For additional detail regarding the FCC's role as one of the principal regulators of undersea cables landing in the United States and its territories, *see* part I.D below.

marine transport, and sometimes these rights and freedoms take 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.[18] 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;[19]
- The freedom to install and maintain submarine cables on the continental shelf,[20] subject to reasonable measures for the exploration of the continental shelf and the exploitation of its natural resources;[21]

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18 *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) ("LOS Convention").

19 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."), 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."); LOS Convention 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 in the exclusive economic zone of all states;[22]
- The ability to install submarine cables in a state's territory or territorial sea subject to conditions and exercise of national jurisdiction;[23] and
- The freedom to maintain existing submarine cables passing through the waters of an archipelagic state without making landfall.[24]

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[20] LOS Convention 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* LOS Convention, 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.").

[21] 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."); LOS Convention, 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.").

[22] LOS Convention 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.").

[23] *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").

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

These treaty obligations are now treated as customary international law,[25] in particular by the United States.[26]

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.[27] 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.[28] 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

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25 *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).

26 The United States recognized these freedoms starting in 1983, even though the United States has never ratified the LOS Convention (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 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).

27 LOS Convention, arts. 56, 60(1), 80.

28 *Id.*, art. 79(2); Continental Shelf Convention, art. 4.

> its resources or the operations of artificial islands, installations and structures under its jurisdiction.[29]

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.

Coastal states also have obligations to prevent willful or negligent damage to cables.[30] And all states "shall have due regard to cables or pipelines already in position."[31] 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.

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29 *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.

30 *See* LOS Convention, 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.").

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

D. The U.S. Government Regulates Undersea Cables Pursuant to Largely Unique National Regulatory Regimes

1. Licensing and Permitting

The United States regulates the installation and operation of undersea cables under laws and regulatory regimes that are largely specific to undersea cables. The principal regulatory regimes include the following:

- ***Federal Communications Commission***: An undersea cable operator must be granted a cable landing license for the installation and operation of any undersea cable in U.S. territory pursuant to the Cable Landing License Act of 1921.[32] Before granting any cable landing license, the FCC must seek the views of the U.S. Department of State (acting through its Office of International Communications and Information Policy), the U.S. Department of Commerce's National Telecommunications and Information Administration, and the Defense Information Systems Agency.[33]

- ***Team Telecom***: For undersea cables connecting the United States with foreign points or with significant foreign ownership, the U.S. Departments of Defense, Homeland Security, and Justice and the Federal Bureau of Investigation (collectively known as "Team Telecom" in this context) review and often request the FCC to impose security-related conditions in the cable landing license in order to assure both infrastructure security and information security. Team Telecom does not act pursuant to any particular law but instead appears to rely on the President's plenary foreign affairs power, role as Commander in Chief, and sole organ of the United States in foreign relations.[34]

- ***U.S. Army Corps of Engineers*** ("ACOE"): The ACOE must authorize the installation of any undersea cable in U.S. waters pursuant to the Rivers and Harbors Act of 1899, as well as the installation of any undersea cable in an estuary pursuant to the Clean Water Act. These cables are sometimes authorized under the ACOE's Nationwide Permit Program. In other cases, they involve the issuance of individual permits following the submission and review of draft environmental impact statements.

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[32] 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; 47 C.F.R. § 1.767.

[33] 47 C.F.R. § 1.767(j).

[34] *See, e.g., United States v. Curtiss-Wright Exp. Corp.*, 299 U.S. 304, 319 (1936); U.S. Constitution art. II.

NASCA notes that the FCC and Team Telecom are not identified as stakeholders or cooperating agencies in the DPEIS.[35]

2. Federal Offenses for Cable Damage

U.S. law provides that damaging an undersea cable—whether deliberately or through negligence—is a federal offense punishable by fine, imprisonment, or both.[36] Federal law imposes obligations on fishing vessels to keep their nets from interfering with or damaging undersea cables, and requires fishing vessels to maintain a minimum distance from any vessel engaged in laying undersea cable or any buoy placed to mark the position of an undersea cable. Violators are subject to imprisonment and financial penalties.[37] In addition, undersea cable owners have a right under U.S. law to sue for damages to their cables.[38] As presently drafted, the DPEIS makes no mention of the threat of cable damage posed by energy-related activities on the OCS, much less the legal consequences of such damage.

As described in part II.A below, it is the undersea cable operators themselves who have developed industry standards and private contractual arrangements for managing marine spatial conflicts and minimizing cable damage. These tools include cable-crossing agreements and minimum separation distances between cables.[39] Such self-help remedies, however, are unlikely

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35 DPEIS at §§ 5.3, 5.4.

36 47 U.S.C. §§ 21 (willful damage), 22 (negligent damage).

37 *See* 47 U.S.C. § 25.

38 47 U.S.C. § 28.

39 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).

to be sufficient in the face of government-led energy development in the OCS, if left uncoordinated with undersea cable activities.

II. ENERGY-RELATED ACTIVITIES ON THE OCS, IF LEFT UNCOORDINATED, POSE A NUMBER OF CRITICAL THREATS TO UNDERSEA CABLES

Undersea cable operators need ready and unfettered access to their cables for repair and maintenance needs and to minimize outage time in the event of a cable fault. To achieve this and to minimize conflicts with other marine activities, undersea cable operators use a variety of coordination and cooperation mechanisms. These include extensive coastal and marine spatial planning, cable spacing and crossing standards, and coordination with other users of coastal and marine territories.

A. Undersea Cable Standards and Requirements Regarding Cable Recovery for Repair, Replacement, or Removal

To recover a cable from the sea floor for repair purposes, a ship can either deploy an ROV, or it can grapple for the cable. ROV use is limited to shallower depths between 50 and 2000 meters. ROV use is also limited to cable laid on the surface of the sea floor. 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 detrenching 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 undersea cables or sea floor installations in the vicinity of the target cable.

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 (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. It is critical that the cable lay flat. If the cable has loops or is elevated above the seafloor, it is virtually impossible to bury the repaired section. Loops are undesirable for a variety of reasons: they 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. Elevation of the cable above the seafloor is undesirable, as it exposes the cable to greater risk of damage by external events. Either exposes even more of the cable to the risk that caused the damage or fault in the first place.

The submarine cable industry has developed cable spacing standards to ensure that installation and maintenance operations do not jeopardize other submarine cables.[40] These spacing requirements are consistent with international treaties granting to submarine cable operators without limitation various rights and freedoms to lay submarine cables.[41] In coastal areas, these include the freedom to lay submarine cables on continental shelves notwithstanding claims of 200-nautical-mile EEZ and to repair existing cables without prejudice.[42] As discussed above, cables can be placed only so close to each other until they endanger other cables during installation and maintenance, or until they impede access for installation and maintenance—particularly if there are multiple installation and maintenance companies operating in the same vicinity above or below the ocean surface. The submarine cable industry therefore developed the following minimum cable separation distances. In shallow water when cables are plow buried, a cable separation of is 500 meters recommended. In deeper water, undersea cable operators follow a guideline according to which two parallel cables are to be separated by a distance equal to the lesser of three (3) times the depth of water or nine (9) kilometers, though actual placement may vary on a case-by-case basis.[43] Similarly, if both operators of parallel cables agree, cables in deeper water may be separated by a distance equal to the lesser of two (2) times the depth of

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[40] Each installation and maintenance company also has more specific methods for handling cable per each cable manufacturer's recommendations.

[41] On the high seas, these include the freedom to lay submarine cables on the bed of high seas. *See* 1884 Convention; High Seas Convention, arts. 2, 26.1; LOS Convention, art. 112. Although the LOS Convention has not yet been ratified by the Senate, the United States has taken the position that the LOS Convention reflects customary international law to which the United States adheres. *See* Pres. Proc. No. 5030. The standards also permit operators to repair existing cables without prejudice. *See* High Seas Convention, art. 26.3.

[42] *See* LOS Convention, arts. 79.2, 79.5.

[43] *See* ICPC Recommendation No. 2, at 10.

water, or (6) six kilometers.[44] For example, a cable in 100 meters of water should be placed no closer than 300 meters to any other cable for any significant parallel length.

Submarine cable operators also use these standards and guidelines as a minimum separation distance from other obstacles, such as seamounts, canyons, wrecks, and fish havens. Where the obstacles are manmade and actively used—such as the anchorages and dredging and dumping areas of third parties—submarine cable operators actively seek even greater separation distances.

Cable owners and suppliers have also established collaborative mechanisms with commercial fisherman, including mechanisms for compensating fishermen for sacrificing gear snagged on cables (rather than have fisherman try to free such gear, with potential damage to the cable).[45]

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[44] *Id.* While the submarine cable operators may agree to place the cables as little as 200 meters apart—either because the length of the parallel is short or the probability of damage and repair is low—most operators take a more conservative approach to cable separation distances. The "three-times-the-depth-of-water" standard allows the repair ship to lay the repaired cable back flat on the seabed without laying it over the adjacent cable.

[45] *See, e.g.*, Oregon Fishermen's Cable Committee, http://www.ofcc.com.

B. Potential Impacts of Oil and Gas Exploration Activities on Undersea Cables

1. Pipeline Crossings

Submarine cable installers and operators prefer not to run cables in parallel tracks for long distances but rather to have the cables cross so that the cables are in close proximity only where they cross. This minimizes complexity for repair operations, among other benefits. Cable operators therefore consult with each other when planning a cable crossing, and it is standard to seek permission for a crossing.[46] They do this to minimize the risk of damage to other cables during installation and maintenance operations, and also to ensure route diversity across a number of cables. This route diversity preserves connectivity between domestic or international points—for a single cable system, or across systems in a region.

As with crossings between cables, cable owners enter into crossing agreements with pipeline owners to minimize conflict and maximize access for maintenance purposes.[47] This protects both the cable operator and the pipeline owner from potential damage to their respective systems from the routine operations and maintenance of the other. Offshore oil and gas activities frequently run both power cables and pipelines from their installations back to shore. Cable owners coordinate with pipeline owners to ensure safe crossing of both types of installation. Each additional power cable or pipeline crossing adds risk, complexity, and cost to the undersea cable operators' installation, operations, and maintenance activities—which ultimately are

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[46] *See* ICPC Recommendation No. 2, at 4. Although permission is generally granted, there have been instances where the crossing company assumes liability for damage of the crossed cable if the crossing is planned in a congested area or in proximity to a repeater or other underwater body.

[47] *See*, *e.g.*, International Cable Protection Committee Recommendation No. 3, available from the International Cable Protection Committee at www.iscpc.org.

reflected in the costs of communications services or in capacity constraints due to difficulties laying new systems.

2. Impeded Access—at Both the Ocean Surface and Seafloor—for Installation and Maintenance

Large offshore developments impede access to undersea telecommunications cable systems both at the surface (for cable vessels) and on the seafloor (for cables). Cable vessels are large vessels, and require space in which to maneuver when installing or repairing undersea cables, and to accommodate the effect of bad weather on the ocean. Offshore developments involving large structures, like oil platforms, present obstacles precluding cable ships from having ready access to the sea floor and to previously-installed cables.

Offshore developments that cover large areas of sea floor have the effect of forcing new undersea telecommunications 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.

C. Potential Impacts of Renewable Energy Activities (Wind, Wave, and Current) to Undersea Cables

1. Bottom Scouring Caused by Wind Turbine Towers

Placement of offshore wind turbine towers near undersea cables increases the likelihood of cable fault due to the risk of seafloor scouring. Seafloor scouring is the effect of currents eroding sediment in the areas around a structure on the sea floor. Scouring can lead undersea cables, which are typically laid either directly on or trenched into the seafloor, to be exposed to current and potential threats. As noted in part II.A above, when undersea cables throw loops or are suspended above the seafloor, 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 seafloor, which increases the likelihood of scouring.[48] Thus, seafloor scouring around wind turbine tower piles and support structures, particularly in large wind farm arrays, may lead nearby undersea cables to be exposed. Scouring could also lead undersea cable operators to require that cables be buried more deeply, making installation and subsequent retrieval for repairs more difficult, time-consuming, and costly. And undersea cables can be made more vulnerable because of modifications in seafloor topography—disturbed sediments may redeposit above a cable, but in a looser state, increasing the risk of erosion and abrasion.[49]

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48 *See* RAVE-Projekt zur Geologie, Untersuchungskonzept - Erste Ergebnisse, Oct. 10, 2010, www.bsh.de/de/Meeresnutzung/Wirtschaft/Windparks/StUKplus/Praesentationen10Mai2010/Praes_Lambers-Huesmann.pdf (in German); *see also* 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), www.boemre.gov/offshore/RenewableEnergy/PDFs/AtlanticWorkshop2011/4_McNeilan_Fugro_SeabedScourConsiderations.pdf.

49 *See id.*

2. Impeded Access—at Both Ocean Surface and Seafloor—for Installation and Maintenance

As noted above, large offshore developments force new undersea telecommunications cable projects into "gaps" on the sea floor between developments. Because offshore developments frequently are sited relatively close to shore, the result is to create *de facto* cable "corridors," because undersea telecommunications cable operators are unlikely to choose to route through a wind farm array, given the costs and risks associated with such locations. As a result, telecommunications cables in shallow water will be concentrated in relatively narrow "corridors" that dramatically limit infrastructure route diversity and increase risks of system outages from damage to multiple cables at once.

Concentrating cables in corridors also increases the risk that damage to undersea cables from anchors or fishing nets will have catastrophic effects on national critical communications infrastructure. Cable concentration also poses a national security risk, because malicious damage to undersea telecommunications cable systems will be much easier to effect and more devastating if such corridors of concentrated cable deployment develop. There are only limited points along the United States coastline suitable for cable landing, creating security and damage risks; additional concentration because of offshore G&G activities poses a serious danger to system redundancy and critical infrastructure protections.

3. Power Cable Crossings

Offshore energy systems, including wind farms and other alternative energy sources, run power transmission cables back to shore. 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. Therefore, when a cable crossing situation arises, it now poses a risk of "sterilizing" a much larger section of crossed telecommunications cable than a standard telecom-to-telecom crossing. For an undersea telecommunications cable owner planning to install a new undersea telecommunications cable that will cross an energy export cable, installation costs (for negotiating multiple cable crossing agreements) and risks both to the cable and to its commercial agreements in the event of delay have dramatically increased.

4. Other Potential Impacts

Renewable energy projects often require very large areas, effectively precluding a cable operator from using such areas for undersea cable routes. Undersea telecommunications cable systems, in contrast, pose far smaller sterilized "footprints" than a typical renewable energy project. This effective preclusion reduces undersea cable operators' ability to coordinate with or avoid other offshore activities (often the easiest and cheapest solution). As a result, the probability of a cable route having to pass through heavily fished areas, anchorages, dumping grounds, dredged areas, and similar regions increases, as does the accompanying likelihood of cable damage or fault. National coastal and marine spatial planning may help mitigate this effect, but only if it is fully informed about the needs of and impacts on all stakeholders, including undersea telecommunications cable operators.

5. The Experience of the United Kingdom

The efforts by the United Kingdom to promote and increase renewable energy provide instructive examples of the issues relating to undersea cable and alternative energy sites. The Crown Estate granted licenses to alternative energy (wind and wave) providers in 2009, and only subsequently began working with undersea cable owners to manage heightened risks of cable damage arising from increased use of the seafloor and the potential impact of seafloor installations such as wind turbines. A U.K. industry consortium of submarine cable owners, known as Subsea Cables UK is currently working with the Crown Estate (which manages most of the seabed within the U.K. territorial sea and regulates offshore wind projects within the U.K. EEZ) to devise guidelines setting forth the minimum separation needed between alternative energy facilities and undersea cables, and guidelines protecting a cable ship laying and maintaining cable, including access to cable on the seafloor.[50] These guidelines are expected to be released later in 2012.

D. Potential Impacts of Marine Minerals Activities on Undersea Cables

1. Direct Physical Disturbance

Marine mineral extraction activities also pose certain risks to undersea telecommunications cables. The objective of deep-sea mining is to harvest polymetallic nodules, cobalt-rich manganese crusts, and seafloor massive sulfides.[51] 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.[52]

Likewise, minerals mining operations present a threat of erosion and abrasion similar to that presented by wind farm operations; destabilization of the seafloor; and redeposited sediments. All of these may result in exposing or suspending cables above the seafloor, thereby

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[50] *See* Subsea Cables UK, www.ukcpc.org.uk.

[51] *See Lessons Learned from Deep-Sea Mining*, SCIENCE, July 28, 2000, at 551.

[52] *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.

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. Risks of cable fault increase, while the presence of marine mining activities limits cable vessel access for maintenance and repair, increasing the complexity of such activities, and driving up the time and costs involved.

2. Impeded Access—at Both Ocean Surface and Seafloor—for Installation and Maintenance

As noted above, large offshore developments impede access to undersea telecommunications cable systems both at the surface (for cable vessels) and on the seafloor. Further, because marine mining projects occur where minerals are deposited and cannot be relocated for coordination purposes, new undersea telecommunications cable projects may be forced to route around such operations into what "gaps" may exist between developments. Such gaps may not permit the most efficient (*e.g.*, straight line) cable placement. This not only limits access for cable installation and repair but also adds enormous complexity to what is already a very complex task.

III. AS DRAFTED, THE DPEIS DOES NOT COMPLY WITH NEPA OR CONGRESS'S DIRECTIVE

A. Congress Did Not Limit Its Directive to Energy Matters

The DPEIS "covers the potential significant environmental effects of…three program areas managed by the Bureau of Ocean Energy Management (BOEM): oil and gas exploration and production; renewable energy; and marine minerals."[53] This scope, however, is not sufficient to meet the congressional directive under which the DPEIS was initiated; nor does it comply with the NEPA. As described above, undersea cable and related telecommunications

[53] DPEIS, Vol. I, abstract.

activities also occur in the Atlantic OCS. BOEM's narrow focus on energy and mining activities alone renders the PEIS incomplete and inadequate.

The Conference Report for the Department of the Interior, Environment and Related Agencies Act, 2010, did not limit the scope of its directives to those agencies to only energy matters. Indeed, in directing BOEM (then known as the Minerals Management Service) to conduct a PEIS, the conference specifically indicated that the PEIS should review *all* ocean floor activities that could affect potential development in the Atlantic OCS.[54] Moreover, the conference report acknowledges the "information gaps relating to resource potential in the OCS."[55] Those information gaps include undersea cable activities, which have consistently been ignored by agencies, including BOEM, in reviews under NEPA.

Federal agencies and private entities operating on the OCS need a better understanding of the activities of undersea telecommunications cable operators on the OCS, in order to minimize conflict among parties operating on the OCS. In particular, BOEM must account for the nature of cable installation and repair operations above and below the ocean surface, and the consequent industry standards that have been developed over many decades to facilitate those operations, as it proceeds with revisions to the DPEIS. These standards exist to 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. They also

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54 Dep't of the Interior, Environment, and Related Agencies Appropriations Act, H.R.2996 No. 111-316, at 98 (2010) (Conf. Rep.) ("[T]he conferees direct the Minerals Management Service, pursuant to the National Environmental Policy Act, to conduct a Programmatic Environmental Impact Statement (PEIS) to evaluate potential significant environmental effects of multiple geological and geophysical activities in the Atlantic OCS and provide a detailed timeline for completion of the PEIS no later than 90 days after enactment of this Act. The conferees believe this request is consistent with the Department's stated desire to fill in information gaps relating to resource potential in the OCS.")

55 *Id.*

ensure that installation and maintenance operations do not jeopardize other submarine cables as well as ensure consistency with international treaties granting to submarine cable operators without limitation various rights and freedoms to lay submarine cables.

B. Coordination with the FCC Is Required Under NEPA

Under NEPA, federal agencies—including BOEM—must establish procedures to identify and account for the environmental impact of projects they undertake or authorize.[56] To that end, NEPA established the Council on Environmental Quality ("CEQ"), tasking it to oversee the programs and activities of the federal government in order to determine whether those programs and activities are contributing to the achievement of U.S. environmental policy.[57] CEQ's regulations "tell federal agencies what they must do to comply with the procedures and achieve the goals of [NEPA]."[58]

The CEQ has provided an approach to NEPA implementation and compliance which applies to all federal agencies, including BOEM. Applicable here, the CEQ rules provide that for "major Federal actions significantly affecting the quality of the human environment," NEPA requires agencies to prepare an environmental impact statement ("EIS"), as BOEM is now doing.[59]

In preparing an EIS, however, NEPA also requires the lead agency to "consult with and obtain the comments of any Federal agency which has *jurisdiction by law or special expertise with respect to any environmental impact involved*."[60] In the context of activities occurring on

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[56] 42 U.S.C. §§ 4321-4370e.

[57] 42 U.S.C. § 4344(3).

[58] 40 C.F.R. § 1500.1.

[59] 42 U.S.C. § 4332.

[60] *Id.* (emphasis added).

the Atlantic OCS, those agencies would include not only BOEM and the ACOE, but also the FCC, Team Telecom, the Department of State (particularly the Office of Ocean and Polar Affairs and the Office of the Legal Adviser, with respect to maritime jurisdiction and other law of the sea issues), and any other agencies that regulate undersea cable permitting, placement, maintenance, and repair. Such coordination and consultation is of critical importance for submarine cable projects, which, as noted above, require numerous authorizations and approvals from a variety of federal agencies.

To date, however, there has been little or no coordination between BOEM (with statutory responsibility for regulating energy-related activities on the OCS), the FCC (with legal responsibility for regulating undersea cables landing in the United States) and Team Telecom (which regulates national-security and law-enforcement aspects of undersea cables).[61] To ensure better coordination with other agencies, BOEM must make better use of the "lead agency" and "coordinating agency" provisions of NEPA. BOEM must also cooperate with state and local agencies "to the fullest extent possible to reduce duplication between NEPA and State and local requirements, unless . . . specifically barred from doing so by some other law" including "[j]oint planning processes" and "[j]oint environmental assessments."[62]

NASCA also urges BOEM to articulate measures to achieve better coordination with other federal and state agencies outside of this DPEIS. BOEM should make better use of the interagency coordination procedures established by NEPA, including the provisions for "lead agencies" and "coordinating agencies" and for elimination of duplicative documentation. BOEM should establish additional formal coordination procedures with other coordinating agencies—

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[61] BOEM appears to have engaged in some coordination with ACOE. DPEIS, vol. 1, at viii, §§ 1-6, 5-5.

[62] 40 C.F.R. § 1506.2(b).

such as the FCC and the Team Telecom agencies. The adoption of such measures will ensure a PEIS that satisfies the requirements of NEPA and the Congressional Directive, and that provides BOEM with valuable and relevant information from all affected agencies and stakeholders, permitting it to conduct a more informed analysis.

BOEM must also ensure that U.S. treaty obligations and customary international-law protections for undersea cable are not compromised. Many of the G&G activities contemplated in the DPEIS could have the effect of prohibiting or impeding the installation or maintenance of undersea cable, in violation of those obligations and protections. Such activities may also result in damage to undersea cable, creating liabilities under federal law. Coordination with the agencies responsible for overseeing undersea cable projects will ensure that G&G activities in the Atlantic OCS do not inadvertently run afoul of these U.S. legal obligations.

IV. BOEM SHOULD REVISE AND SUPPLEMENT THE DPEIS TO COMPLY WITH THE LAW AND THE CONGRESSIONAL DIRECTIVE AND TO ACHIEVE MORE EFFECTIVE COORDINATION OF MARINE ACTIVITIES

NASCA urges BOEM to revise the draft PEIS as set forth below to account for undersea cables and other telecommunications activity on the seafloor both to comply with the law and to achieve effective coordination of marine activities. Consequently, it is critical that the DPEIS recognize that different marine activities have different legal rights and freedoms.

A. Undersea Cable Activity Is "Reasonably Foreseeable" for the Purpose of the DPEIS

BOEM should revise Alternatives A and B to include undersea cable activity as "reasonably foreseeable activity" in the Atlantic OCS, using the detail provided in parts I and II above. The D.C. Circuit has found that NEPA requires that a determination of reasonably foreseeable activities must be "fully informed" and "well-considered."[63] In the DPEIS, however, there is no evidence of BOEM being "fully informed" or that its conclusions are "well-considered" vis-à-vis undersea cables. In fact, nowhere does the DPEIS acknowledge the presence of existing undersea cables or the prospect of future undersea cable projects, or the effects that the proposed G&G activities will have on those cables.

Undersea cables are clearly a "reasonably foreseeable activity" in the Mid- and South Atlantic Planning Areas. *First*, BOEM's own planning tool—the Multipurpose Marine Cadastre ("MMC")—includes data about existing undersea cables traversing these planning areas.[64] As NASCA has indicated in separate discussions with BOEM, the data in the MMC is both insufficient and out of date. (It does not identify specific systems or provide third parties with any means of contacting a system owner for consultative purposes.) NASCA has provided additional data for inclusion in the MMC, but that data does not yet appear in the MMC. *Second*, it is widely known, given the FCC's public licensing database showing cable landing license applications, media coverage, and the availability of information in response to a simple Google query, that additional systems are planned for the Mid- and South Atlantic Planning Areas.[65]

The potential impact of the G&G activities contemplated in the DPEIS on undersea cable is not "highly speculative." To the contrary, as noted in part II.A above, undersea cable

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[63] *Nevada v. Dep't of Energy*, 457 F.3d 78, 93 (D.C. Cir. 2006). Though agencies are not required to consider "highly speculative harms" in an EIS, they must adequately identify and evaluate the adverse environmental effects of proposed action. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 356 (1989).

[64] *See* Multipurpose Marine Cadastre, www.marinecadastre.gov (showing cable location information within the "Navigation and Marine Infrastructure" layer). The cable data—which was supplied by the National Oceanic and Atmospheric Administration—was last updated in March 2011.

[65] *See, e.g.*, FCC, MyIBFS (database); TeleGeography Interactive Submarine Cable Map, www.submarinecablemap.com.

projects—whether maintenance and repair of existing cable or laying of proposed cable—requires high levels of coordination, coordination that undersea cable operators undertake today and that is entirely foreseeable in the Atlantic OCS. For instance, high-voltage energy transport cables for wind farms in the Atlantic OCS will require coordination with undersea telecommunications cables to ensure proper spacing and minimize interference with cable laying routes and maintenance work. BOEM's failure to acknowledge this kind of necessary coordination in the DPEIS will create greater burdens on both the undersea telecommunications industry and energy industry. Without recognition of the need for coordination, conflicts will be dealt with on an *ad hoc* basis rather than programmatically—in direct contrast to the Congressional mandate under which the DPEIS is being developed.

B. BOEM Must Include in the DPEIS "Moderate" and "Major" Impacts to Undersea Cables

BOEM should add a conclusion with respect to vessel traffic, grab-and-core sampling, buoy founding and anchoring, and well drilling, and any other activities under Alternatives A and B that may have an impact on undersea cables that would be "moderate" or "major" absent further modifications. In determining those activities that would have a "moderate" or major" impact on undersea cables, BOEM must consider several factors set forth by the EPA, including whether those activities will affect public safety or may threaten a violation of Federal law.[66] BOEM cannot rely on conclusory determinations of intensity.[67] Because of the nature of undersea cable activities—including placement on the seafloor and spacing requirements for placement, repair, and maintenance, many of the G&G activities contemplated in the DPEIS that

[66] 40 C.F.R. § 1508.27(b) (describing the factors to be considered in evaluating intensity of impact).

[67] *See Bluewater Network v. Salazar*, 721 F. Supp. 2d 7, 44 (D.D.C. 2010) (noting that it would be arbitrary and capricious for an agency to rely on conclusory determinations of intensity).

are expected to have a negligible impact on other activities may have more dire consequences for undersea cable. As discussed in part II.A above, the undersea telecommunications industry has long worked with other industries, including commercial fishing, to develop ways of minimizing damage to undersea cables caused by other marine activities. The DPEIS should include a conclusion that incorporates the undersea telecommunications industry's long experience with such coordination into the proposed G&G activities.

C. The DPEIS Should Describe the Legal-Regulatory Regime Governing Undersea Cables Landing in the United States

BOEM should describe the other laws, regulations, treaties, and agencies relating to undersea cables, given the potential for conflict with uncoordinated undersea-cable and energy-related activities. The legal and regulatory regime governing undersea cables, described above in parts I.C and I.D, may restrict energy-related activities contemplated under the DPEIS due to the rights and freedoms granted the installation and maintenance of submarine cables by various international treaties dating back to 1884. Many of those rights and freedoms are not available to other marine activities, commercial fishing, or marine transport. As such, the DPEIS must describe the legal and regulatory landscape and explore the potential impact, including limitations, it might have on the G&G activities described therein.

D. BOEM Should Designate Additional "Cooperating Agencies"

BOEM should add the FCC (and possibly other agencies) as "cooperating agencies" under NEPA, and describe the unique legal-regulatory regime applicable to undersea cable that requires coordination with those agencies. NEPA has established provisions for "lead agencies" and "coordinating agencies" for precisely this sort of situation. Naming the FCC and other agencies as "cooperating agencies" will ensure that BOEM has valuable and relevant information from all affected agencies and stakeholders, permitting it to conduct a more informed analysis. It will also ensure that those agencies with jurisdiction over and expertise regarding undersea cable can help BOEM safeguard against violations of U.S. treaty obligations, customary international law as observed by the United States, and federal law, as well as ensure that BOEM understands how the legal-regulatory regime governing undersea cable could constrain energy-related facilities as a legal matter.

CONCLUSION

For the reasons stated above, NASCA urges BOEM to revise its DPEIS to account for the impact of G&G activities on undersea telecommunications cable systems in the Mid- and South Atlantic Planning Areas of the OCS, and to consult with all the agencies responsible for overseeing and regulating those systems.

Respectfully submitted,

Kent D. Bressie
Madeleine V. Findley
Kristine Laudadio Devine
WILTSHIRE & GRANNIS LLP
1200 18th Street, N.W., Suite 1200
Washington, D.C. 20036-2516
+1 202 730 1337 tel

Counsel for the
North American Submarine Cable Association

30 May 2012

APPENDICES

1. *Submarine Cables and the Oceans – Connecting the World*, UNEP-WCMC Biodiversity Series No. 31 (UNEP-WCMC and ICPC, 2009)

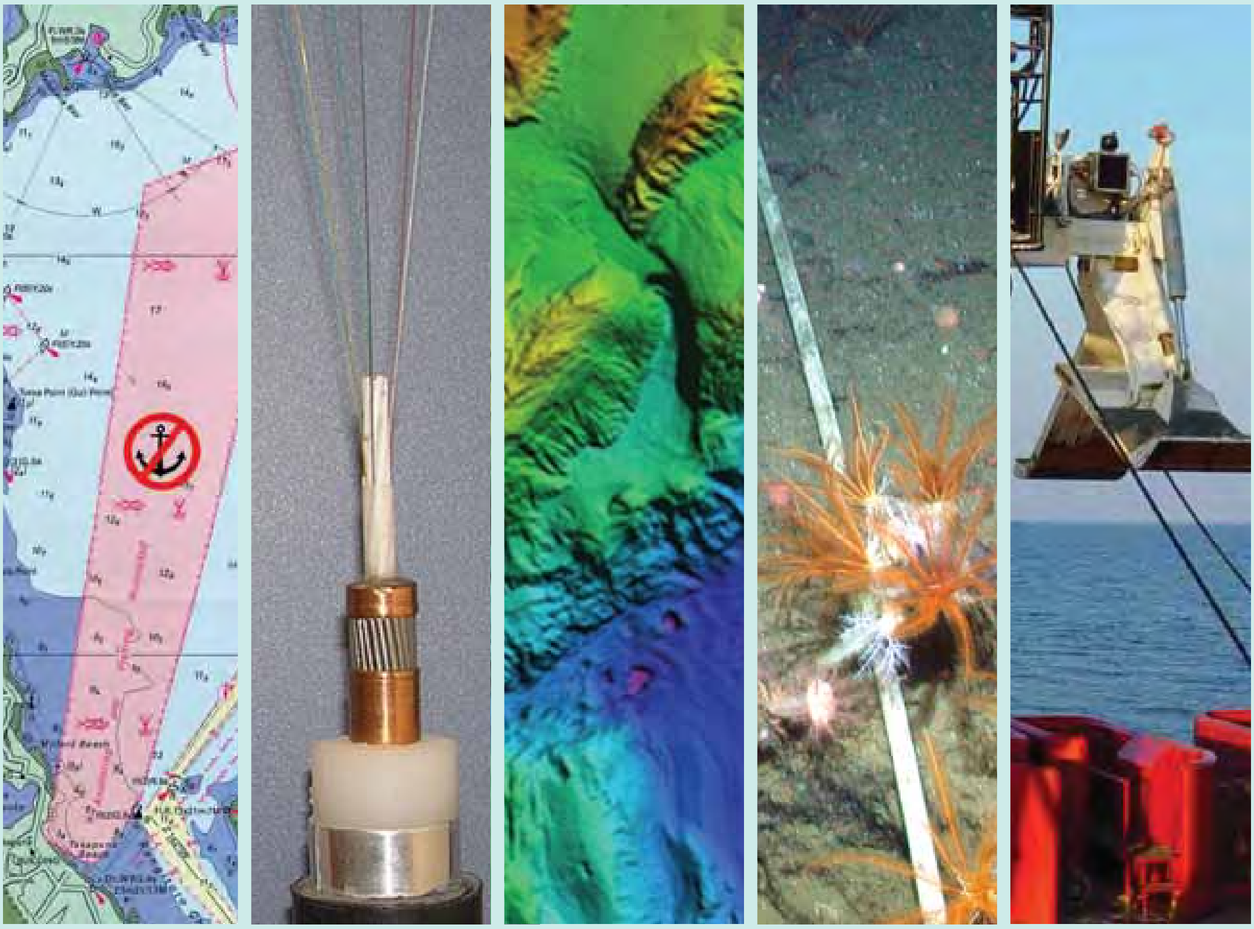
2. International Cable Protection Committee, About Submarine Telecommunications Cables (Oct. 2011)

3. Map Showing Existing Submarine Telecommunications Cables within the Mid and South-Atlantic Planning Areas of the OCS

APPENDIX 1

SUBMARINE CABLES AND THE OCEANS – CONNECTING THE WORLD, UNEP-WCMC BIODIVERSITY SERIES NO. 31 (UNEP-WCMC AND ICPC, 2009)

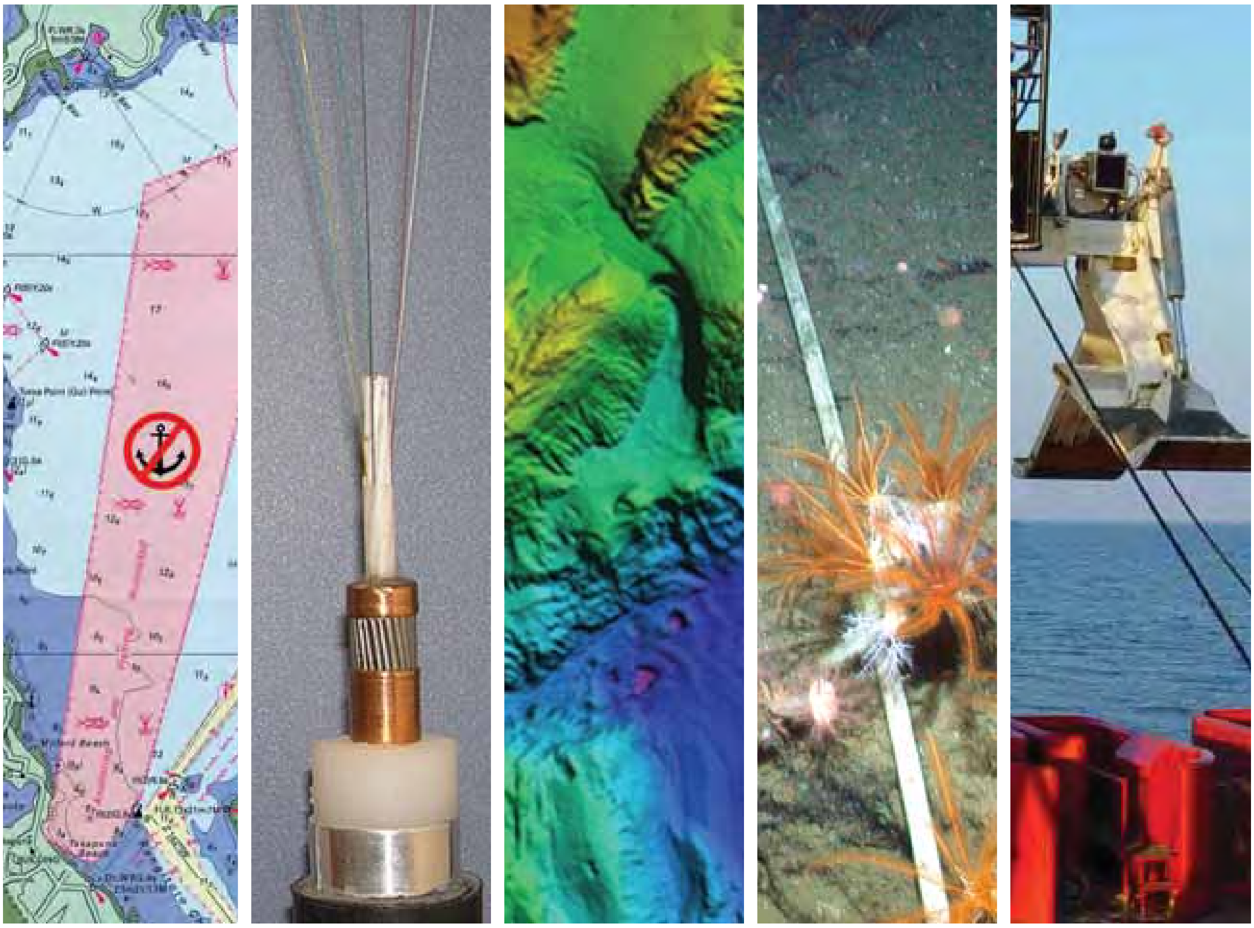
Submarine cables and the **oceans:** **connecting** the **world**



UNEP WCMC

International Cable Protection Committee

Submarine cables and the **oceans: connecting** the **world**



UNEP WCMC

International Cable Protection Committee

UNEP World Conservation Monitoring Centre
219 Huntingdon Road
Cambridge, CB3 0DL
United Kingdom
Tel: +44 (0) 1223 277314
Fax: +44 (0) 1223 277136
Email: info@unep-wcmc.org
Website: www.unep-wcmc.org

International Cable Protection Committee Ltd (ICPC)
PO Box 150
Lymington, SO41 6WA
United Kingdom
Tel: +44 (0) 1590 681673
Fax: +44 (0) 870 432 7761
Email: secretary@iscpc.org
Website: www.iscpc.org

The United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) is the biodiversity assessment and biodiversity policy support arm of the United Nations Environment Programme (UNEP), the world's foremost intergovernmental environmental organization. The Centre has been in operation for over 25 years, combining scientific research with practical policy advice.

The International Cable Protection Committee Ltd (ICPC) is a non-profit organization that facilitates the exchange of technical, legal and environmental information concerning submarine cable installation, maintenance and protection. It has over 100 members representing telecommunication and power companies, government agencies and scientific organizations from more than 50 countries, and encourages cooperation with other users of the seabed.

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AUTHORS

Lionel Carter (Introduction and Chapters 3, 5, 6, 8), Victoria University, Wellington, New Zealand. lionel.carter@vuw.ac.nz
Douglas Burnett (Chapter 4), Squire, Sanders & Dempsey L.L.P, New York, USA. dburnett@ssd.com
Stephen Drew (Chapter 7), Tyco Telecommunications, New Jersey, USA. scdrew@tycotelecom.com
Graham Marle (Introduction), Qualtrack Ltd, Lymington, UK. graham.marle@qualtrack.com
Lonnie Hagadorn (Chapters 2, 3), formerly Flag Telecom, USA. lhagadorn@earthlink.net
Deborah Bartlett-McNeil (Chapter 1), formerly Global Marine Systems Limited, Chelmsford, Essex, UK. debsmcneil@yahoo.co.uk
Nigel Irvine (Chapter 5), Verizon, Reading, UK. nigel.irvine@uk.verizonbusiness.com

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For all correspondence relating to this report please contact:
info@unep-wcmc.org or secretary@iscpc.org

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Foreword

There are many things and services in our everyday life that we take for granted, and telecommunications is one of them. We surf the internet, send emails to friends and colleagues abroad, talk to family members in foreign countries over the phone, book airline seats and make banking transactions without actually realizing and appreciating the sophisticated technology that enables us to do so.

There is a common misconception that nowadays most international communications are routed via satellites, when in fact well over 95 per cent of this traffic is actually routed via submarine fibre-optic cables. Data and voice transfer via these cables is not only cheaper, but also much quicker than via satellite.

The first submarine cable – a copper-based telegraph cable – was laid across the Channel between the United Kingdom and France in 1850. Today, more than a million kilometres of state-of-the-art submarine fibre-optic cables span the oceans, connecting continents, islands and countries around the world. Arguably, the international submarine cable network provides one of the most important infrastructural foundations for the development of whole societies and nations within a truly global economy.

At the beginning of the submarine cable era, there was a widely held belief that the riches of the ocean were too vast ever to be affected by humans. Apart from shipping and regional fishing, there were few other uses of the sea and most of the marine environment (the little that was known) was still relatively pristine.

Today, the situation is vastly different. Human activities, directly or indirectly, have affected and altered all environments world-wide, including the 71 per cent of the planet that is ocean. The number and the intensity of maritime uses have increased dramatically and will continue to do so in the future, stretching the capacity of the oceans and their finite space and resources to the limit – or even beyond. In the light of the actual and potential pressures and impacts this creates on marine biodiversity and ecosystems (including the services and functions they provide for humankind and life on Earth), governments and international organizations have recognized that there is an urgent need for wise conservation and protection in concert with the sustainable management and use of the oceans and their resources. Even the placement and operation of submarine telecommunications cables, as one of the oldest and arguably one of the most important uses of the sea, has to be considered in this process. In order to focus and guide these deliberations and decision making, an objective, factual description of this industry and the interaction of submarine telecommunications cables with the marine environment is needed: information that the reader will find in this report.

We hope that this report will contribute to and strengthen the ongoing exchange of information, mutual education and cooperation between all stakeholders, so that, despite increasing technological change and environmental pressures, we can continue to share the seabed in harmony for the benefit of all.

Ibrahim Thiaw
Director, Division of Environmental Policy Implementation, UNEP

Jon Hutton
Director, UNEP World Conservation Monitoring Centre

Mick Green
Chairman, International Cable Protection Committee

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Contents

Acronyms and abbreviations

ACC	Antarctic Circumpolar Current
ACMA	Australian Communications and Media Authority
AT&T	American Telephone and Telegraph Company
ATOC	Acoustic Thermometry of Ocean Climate
CANTAT	Canadian Trans-Atlantic Telephone cable
CBD	Convention on Biological Diversity
CPZ	Cable protection zone
DTS	Desktop study
EEZ	Exclusive economic zone
EIA	Environmental impact assessment
ENSO	El Niño-Southern Oscillation
ESONET	European Seafloor Observatory Network
FAD	Fish aggregating devices
FAO	Food and Agriculture Organization of the United Nations
GCCS	Geneva Convention on the Continental Shelf
GCHS	Geneva Convention on the High Seas
GISS	Goddard Institute for Space Studies, NASA
GPS	Global positioning system
ICES	International Council for the Exploration of the Sea
ICPC	International Cable Protection Committee
IEEE	Institute of Electrical and Electronic Engineers, USA
IPCC	Intergovernmental Panel on Climate Change
ITLOS	International Tribunal for the Law of the Sea
MBARI	Monterey Bay Aquarium Research Institute, USA
NASA	National Aeronautics and Space Administration, USA
NEPTUNE	North-East Pacific Time-series Undersea Networked Experiments
NIWA	National Institute of Water and Atmospheric Research, New Zealand
NOAA	National Oceanic and Atmospheric Administration, USA
OFCC	Oregon Fishermen's Cable Committee
OOI	Ocean Observatories Initiative
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic
ROV	Remotely operated vehicle
SCIG	Submarine Cable Improvement Group
TAT-1	Trans-Atlantic Telephone, first trans-ocean telephone cable
UKCPC	United Kingdom Cable Protection Committee
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UV-B	Ultra-violet light, type B
WCMC	World Conservation Monitoring Centre (of UNEP)

Introduction

This report results from collaboration between the United Nations Environment Programme (UNEP) and the International Cable Protection Committee (ICPC), which represents the majority of ocean users within the submarine telecommunications cable industry. Why is such a report required? The last 20 years have seen exponential growth of and increasing reliance on the internet for communication, commerce, finance, entertainment and education. That remarkable development has been accompanied by rapid growth in international telephone communications. Whether sending an email, making an airline booking or simply telephoning overseas, there is more than a 95 per cent probability that those actions will involve the international submarine cable network. In recognition of its importance as the backbone of the internet, governments now view the submarine telecommunications cable network as *critical infrastructure* that deserves a high level of protection (e.g. ACMA, 2007).

The communications revolution has occurred against a backdrop of greater pressure on the ocean from increased human activities, which range from the exploitation of resources to anthropogenic global warming (e.g., UNEP-WCMC, 2009; IPCC, 2007). In response to concerns about potential and actual impacts on the marine environment, governments and international organizations have stepped up their efforts to ensure the conservation, protection and sustainable management/use of coastal seas and deep offshore waters. In the light of recent scientific discoveries (e.g. Masson *et al.*, 2002; Freiwald *et al.*, 2004), discussions about the risks to vulnerable and threatened marine ecosystems and biodiversity in areas beyond national jurisdiction have emerged. It was this increased international awareness and interest in the deep and high seas environments that led UNEP and the ICPC to collaborate in the preparation of this report in 2004, with the shared objective of providing a factual context for discussions involving submarine fibre-optic cables and the environment. As such, it allows for more informed decision making, especially when weighing the benefit of an activity against any potential negative environmental impact (e.g. UNEP, 2007). It should be noted that *Submarine Cables and the Oceans – Connecting the World* focuses exclusively on fibre-optic telecommunications cables, and hence does not address submarine power cables.

The opening chapters of this report are a compendium of information that starts with a history of submarine telecommunications cables. The first transoceanic cable came into full operation in 1866, when a link was established between Ireland and Newfoundland that allowed transmission of seven words per minute via telegraph. Today, a modern fibre-optic cable can transport vast amounts of data and is capable of handling literally millions of simultaneous telephone calls. Even so, deep-ocean fibre-optic cables are no larger than 17–21 mm diameter – about the size of a domestic garden hose. Closer to shore (in water depths shallower than about 1,500 m), a cable's diameter may increase to 40–50 mm due to the addition of protective wire armouring. Chapter 3 focuses on submarine cable operations and presents an insight into the technology that permits accurate placement of a cable on or into the seabed. Modern seabed mapping systems such as multibeam side-scan sonar and high-definition seismic profilers, used in conjunction with satellite navigation equipment, permit submarine cables to be installed with unprecedented precision. Thus, hazardous zones and ecologically sensitive locations, such as volcanic areas and cold-water coral communities, can be avoided. All cables eventually come ashore, and it is in these shallow coastal waters that they are at most risk from human activities, especially ships' anchoring and bottom trawl fishing, which are together responsible for most submarine cable faults. As a result, special protective measures are needed that typically include the addition of steel armour to the cable exterior and, where possible, burial into the seabed. Cable deployment within the waters of a coastal state generally requires some form of environmental impact assessment (EIA) covering the potential effects of the survey and laying operations on the local environment, other seabed users and underwater cultural heritage sites.

The success and very existence of international submarine cable systems owe much to the treaties that the nations of the world have introduced into customary international law since 1884. These international norms are widely accepted and followed by the cable industry as well as the global community. They are an excellent example of international law working at its best in balancing competing uses in the ocean. Chapter 4 provides a basic restatement of the current international legal regime that underpins the world's undersea communications network.

Open-file information from environmental agencies, together with published studies, forms the basis of Chapter 5, which examines the environmental impacts of modern submarine cables and associated operations. The main threats to cables are found in water depths shallower than about 1,500 m, the present limit of most bottom trawl fishing, although some boats are extending that limit to 2,000 m depth. In these continental shelf and slope areas, cables require some form of protection. This may be achieved through legislation for the creation of protection zones (e.g. ACMA, 2007), or by physical means such as burial beneath the seabed. In the case of designated and controlled protection zones, there may be no need to bury cables, in which case they are exposed to waves, currents and the marine biota. How a cable interacts with the environment depends on the many influences and factors that shape the ocean. However, the small physical size of a telecommunications cable implies that its environmental footprint is likely to be small and local; a suggestion that is borne out by several studies, e.g. Kogan *et al.* (2006). Using a combination of sediment samples and direct observations made with a remotely operated vehicle (ROV), Kogan *et al.* concluded that a telecommunications cable off Monterey Bay, California, had minimal to no impact on the fauna living in or on the surrounding seabed, with the exception that the cable locally provided a firm substrate for some organisms that otherwise would not have grown on the mainly soft seafloor sediments. These results contrast with the findings of an earlier study by Heezen (1957), who documented a significant impact on marine life, namely the entanglement of whales with old telegraph cables. However, such distressing occurrences were restricted to the telegraph era (1850s to c.1950s). With improved design, laying and maintenance techniques, which developed with the first coaxial submarine cables in the 1950s and continued into the fibre-optic era beginning in the 1980s, no further entanglements with marine mammals have been recorded (Wood and Carter, 2008). The remainder of Chapter 5 considers the environmental effects of cable burial and recovery as well as broader issues concerning the relationship between cables and ecologically sensitive areas, and the potential use of cable protection zones as *de facto* marine sanctuaries.

The December 2006 earthquake off southern Taiwan focused the world's attention not only on the human tragedy, but also on the impact of natural hazards on the submarine cable network. The magnitude 7.0 earthquake triggered submarine landslides and dense sediment-laden flows (turbidity currents), which passed rapidly down to the +4,000 m-deep ocean floor, breaking nine fibre-optic submarine cables en route (Figure 1). Southeast Asia's regional and global telecommunications links were severely

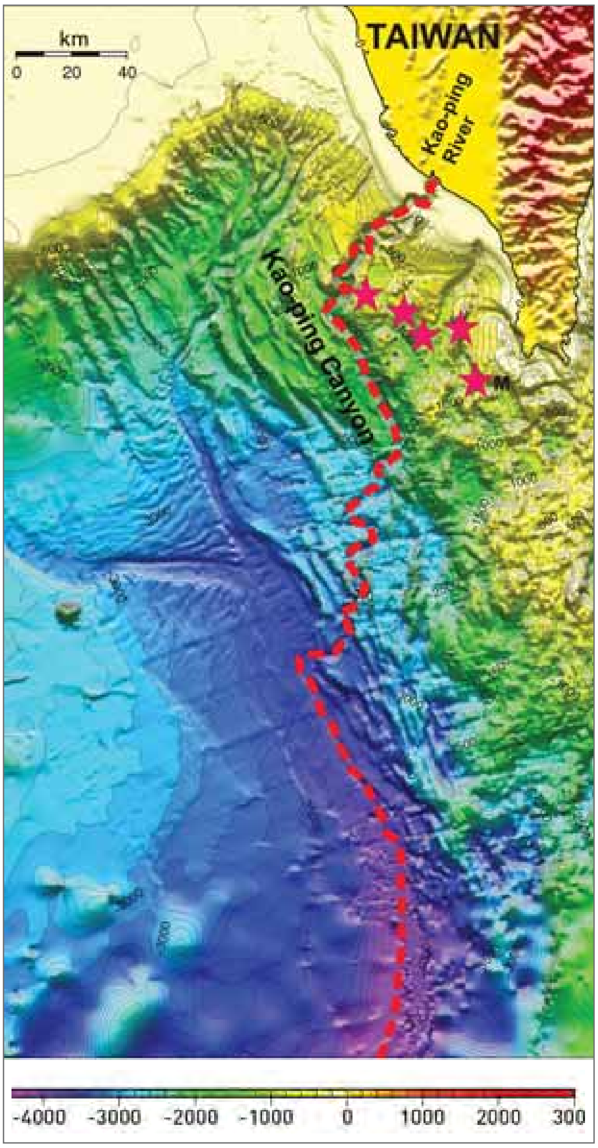


Figure 1: On 26 December 2006, a magnitude 7.0 earthquake and after shocks (pink stars) set off several submarine landslides off southern Taiwan. These slides transformed into fast-flowing mud-laden currents that sped down Kao-ping submarine canyon (red dashes) into a deep-ocean trench: a distance of over 300 km. Nine cables were broken en route, disrupting international communications for up to seven weeks. *Source: Professor C.S. Liu, Institute of Oceanography, National Taiwan University.*

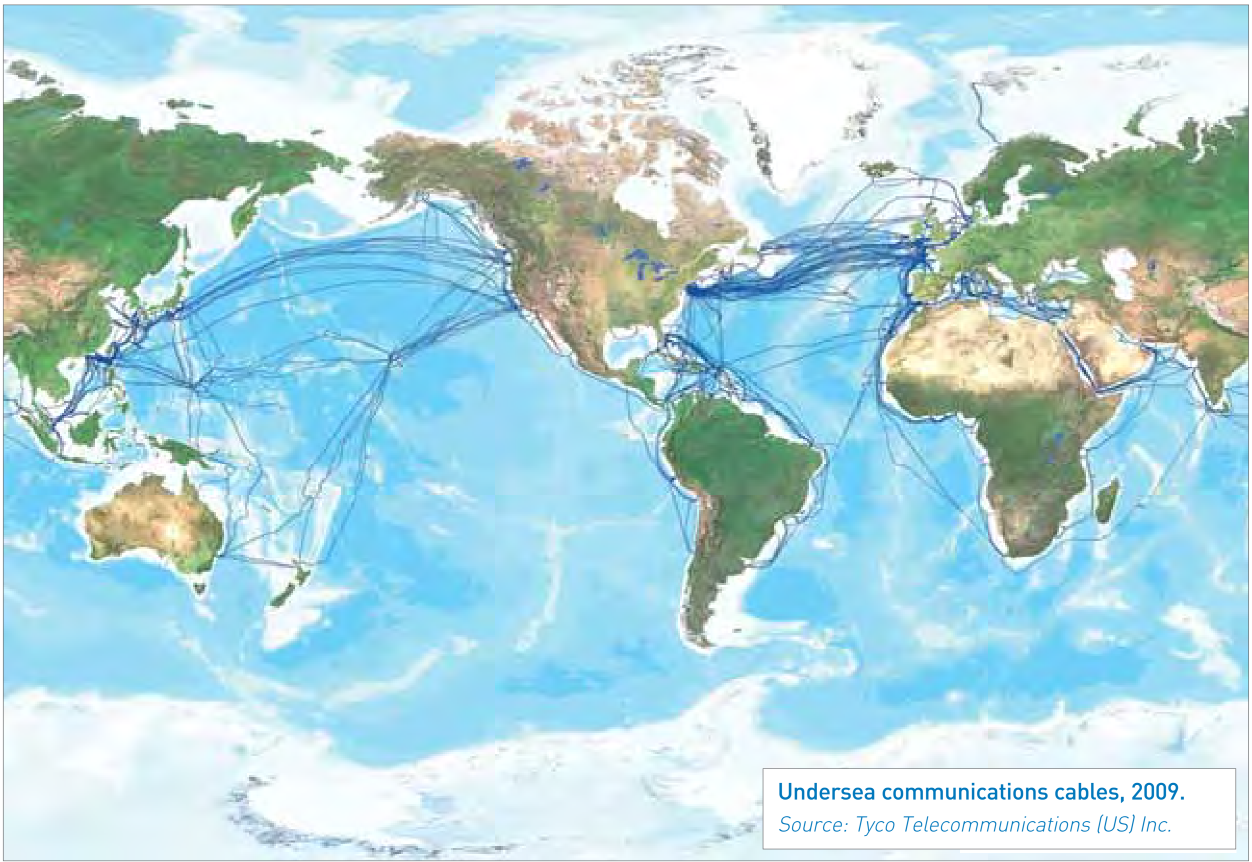
disrupted, affecting telephone calls, the internet and data traffic related to commerce and the financial markets. As outlined in Chapter 6, such natural hazards generate less than 10 per cent of all cable faults, but fault occurrence rises to around 30 per cent for cables in water deeper than c.1,500 m, i.e. beyond the main zone of human offshore activities. And, as seen off Taiwan in 2006 and Newfoundland in 1929, the consequences of major hazards can be profound. Seismically triggered submarine landslides and turbidity currents, along with major storms, wave and current action, and even river floods, pose the largest natural threat to cables, with volcanic eruptions and iceberg scour playing very minor roles. Furthermore, cables are unlikely to be exempt from the anticipated changes in the ocean resulting from human-influenced climate change. High on the list of potential hazards are rising sea level and more powerful storms, which together are likely to threaten the shallow and coastal reaches of cable routes. Regional changes in wind patterns, precipitation and ocean currents are also likely to have an effect.

Integrating cable activities with other seabed uses is the theme of Chapter 7. Mid-water to bottom trawl fishing, dredging, ships' anchoring and some recreational activities threaten underwater communications. Because it is the most significant cause of cable faults, Chapter 7 concentrates on fishing, presenting an overview of fishing gear and practices, risks to cables, fishing vessels and crew, and means of reducing those risks. Risk reduction is achieved through close consultation between cable engineers and fishermen so that there is a full understanding of their respective equipment and operations, e.g. knowledge of the type of trawl gear deployed allows engineers to identify a suitable burial depth for a cable. Other mitigation measures may involve cable routing, armouring, clear identification of cable routes on marine charts, educational material and stakeholder working groups consisting of fishing and cable representatives.

The report ends with a discussion of future activities in the ocean based on present trends in offshore conservation, renewable energy development and resource exploitation. There is no doubt that the oceans, and especially the coastal seas, are under increasing pressure from a growing range of human activities. The past decade has witnessed an expansion of offshore renewable energy schemes (in particular wind turbine farms) as nations seek to lower emissions of greenhouse gases and establish secure supplies of energy. Fishing activities are changing due to reduced stocks in coastal seas. Trawling is now moving into deeper waters, although this may be tempered by the increased costs of operating further offshore, lower biomass in more distant, deeper waters and rapid stock depletion because of fish life-history characteristics (e.g. Clark *et al.*, 2000; Pauly *et al.*, 2003). As China, India and other nations develop their industrial sectors, the import of raw materials and export of manufactured goods have expanded. Shipping routes, traffic volumes and vessel size have all undergone major adjustments brought about by profound shifts in the global economy. Offshore exploration and production of hydrocarbons are also set to extend into deeper water, with operations taking place at depths of 3,000 m and beyond. Deep-sea mining for minerals has recently attracted increased interest, with commercial operations planned for the near future. Furthermore, the science community is establishing long-term ocean observatories (e.g. Ocean Sites, 2009) to determine how the deep ocean and seabed function, to discover what biodiversity and ecosystems they harbour, and to detect natural hazards and responses to climate change.

As a consequence of these pressures, nations and international groups are seeking to preserve ocean ecosystems through the formation of marine protected areas and similar devices (e.g. OSPAR Commission, 2009). In the face of increasing human activities in the marine environment, it has become vital for relevant parties and stakeholders to communicate and cooperate. In this manner, harmonious development and conservation of the 71 per cent of Earth's surface found beneath the oceans can be realized. This is far from an idle sentiment: it is founded on the extensive experience of the collaborators of *Submarine Cables and the Oceans – Connecting the World,* actively working with other seabed users.

1. A history of submarine cables



Undersea communications cables, 2009.
Source: Tyco Telecommunications (US) Inc.

TELEGRAPH ERA

Submarine cables were born around the 1820s. Baron Schilling von Canstatt, an attaché with the Russian Embassy in Munich, successfully exploded gunpowder mines using insulated wires laid across the River Neva, near St Petersburg (Ash *et al.*, 2000). His interest moved to the electric telegraph, which he integrated with another earlier device known as Schweigger's 'Multiplier', in order to improve the sensitivity of a compass needle. Once combined, 'Schilling's Telegraph' was able to communicate messages through a directed needle that moved across black and white paper disks representing letters of the alphabet and numbers (Stumpers, 1884; Ash *et al.*, 2000).

Inventions involving telegraphy escalated through the 19th century. In 1836, English chemist and inventor, Edward Davey, came close to completing a practical telegraph system. He envisioned an electric telegraph that could be insulated for protection and placed underwater with relay-type 'repeaters' to boost weak signals along the cable. This was the forerunner of the submarine telegraph cable. Close to success, Davey unexpectedly departed for Australia, leaving his main competitors, William Cooke and Charles Wheatstone, to complete an operational telegraph (Stumpers, 1884; Ash *et al.*, 2000). Their system was patented in 1837 and involved the identification of alphabetic letters by deflections of magnetic needles. At about the same time, Samuel Morse patented a telegraph based on an electromagnetic system that marked lines on a paper strip. The technique came into commercial reality in 1844 when a communications link was made between Baltimore and Washington, DC.

The concept of insulating submarine telegraph cables to make them durable, waterproof and sufficiently strong to withstand waves and currents, fostered several trials with different materials. In 1843, Samuel Morse produced a prototype by coating a hemp-covered cable in tar and pitch;

Figure 1.1: Tapping gutta percha, a natural polymer used for insulating early submarine cables. *Source: Bright (1898); courtesy of archives of BT Heritage.*

Figure 1.2: The steam tug, *Goliath*, laying the first international submarine cable between Dover and Calais, 28 August 1850. The vessel was accompanied by HMS *Widgeon*. *Source: Bright (1898).*

insulation provided by a layer of rubber also gave the cable strength and durability (Ash *et al.*, 2000). By the late 1840s, the basic technology existed to manufacture submarine cables, and in 1848 the Gutta Percha Company received its first order for wire insulated with a newly discovered natural polymer from Malaya – gutta percha (Figure 1.1) (Kimberlin, 1994; Gordon, 2002; ICPC, 2007).

An English merchant family, headed by the brothers James and John Brett, financed a submarine cable across the English Channel from Dover to Calais. Constructed from copper wire and gutta percha without any form of protection, the cable was laid by the tug *Goliath* on 28 August 1850 (Figure 1.2) (Kimberlin, 1994; Ash *et al.*, 2000; Gordon, 2002). The cable lasted for just a few messages before it succumbed to vigorous waves and currents. A year later it was replaced by a more robust design comprising four copper conductors, each double coated with gutta percha, bound with hemp and heavily armoured with iron wires. This improved version extended the cables' working life to a decade. After installation, John Brett sent a special message to soon-to-be Emperor of France, Napoleon III – an act that symbolically marked the day that submarine telecommunications became an industry. By 1852, cables also connected England to the Netherlands and Germany, with other links between Denmark and Sweden, Italy and Corsica, and Sardinia and Africa.

Submarine cables of that time were far from perfect.

The copper used for the conductors tended to be hard, brittle and poorly conductive, while the gutta percha insulation was sometimes lumpy and only moderately flexible. There was a need to improve cable design and materials as the emerging communications industry looked to the Atlantic Ocean as the next great challenge (Figure 1.3). Such a communications link would allow British and American businesses to develop trade – particularly the British cotton industry.

In 1854, Cyrus Field, a wealthy American paper merchant, became interested in laying a telegraph cable across the Atlantic Ocean (Gordon, 2002). Along with John Brett and Sir Charles Bright, he founded the Atlantic Telegraph Company in 1856 (Ash *et al.*, 2000). Its board members included William Thomson, the eminent physicist who later became Lord Kelvin. After an unsuccessful attempt in 1857, the company laid the first trans-Atlantic cable in 1858, when Ireland was linked to Newfoundland (Figure 1.4). However, success was short lived, and after 26 days of operation the cable failed. Following three other attempts, a new and improved cable was laid in 1866 from the *Great Eastern* cable ship by the Telegraph Construction & Maintenance Company (TELCON) – a merger of the Gutta Percha Company and Glass, Elliot & Company (Figure 1.5). The new and more durable cable provided reasonably reliable communication at around 12 words per minute across the Atlantic. On its return journey to England, the *Great Eastern* recovered the cable lost the year before. A repair was made and connection with Newfoundland completed to provide a second trans-Atlantic cable link (Ash *et al.*, 2000; Gordon, 2002).

As telegraph technology and laying techniques improved, the submarine network expanded greatly. To facilitate government and trade, cables linked the United Kingdom with the many outposts of its empire. By the early 20th century, much of the world was connected by a network that enabled rapid communication and dissemination of information for government, commerce and the public.

The durability and performance of telegraph cables improved with new conducting, strengthening and insulating materials. Alloy tapes and wires, such as the iron-nickel, permalloy, and the copper-iron-nickel, mu-metal, were used to increase cable performance (particularly the speed of signalling) in the 1920s. Staff employed to send and receive telegraphic messages at relay stations were gradually replaced by electro-mechanical signallers. Transmission speeds increased progressively, and by the late 1920s speeds exceeding 200 words per minute became the norm.

By the 1930s there were just two cable manufacturers in Britain, TELCON and Siemens Brothers. The Great Depression and competition from radio-based communications made business difficult. As a result, TELCON merged with the submarine communications cable section of Siemens Brothers to form Submarine Cables Limited. Despite the technological advances of the telegraph, the developing radio industry could do something that the telegraph could not – namely produce intercontinental voice communications. Marconi's company, Imperial, owned the patent to radio communication; it joined forces with the cable industry after they were encouraged to merge by the UK government. And so, in 1934, Cable & Wireless was born. The new partnership enabled even more rapid communications, which came into their own during the Second World War. Radio was used for communicating with troops,

Figure 1.3: Loading gutta percha insulated cable for the *Great Eastern* cable ship. *Source: courtesy of archives of BT Heritage.*

Figure 1.4: HMS *Agamemnon* laying the first Atlantic cable in 1858. *Source: ARC photographs from archives of BT Heritage.*

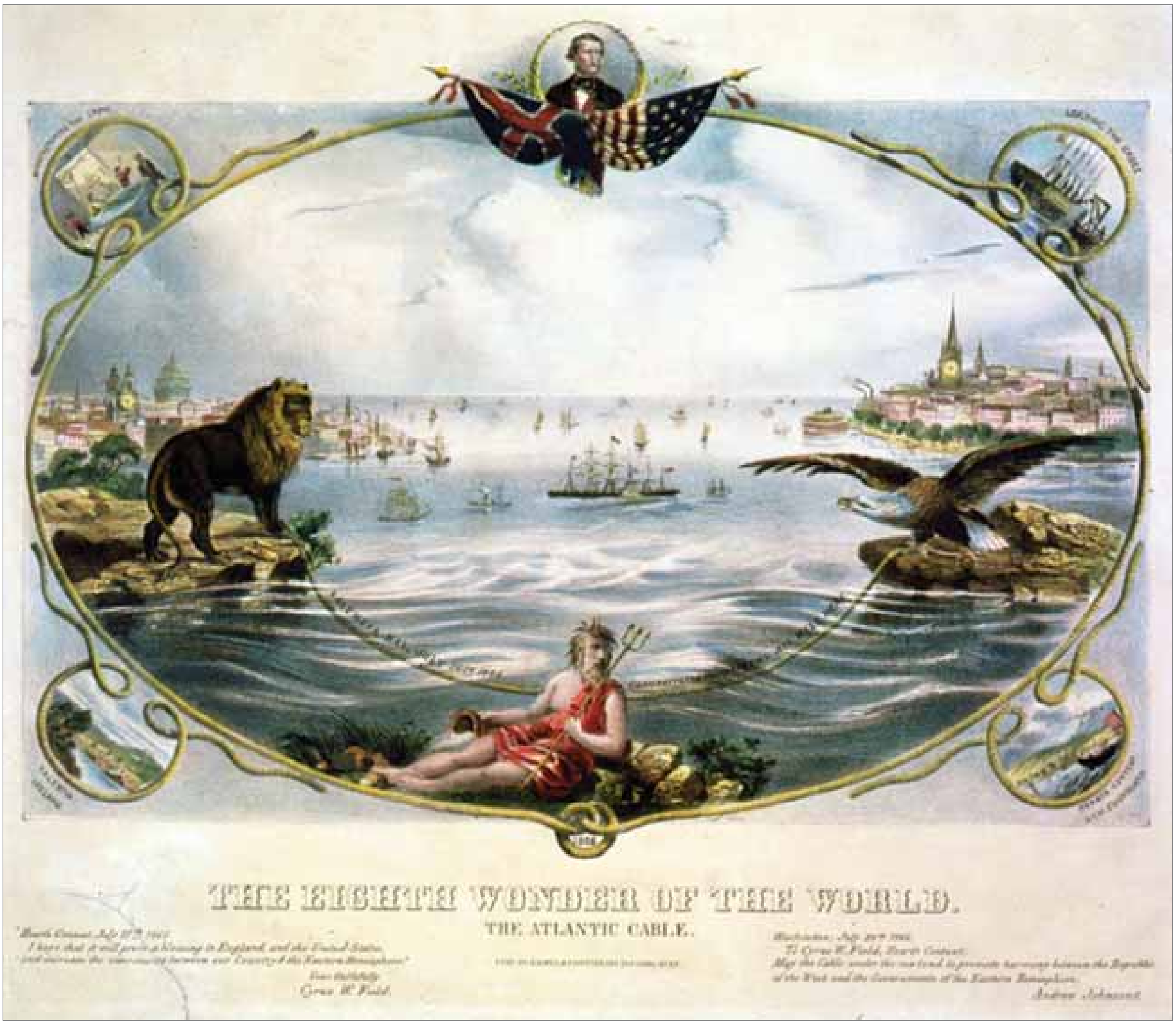


Figure 1.5: The first trans-Atlantic cables were promoted as the Eighth Wonder of the World by Cyrus Field and his colleagues, who emphasized cooperation between the United Kingdom and the United States. *Source: Kimmel and Foster (1866). Lithograph, Library of Congress.*

and submarine cables provided secure networks that could not be intercepted easily.

TELEPHONIC ERA

Following Alexander Graham Bell's invention of the telephone in 1875, it was only a matter of time before phone lines linked continents by submarine cables. Initial attempts in the United States and United Kingdom met with limited success. The British Post Office laid a telephone cable across the English Channel, but inherent deficiencies of the gutta percha insulation meant that signals were limited to short distances before they became distorted. The discovery of polyethylene in 1933 made trans-oceanic telephony possible. In 1938, a polyethylene-encased cable was developed with a copper coaxial core capable of carrying a number of voice channels (Chapter 2). That innovation, along with the use of repeaters to boost the signals, meant that a trans-oceanic cable with multiple voice channels was achievable. Thus in 1955–1956, two cables were laid between Scotland and Newfoundland as a joint venture between the British Post Office, American Telephone and Telegraph (AT&T) and the Canadian Overseas Telecommunications Corporation. The system, named TAT-1, came into service on 25 September 1956, and in the first day of operation carried 707 calls between London and North America. The era of submarine coaxial telephone communications had begun. With it came a suite of technological developments relating to the design of signal-boosting repeaters, new methods of

Figure 1.6: CS *Long Lines* which, together with cable ships from France and the United Kingdom, laid the first trans-Atlantic fibre-optic cable (TAT-8). *Source: AT&T Inc.*

cable laying and improved methods of strengthening cables, especially in deep water where as much as 6 km of cable could be suspended through the water as it was laid on the ocean floor from a cable ship.

In the 1970s and early 1980s, these relatively low-bandwidth cables were only cost-effective on high-density communication routes, with the bulk of global trans-oceanic traffic carried by satellites. The last coaxial system across the Atlantic Ocean was TAT-7, which had a capacity of 4,000 telephone channels. However, to achieve this repeaters had to be installed at 9 km intervals, which made the technology very expensive. A more cost-effective solution was needed to meet the increasing demand for more capacity at reasonable cost. The race to develop fibre-optic technology for application in submarine cables began in the mid-1970s, thus heralding the dawn of another technological revolution in submarine communications.

FIBRE-OPTIC ERA

Glass fibres could carry 12,000 channels, compared to 5,500 for the most advanced coaxial cable. Furthermore, the quality of fibre-optic communication was superior. However, at this stage it was difficult to envisage that fibre-optic cables would form a global network. Over the next decade, scientists continued to improve and refine fibre-optic technology. The world's first trial of a submarine fibre-optic cable was in Loch Fyne in 1979 (Ash *et al.*, 2000). The trials proved that the cable could withstand the mechanical stresses involved in laying, as well as retaining the required stability of transmission characteristics. By 1986, the first international system was installed across the

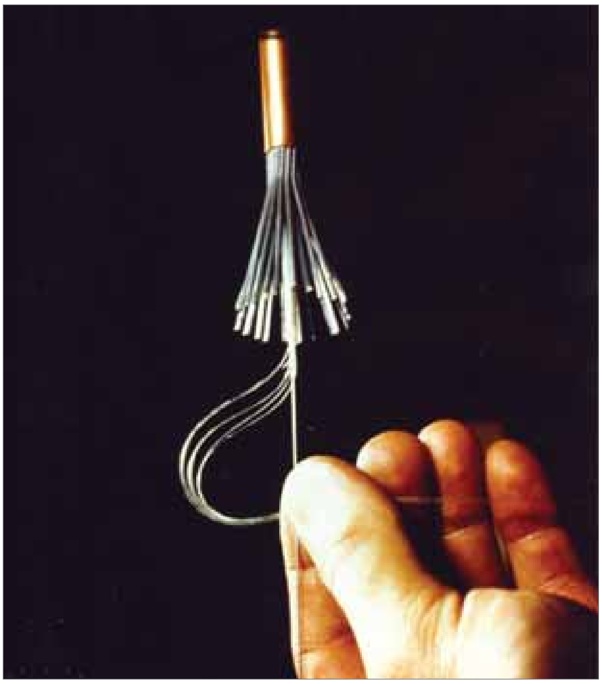


Figure 1.7: A section of TAT-8, the first trans-oceanic fibre-optic cable which, together with a developing internet, heralded a new age of communications. *Source: AT&T Inc.*

English Channel to link the United Kingdom and Belgium. In 1988, the first trans-oceanic fibre-optic cable was installed, which marked the transition when submarine cables started to outperform satellites in terms of the volume, speed and economics of data and voice communications. TAT-8 linked the United States, United Kingdom and France and allowed for a large increase in capacity (Figures 1.6 and 1.7). At about that time, the internet began to take shape. As newer and higher-capacity cable systems evolved, they had large bandwidth at sufficiently low cost to provide the necessary economic base to allow the internet to grow. In essence, the two technologies complemented each other perfectly: cables carried large volumes of voice and data traffic with speed and security; the internet made that data and information accessible and usable for a multitude of purposes. As a result, communications, business, commerce, education and entertainment underwent radical change.

Despite the success of submarine telecommunications, satellite transmission remains a necessary adjunct. Satellites provide global broadcasts and communications for sparsely populated regions not served by cables. They also form a strategic back-up for disaster-prone regions. By comparison, submarine cables securely and consistently deliver very high-capacity communications between population centres. Such links are also cost-effective, and the advantages of low cost and high bandwidth are becoming attractive to governments with low population densities. The amount of modern submarine fibre-optic cables laid in the world's oceans has exceeded a million kilometres and underpins the international internet. Almost all trans-oceanic telecommunications are now routed via the submarine cable network instead of satellite.

2. Inside submarine cables

DESIGNED FOR THE DEEP

A submarine cable is designed to protect its information-carrying parts from water, pressure, waves, currents and other natural forces that affect the seabed and overlying waters. Most of these forces change with depth. Temperatures become colder, pressure increases and wave effects lessen, but strong current action can occur at any depth. There are also the impacts of human activities, most notably fishing and shipping.

Designing cables to meet such challenges has been a quest for more than 160 years. In 1842, for instance, a telegraph cable laid across the East River, New York, by Samuel Morse, was soon damaged by a ship's anchor. Designing cables to cope with such mishaps progressed rapidly. Redesigning the first cables across the English Channel in 1851 and the first trans-Atlantic link in 1858 allowed these pioneering systems, which had failed on their first deployments, to operate successfully (Chapter 1). Nevertheless, the fundamental design of telegraph cables changed little for the next 100 years (Figure 2.1; Haigh, 1968).

Telegraphy involved the transmission of coded electrical impulses through a conductor, which in a submarine cable was a stranded copper wire with gutta percha insulation wrapped in brass or jute tape (Figure 2.1). This construction, however, had insufficient strength to withstand deployment or recovery from any appreciable water depth. As a result, a sheathing of wires or *armour* was added to provide strength. Armour also protected the cable, and various wire types and layers were devised to meet different seabed conditions. Two-layered or double armour helped protect against anchors and fishing gear, as well as abrasion under wave and current action in coastal seas. Heavy single-armoured cable was designed

Figure 2.1: Submarine telegraph cables from the early 1900s, with the inner copper conductor for transmitting messages, an insulating layer of the tree resin, gutta percha, and one or more outer layers of iron wire for strengthening and protecting the whole assembly. *Source: Lonnie Hagadorn.*

Figure 2.2: Cables of the coaxial telephonic era, with a core of steel wires for strength, an inner copper sheath, which also acted as the conductor, encased in polyethylene dielectric, and an outer conductor. The assembly was coated with black polyethylene which, in shallow water, was armoured for protection. *Source: Lonnie Hagadorn.*

for intermediate water depths beyond the reach of anchors and most trawl fishing gear. Light single armour was a deep-water design that allowed cables to be laid in full ocean depths (Haigh, 1968).

ANALOGUE CABLES ARRIVE

Coaxial or analogue cables came into use in the 1950s and continued for the next 40 years and more. They differed from telegraph cables in three key ways:

1. Instead of gutta percha, polyethylene was used exclusively as the insulator or dielectric. It also formed the outer sheath of deep-ocean designs (Figure 2.2).
2. The cable core had a coaxial structure consisting of an inner and outer conductor of copper separated by polyethylene insulation material.
3. The first trans-Atlantic analogue cable (TAT-1) used traditional armour for strength. However, later cables used fine-stranded, high tensile strength steel wires encased in the central conductor. As a result, deep-ocean systems did not require armour, although cables in shallow seas still needed a strong outer casing for protection (Figure 2.2).

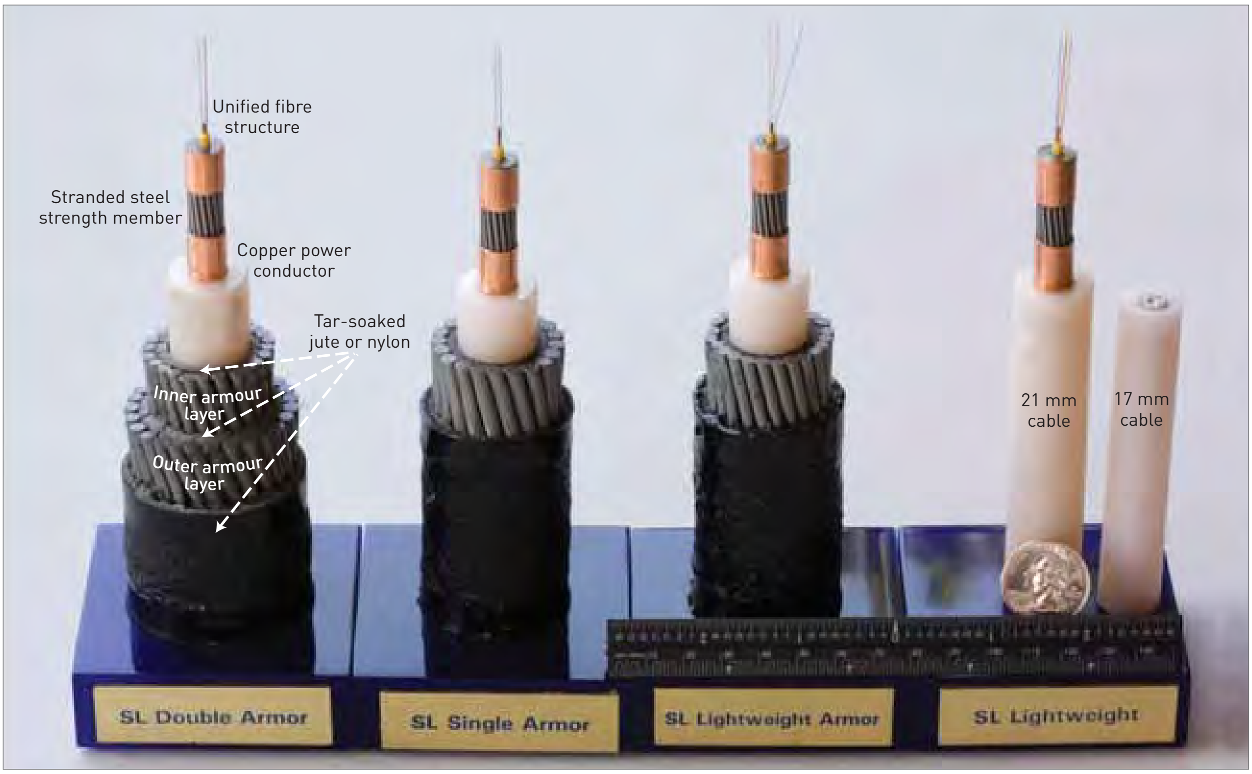
TAT-1 had about 36 individual voice channels, and used two cables, one for each direction of transmission. In addition, electrically powered amplifiers or repeaters were needed to boost the transmission, and these were inserted into the cable at spacings of c.68 km in deep water (Bell, 1957).

Analogue cable and repeater technology improved rapidly through the 1960s and 1970s, allowing a cable to carry up to 5,000 telephone calls. However, this increase in bandwidth was accompanied by an increase in cable size and repeater numbers, whose spacing was reduced to 6–9 km in the highest capacity systems. This made it extremely expensive to install trans-oceanic communication systems (Bell, 1957, 1964, 1970, 1978).

THE DIGITAL LIGHT-WAVE REVOLUTION

During the late 1970s and early 1980s, development focused on fibre-optic submarine cables that relied on a special property of pure glass fibres, namely to transmit light by internal reflection. By coding information as light pulses, data could be sent rapidly around the world. In 1985, the first deep-water repeatered design was laid off the Canary Islands. By 1988, the first trans-Atlantic fibre-optic cable (TAT-8) had been installed, followed several months later by

Figure 2.3: Shallow- to deep-water (left to right) fibre-optic cables, with a core supporting pairs of hair-like optical fibres surrounded by a layer of wire to provide strength, a copper conductor to power the repeaters or amplifiers that process the light signal, and a case of polyethylene dielectric. Wire armour is added for protection. *Source: Lonnie Hagadorn.*



the first trans-Pacific system. Such cables usually had two or more pairs of glass fibres. Originally, a pair could transmit three to four times more than the most modern analogue system. Today, a cable with multiple fibre-optic pairs has the capacity for over 1 million telephone calls. Despite this greatly enhanced capacity, modern cables are actually much smaller than analogue predecessors. Deep-ocean types are about the size of a garden hose (17–20 mm diameter), and shallow-water armoured varieties can reach up to 50 mm diameter (Figures 2.3 and 2.4). This means that instead of making four or five ship voyages to load and lay an analogue cable across the Atlantic, only one or two voyages are now required for fibre-optic types. It also means that the footprint of the cable on the seabed is reduced (AT&T, 1995).

Modern repeaters

With the digital light-wave revolution came major changes in the design of repeaters (Figure 2.5). Light signals still required amplification, and initially electronic regenerators were placed along a cable to boost signals. New systems, however, rely on optical amplifiers – glass strands containing the element erbium. Strands are spliced at intervals along a cable and then energized by lasers that cause the erbium-doped fibres to 'lase' and amplify optical signals. The typical spacing for this type of repeater is 70 km.

Fibre design changes

Since the advent of fibre-optic systems, major advances have been made in the manufacturing technology of the actual fibres. Various impurities or *dopants* are now added or removed from the glass to change its light-transmitting properties. The result is that the speed at which light passes along a glass fibre can be adjusted and controlled. This allows customized cables to be built to meet the specific traffic and engineering requirements of a route. This specialist use has increased the need for specialized repair services. The correct spare cable and fibre type must be used, which means that a comprehensive stock has to be carried by the cable repair authority. Repairs typically require removal of the damaged section followed by the splicing or jointing of the replacement section. During the telegraph and analogue eras, a single repair joint was a relatively quick (3–6 hours) and simple operation. It has now become a lengthy (10–24 hour), very specialized task that requires expensive and sensitive equipment. Hair-thin optical fibres must be aligned and spliced perfectly, followed by full testing before making the mechanical joint to give the repair strength and protection (AT&T, 1995).

CONCLUSIONS

The progress made in submarine cable design over the last 50-plus years has been remarkable. The world has

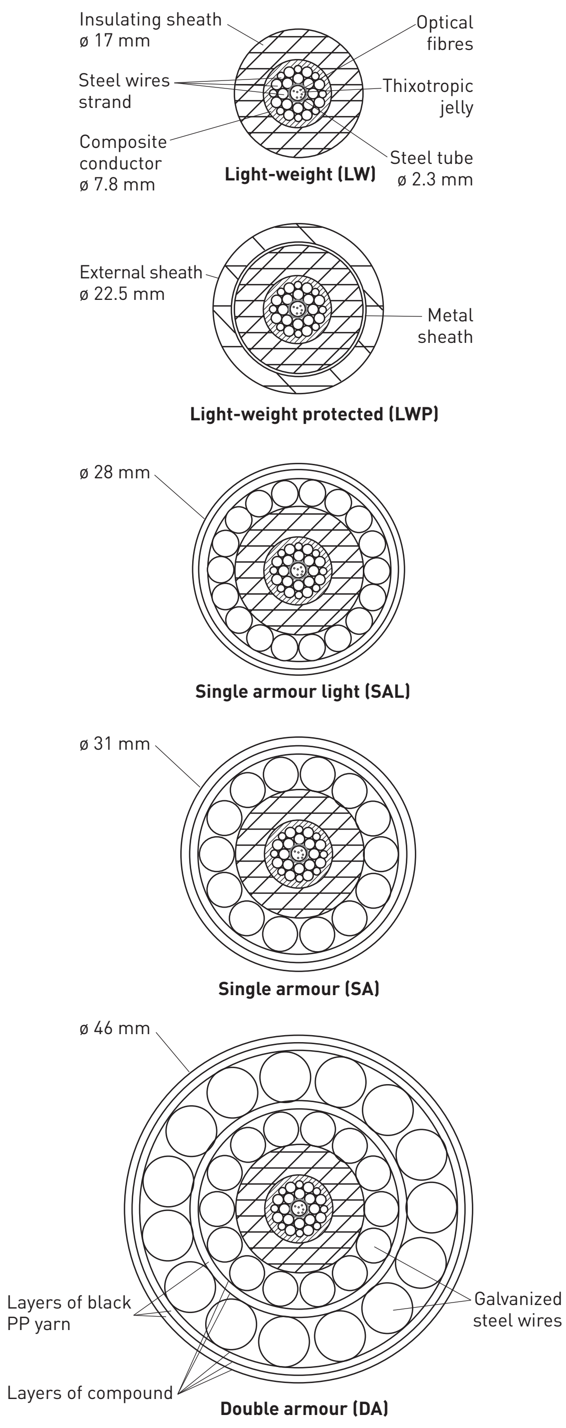


Figure 2.4: Modern fibre-optic cables (life-size), ranging from the typically used deep-ocean types (top two) leading to the shallow-water armoured varieties, which in many instances are now laid and buried into the seabed for additional protection. *Source: Lonnie Hagadorn.*

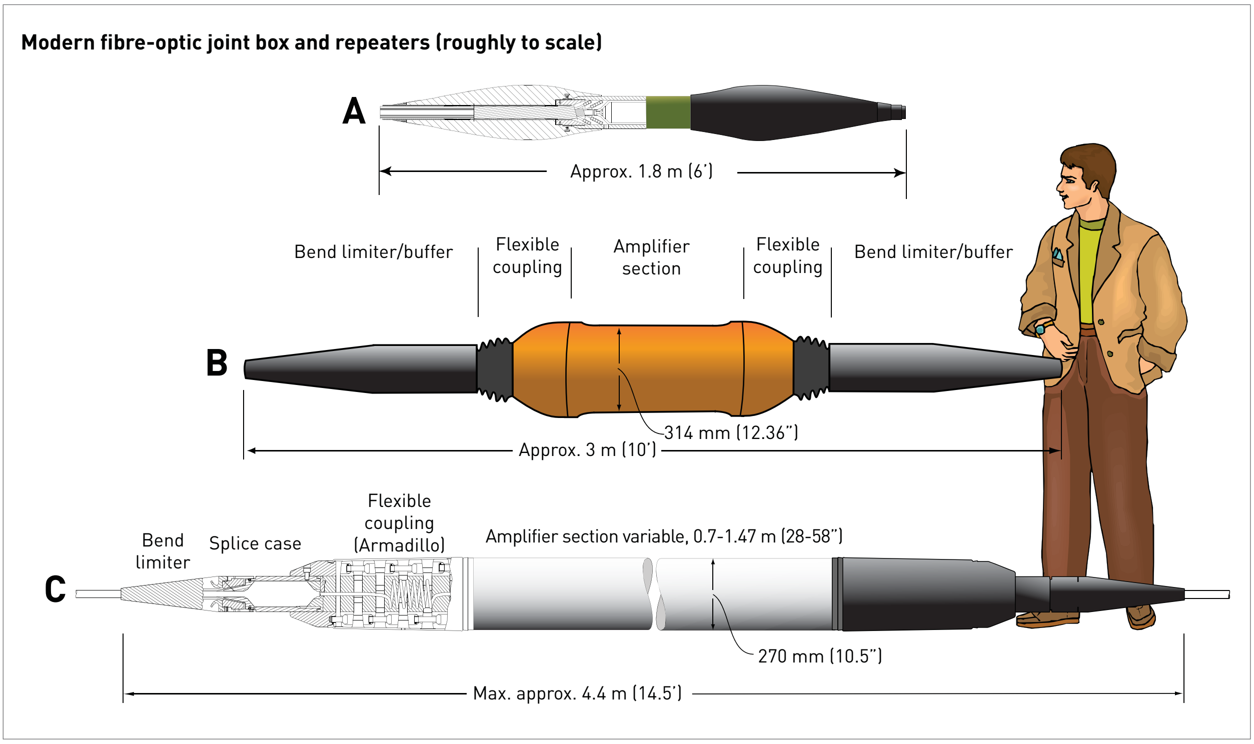


Figure 2.5: Representative repeaters from different manufacturers. The housings can accommodate as many as eight individual regenerators, or more recently, optical amplifiers. *Source: Lonnie Hagadorn.*

gone from single-circuit telegraph cables to fibre-optic systems with almost unlimited voice and data carrying capacities. The physical size of the cable itself has shrunk dramatically, and the reliability of the submarine components is down to just a few failures over the entire life of a long-distance system, which is typically 15–20 years. One can only wonder what progress the next 50 years will bring!

3. Survey, lay and maintain cables

ROUTE SELECTION

A key part of route selection is the identification and understanding of marine geopolitical boundaries that a proposed route may encounter. Access to databases such as Global Maritime Boundaries (NASA, 2009) can prevent unnecessary passage through areas where geopolitical constraints could affect the application or permit to place and maintain a cable on the seabed.

Definition of these maritime boundaries is provided by the United Nations Convention on the Law of the Sea (UNCLOS) (Chapter 4). The extent to which any coastal state controls cable-related activities within its territorial seas and exclusive economic zone varies, and depends on the nature and geographical jurisdiction of federal, state and/or local regulations that enact the provisions of UNCLOS in domestic legislation. For countries that have not ratified UNCLOS, the focus is on existing domestic legislation.

ROUTE SURVEY

Following the identification of potential cable landings that are to be connected, it is most effective to conduct a full review of pertinent available information in order to define the most efficient and secure route that will then be fully surveyed. This preliminary engineering, commonly referred to as a desktop study (DTS), is generally conducted by marine geologists with cable engineering experience who assemble all available hydrographic and geologic information about the pertinent region, commission fisheries and permitting reports if appropriate, consider the location and history of existing nearby cables and other obstructions, and then design an optimal route to be surveyed. The DTS will also generally include visits to the landings to determine where the cable crosses the beach and links to the cable terminal. Visiting landing sites also provides an opportunity to consult with local officials about possible cable hazards, environmentally sensitive areas, requirements to gain a permit to operate, fisheries, development plans and land access, amongst other factors. A comprehensive DTS will provide an optimal route design that can then be surveyed in the most cost-effective manner.

Based on the DTS, an efficient survey can then be designed along an optimized route to fully characterize that route and to avoid hazards and/or environmentally significant zones that may not have been identified from existing information. Surveys include water depth and seabed topography, sediment type and thickness, marine faunal/floral communities, and potential natural or human-made hazards. Where appropriate, measurements of currents, tides and waves may be needed to evaluate the stability of the seabed, movement of sediment and ocean conditions that may affect cable-laying and maintenance operations.

A route survey commonly covers a swath of seabed c.1 km wide in water depths down to about 1,500 m, reflecting the need to bury cables for protection according to local conditions. The width of the survey corridor can be adjusted largely in consideration of the expected complexity of the seabed, and the depth to which these complete surveys are conducted will be based on local hazards, particularly bottom trawl fishing and shipping activities, which may require the cable to be buried. Water depth is traditionally measured by echo-sounding, which has now developed into seabed mapping or *multibeam* systems. Whereas conventional echo-sounders measure a single profile of water depth directly under the ship, multibeam systems provide full depth coverage of a swath of seabed with a width that is three to five times the water depth (Figure 3.1). Thus, in deep water, a single multibeam track can be up to 20 km wide. As a result, sectors of the seabed are fully covered by a dense network of depth soundings that yield highly accurate images and charts (Figure 3.2).

As multibeam data are collected, side-scan sonar systems may be deployed to produce photographic-like images of the seabed surface. Termed *sonographs*, the images are used to identify zones of rock, gravel and sand, structures such as sand waves, and human-made objects ranging from shipwrecks to other cables. These images, together with multibeam data and seabed photography, have also been used successfully to map benthic habitats and communities (e.g. Pickrill and Todd, 2003). If cable burial is required, seismic sub-bottom profilers are deployed to measure the type and thickness of sediment below the seabed as well as possible natural hazards (Chapter 6). Like echo-sounders, the seismic profilers direct acoustic energy from the ship to the seabed. However, instead of just echoing off the seabed surface, the energy also penetrates through the substrate and reflects off layers of sediment to produce records of their thickness and structure. Sediment coring and other geotechnical testing of the seabed are also generally conducted to help determine its stability and suitability for cable burial.

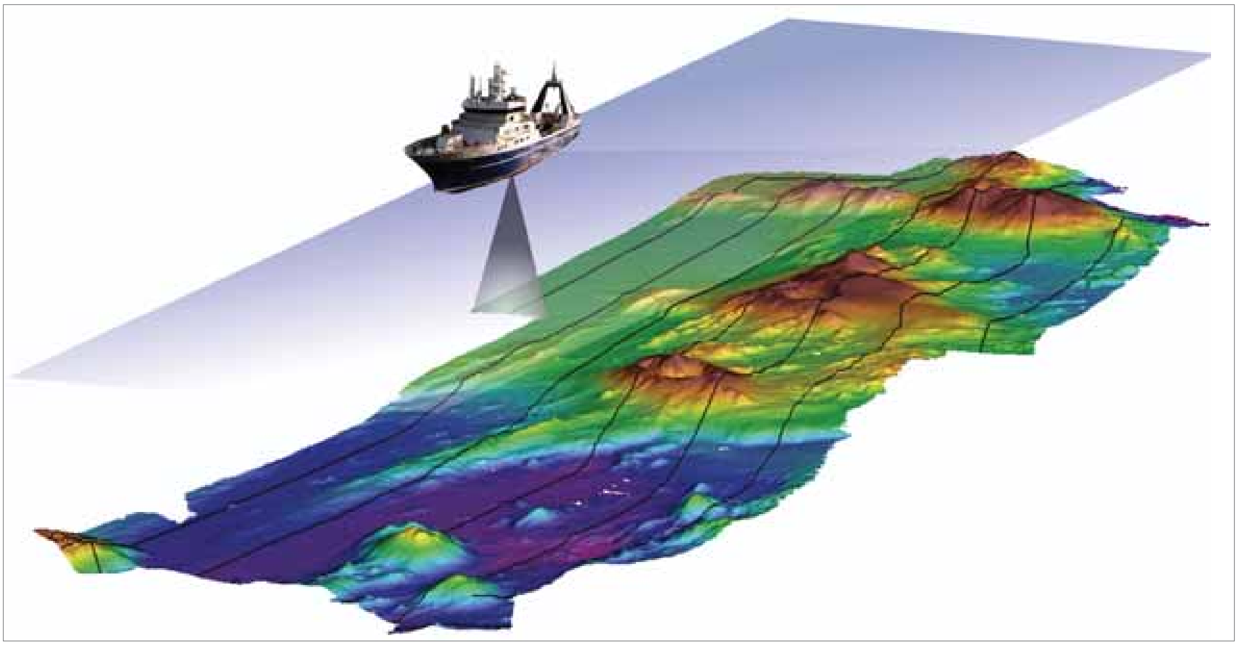


Figure 3.1: 'Mowing the lawn': a survey ship, equipped with a multibeam mapping system and guided by satellite navigation, charts the seabed to provide total coverage with depth soundings along a swath of seabed that can be 20 km wide. *Source: NIWA.*

For depths where burial is not required, a single track of a vessel using multibeam bathymetry will generally suffice. The data acquired during such surveys are constantly monitored so that if an unexpected hazard, cable obstruction or benthic community is identified, the surveyors can immediately adjust the planned route and detour around any hazardous or ecologically sensitive areas.

Ultimately, the desktop and field surveys will define a viable cable route and identify the natural and human activities that could impinge on the cable. This information guides the cable design so that it meets the specific conditions of the route.

CABLE DEPLOYMENT

As a cable enters the water, its path to the bottom is affected by the marine conditions and any variation in the operations of the laying vessel (Roden *et al.*, 1964). These can be distilled into three key parameters, which are: the ship's speed over the ground, the speed of the cable as *payed out* from the cable ship, and water depth (other less important factors are not covered here). Initially, a cable must be payed out slowly, with the vessel moving 'slow ahead' until the cable reaches the seabed. This is the *touch-down point*. Then the ship can increase its laying speed up to a practical maximum of about 11–15 km/hr (6–8 knots), periodically slowing down to pass repeaters or amplifiers through the cable-handling machinery that controls cable tension and pay-out speed. Once a steady state is achieved, the cable pay-out speed should approximate ship's speed plus 2–3 per cent, assuming the seabed topography is fairly constant. In this steady state, the catenary of the cable will be minimized in the water column. Laying up-slope, however, requires the pay-out speed to be less than the ship's speed because the water becomes shallower. The opposite is true when laying down-slope, because as water depth increases, more cable is needed to

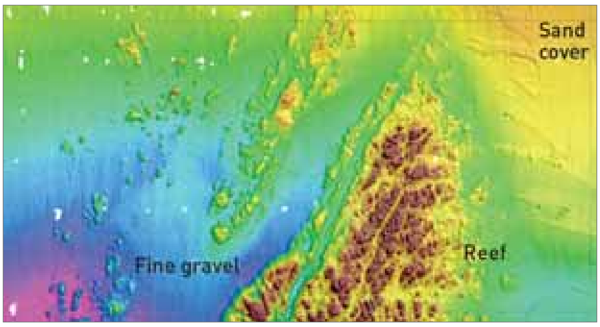


Figure 3.2: A detailed multibeam image of a rocky reef, fractured by faults and joints, and surrounded by a zone of fine gravel that is overlain by a 1 m-thick layer of mobile sand. Ideally, a cable would be buried below the sand and gravel along a route designed to avoid the rocky reef. *Source: NIWA.*

reach the seabed at the engineered touch-down point, assuming the ship's speed remains constant.

Laying operations on a modern vessel undergo constant and accurate monitoring. The ship's position and speed over the ground are measured by the satellite-based differential global positioning system, and the water depth by precision echo-sounders and seabed mapping systems (see *Route survey*), whereas cable pay-out speed and length are recorded by a *rotometer*. Onboard, the cable engineer scrutinizes laying progress with constant reference to the engineered route plan, making adjustments if necessary. In addition, there may be computerized tracking of the entire laying operation that includes detection of external factors such as winds and ocean currents, plus the means to correct for such influences.

Once laid, the cable comes ashore and is connected to the terminal or cable station, which assumes full management of the telecommunications system (Figure 3.3).

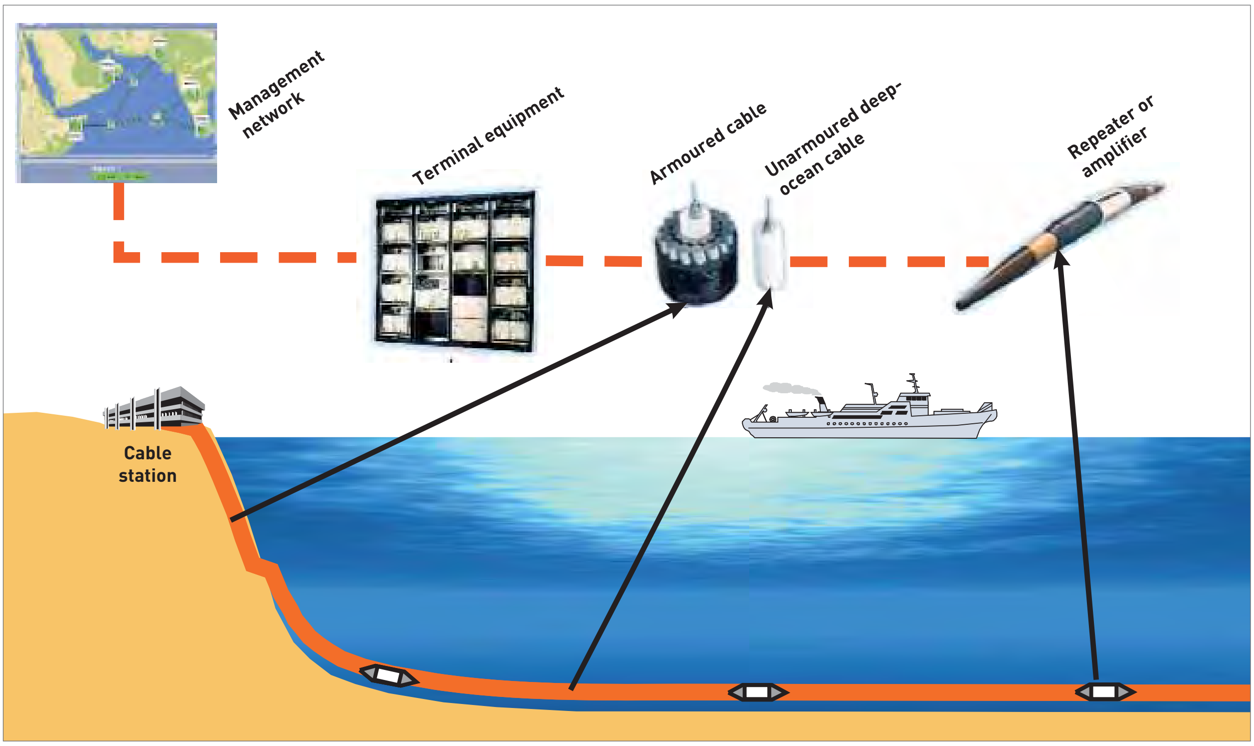
FROM COAST DOWN TO c.1,000–1,500 m WATER DEPTH: THE NEED FOR PROTECTION

Cables that extend across the continental shelf (typically 0–130 m deep) to a depth range of c.1,000–1,500 m, are commonly buried below the seabed to protect them from damage by other seabed users (Chapter 7). The most effective method of burial is by *sea plough* (Figure 3.4). As a cable approaches the seabed, it is fed through the plough, which inserts the cable into a narrow furrow. Different plough designs are available to suit various bottom conditions, e.g. the traditional plough-share is well suited for muddy substrates, whereas sandy sediments may require a plough equipped with a water jet to cut a trench into which the cable is placed. Burial disturbs the seabed along the narrow path of the cable, and this is discussed in Chapter 5.

When towing a sea plough, the ship carefully controls its operations so that cable slack is kept to a practical minimum as it enters the plough. The aim is to lay the cable with near-zero slack, but with enough looseness to fall into the furrow. In areas where the cable crosses another cable or a pipeline, the plough must be either recovered or 'flown' over the crossed section and then re-deployed on the opposite side. These skipped sections may be buried later, either by divers or by a remotely operated vehicle (ROV) fitted with trenching and burial tools as well as video and navigational aids (Figure 3.5).

Even with the latest sea plough and ROV technology, there are areas of seabed where burial is either impractical or impossible, e.g. rugged, rocky zones (Figure 3.2). In such areas, cable pay-out must be regulated to minimize suspensions between rock ridges. At the same time, slack cannot be excessive because heavy, stiff armoured

Figure 3.3: Summary diagram of a submarine cable system. *Source: UK Cable Protection Committee.*



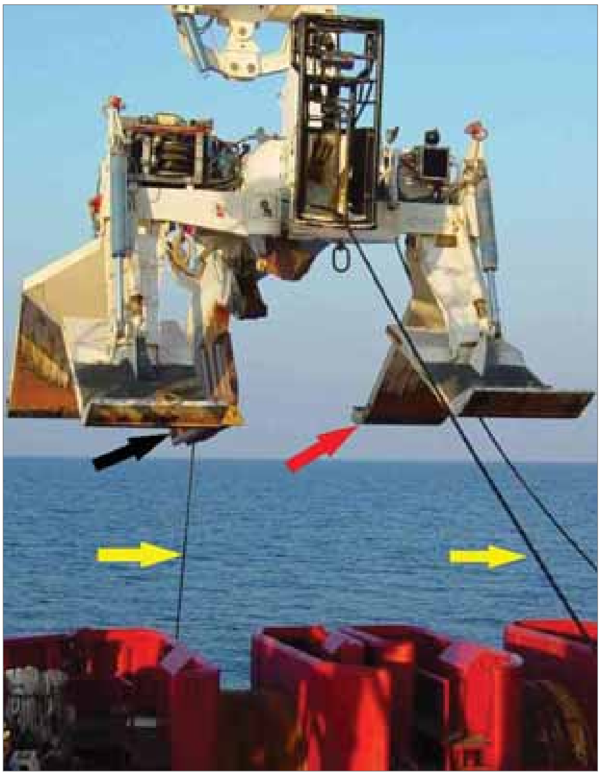


Figure 3.4: A sea plough about to be deployed from a cable ship. The fibre-optic cable (yellow arrows) is fed into a furrow cut by the plough-share (black arrow), which is towed across the seabed on skids (red arrow). *Source: Alcatel Submarine Network (ASN) now Alcatel-Lucent.*

Figure 3.5: TRITON ST-214 remotely operated vehicle (ROV), which is designed to assist burial of cables in areas inaccessible to a sea plough. It also performs cable inspections and recovery operations. *Source: Lonnie Hagadorn.*

cables (necessary for such rugged areas) may form loops if pay-out tension is allowed to approach zero at the touch-down point.

Cable deployment may be followed by a post-lay inspection to ensure that the cable is emplaced correctly either on or into the seabed (Figure 3.6). In shallow water down to c.40 m depth, inspections may be carried out by divers, whereas deeper-water inspections are usually made by an ROV equipped with video and digital cameras whose images are viewed on the surface control vessel in real time (Figure 3.5).

Some areas of the shallow-water seabed are unsuitable for burial and where possible are avoided. However, where rocky areas or zones of high sediment mobility, e.g. surf zone, cannot be avoided, other forms of protection are available and include protective covers of rocks, concrete 'mattresses' and steel or plastic conduits, the choice of which will be dictated by operational and environmental considerations.

BELOW c.1,500 m WATER DEPTH

Below a depth range of c.1,000–1,500 m, cables are deployed mainly on the seabed, although in rare instances burial may extend into deeper water (Chapter 7). This depth limit is presently the extent of modern bottom trawlers, but their forays into deeper water may necessitate burial in even greater water depths.

Typically, cable size and weight decrease with depth as the requirement for protective armour diminishes to zero. Such lightweight cables are easier to handle than armoured varieties, but cable slack must still be controlled carefully so that the cable follows the seabed contours. This may involve engineering 2–3 per cent slack into the laying procedure.

CABLE RECOVERY

Cables are retrieved from the seabed for repairs, replacement or removal (Alcatel-Lucent, 2008). Recovery may result from damage by human activities or natural events (Chapters 6 and 7), failure of components, cable age (design life is typically 20–25 years), or a need to clear congested routes. Recovery generally entails:

- location of the cable and, if a repair is required, identification of the faulted section;
- retrieval of the cable with specially designed grapnels deployed from the repair vessel;
- lifting to the surface for removal or repair.

During the haul-up process – sometimes from 1–3 m below the seabed – the strain on the cable is substantial. Thus recovery, like laying, is a complex process that takes into account a wide range of variables:

- the speed and angle of recovery;

- the ship's track along the cable route;
- the drag of the cable, which may have increased due to biological growth on the cable's exterior;
- water depth, current velocity, wave effects on vessel motion, and any natural or human-made objects, such as ship wrecks, that could potentially snag the ascending cable.

To aid this difficult process, manufacturers provide recovery tension tables that describe the maximum recommended recovery speed in a given water depth and at a given recovery angle for each cable type manufactured.

Figure 3.6: Image of a surface-laid cable taken during a post-lay inspection by an ROV. This image reveals the cable in the throes of burial by mobile gravel. *Source: Transpower New Zealand and Seaworks.*

BEST PRACTICE

Most of the larger companies operating in the submarine cable industry typically work to standards and quality management systems set by the International Organization for Standards under the ISO 9000 and ISO 9001 schemes. In addition, the International Cable Protection Committee (ICPC) publishes recommendations on key issues such as cable routing, cable protection and cable recovery that are available to anyone on request. Although their observance is not mandatory, these recommendations are designed to facilitate quality improvement and are often cited by third parties as examples of best practice in the industry (ICPC, 2009). Guidelines relating to submarine cable activities are also published by the Submarine Cable Improvement Group (SCIG, 2009) and the UK Cable Protection Committee (UKCPC, 2009).

4. International law

INTERNATIONAL CONVENTIONS

The invention of the submarine telegraph cable, and its successful use to span oceans and link nations, was immediately recognized as 'necessary to maintain the vitality of our modern international State system' and 'an interest of the highest order to States' (Twiss, 1880). The international community responded to this recognition with the International Convention for the Protection of Submarine Cables (1884) (Box 4.1).

> **BOX 4.1: INTERNATIONAL CONVENTION FOR THE PROTECTION OF SUBMARINE CABLES, 1884**
>
> The Cable Convention continues to be widely used in the cable industry. While its essential terms are included in the United Nations Convention on the Law of the Sea (UNCLOS), the Cable Convention remains the only treaty that provides the detailed procedures necessary to implement them. See:
>
> - Article 5 special lights and day shapes displayed by cable ships; minimum distances ships are required to be from cable ships;
> - Article 6 minimum distance ships are required to be from cable buoys;
> - Article 7 procedures for sacrificed anchor and gear claims;
> - Article 8 competency of national courts for infractions;
> - Article 10 procedures for boarding vessels suspected of injuring cables and obtaining evidence of infractions.
>
> Article 311(2) of UNCLOS recognizes the continued use of these provisions, which are compatible with and supplement UNCLOS.

> **BOX 4.2: CULPABLE NEGLIGENCE**
>
> The origin of the term 'culpable negligence' is found in Renault (1882), where reference is made to two early English cases: *Submarine Cable Company v. Dixon*, The Law Times, Reports-Vol. X, N.S. at 32 (5 March 1864) and *The Clara Killian*, Vol. III L.R. Adm. and Eccl. at 161 (1870). These cases hold that culpable negligence involves a failure to use ordinary nautical skill that would have been used by a prudent seaman facing the situation that caused the cable fault. Since the term 'culpable negligence' was adopted in UNCLOS without discussion, it is reasonable to assume that the same standard applies under UNCLOS.

This Cable Convention was the foundation of modern international law for submarine cables as contained in the Geneva Conventions on the High Seas 1958 (Articles 26–30) and Continental Shelf 1958 (Article 4) and, most recently, in the United Nations Convention on the Law of the Sea (1982) (UNCLOS). UNCLOS establishes the rights and duties of all states, balancing the interests of coastal states in offshore zones with the interests of all states in using the oceans. Coastal states exercise sovereign rights and jurisdiction in the exclusive economic zone (EEZ) and on the continental shelf for the purpose of exploring and exploiting their natural resources, but other states enjoy the freedom to lay and maintain submarine cables in the EEZ and on the continental shelf (Figure 4.1). In archipelagic waters and in the territorial sea, coastal states exercise sovereignty and may establish conditions for cables or pipelines entering these zones (UNCLOS, Article 79(4)). At the same time, the laying and maintenance of submarine cables are considered reasonable uses of the sea and coastal states benefit from them. Outside of the territorial sea, the core legal principles applying to international cables can be summarized as follows (UNCLOS, Articles 21, 58, 71, 79, 87, 112-115 and 297(1)(a)):

- the freedoms to lay, maintain and repair cables outside of territorial seas, including cable route surveys incident to cable laying (the term laying refers to new cables while the term maintaining relates to both new and existing cables and includes repair) (Nordquist *et al.*, 1993, p. 915);
- the requirement that parties apply domestic laws to prosecute persons who endanger or damage cables wilfully or through culpable negligence (Box 4.2);
- the requirement that vessels, unless saving lives or ships, avoid actions likely to injure cables;
- the requirement that vessels must sacrifice their anchors or fishing gear to avoid injury to cables;
- the requirement that cable owners must indemnify vessel owners for lawful sacrifices of their anchors or fishing gear;

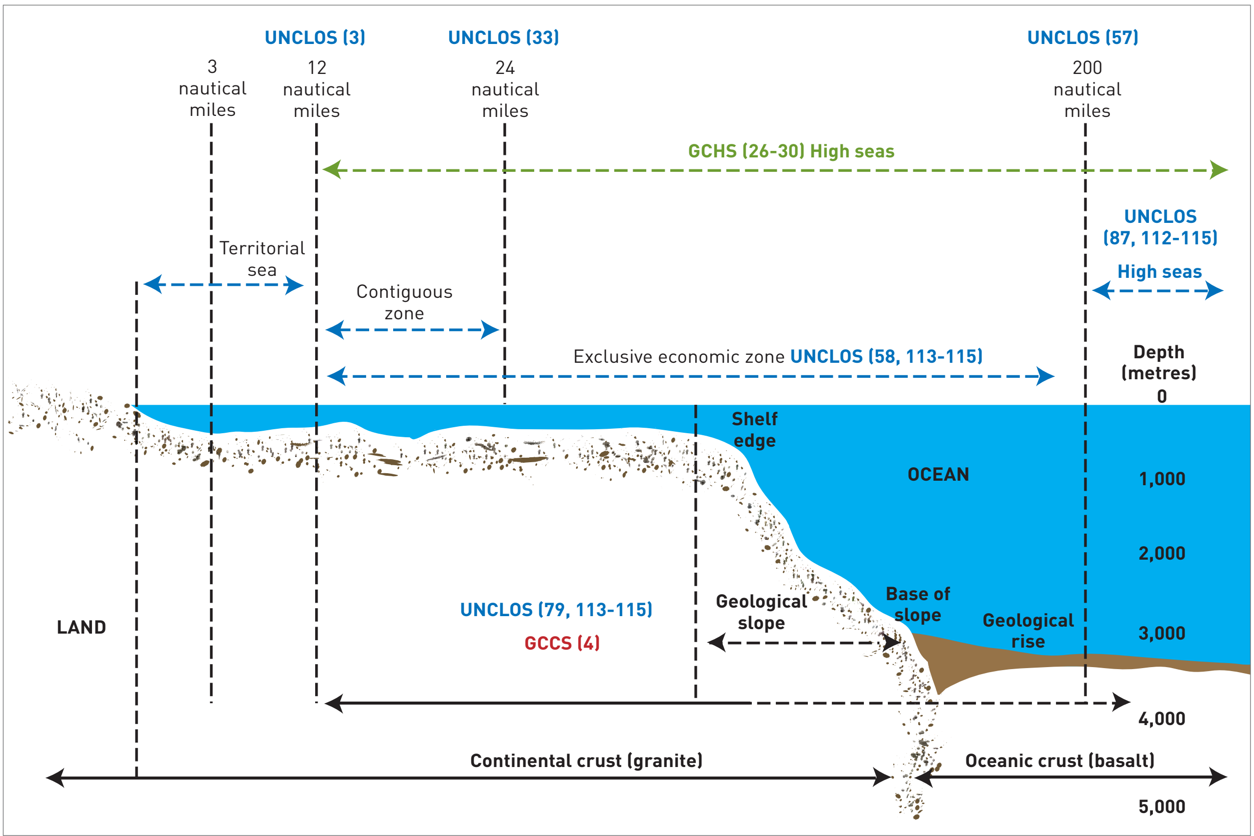
- the requirement that the owner of a cable or pipeline, who in laying or repairing that cable or pipeline causes injury to a prior laid cable or pipeline, indemnify the owner of the first laid cable or pipeline for the repair costs;
- the requirement that coastal states along with pipeline and cable owners shall not take actions which prejudice the repair and maintenance of existing cables.

These traditional rights and obligations were carefully codified by the UNCLOS drafters who were familiar with the historical state practice of cables. Parts IV to VII of UNCLOS set out the rights and obligations in the following UNCLOS designated zones: archipelagic waters, the EEZ, the continental shelf and the high seas (Figure 4.1). UNCLOS treats all cables the same, whether they are used for telecommunications or power transmission or for commercial, military or scientific purposes.

While natural occurrences such as submarine landslides or turbidity currents occasionally damage submarine cables, the most common threat to cables is other human activities, especially bottom fishing (Chapter 7). In many countries, careful route planning helps to avoid damage to cables and to cultural seabed features (Wagner, 1995). With respect to potential adverse impacts caused by submarine cables, UNCLOS indirectly takes into account their potential environmental impact by distinguishing cables from submarine pipelines, i.e. on the continental shelf it allows a coastal state to delineate a route for a pipeline but not for a cable (Article 79(3)). The reason for this distinction is that there is clearly a need to prevent, reduce and control any pollution that may result from pipeline damage. By comparison, damage to a submarine telecommunications cable is unlikely to involve pollution (Nordquist *et al.*, 1993, p 915), but may significantly disrupt international communications and data traffic.

More generally, UNCLOS, in its preamble, recognizes the desirability of establishing 'a legal order for the seas and oceans which will facilitate international communication, and will promote the peaceful uses of the oceans and seas, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment'.

Figure 4.1: Legal boundaries of the ocean from territorial sea to exclusive economic zone and onto the high seas (figures in parenthesis refer to treaty articles). *Source: D. Burnett.*



Submarine cables clearly facilitate international communication, along with freedoms of navigation and overflight. Part XII of UNCLOS establishes the legal duty of all states to protect and preserve the marine environment (Article 192). It establishes a general legal framework for this purpose, which balances economic and environmental interests in general as well as the interests of coastal states in protecting their environment and natural resources and the rights and duties of other states. To flesh out the framework, it requires states to adopt more detailed measures to ensure that pollution from activities under their control does not cause environmental damage to other states or areas beyond national jurisdiction. States shall, consistent with the rights of other states, endeavour to observe, measure, evaluate and analyse, by recognized scientific methods, the risks or effects of pollution of the marine environment (Article 204).

Figure 4.2: Rights and obligations relating to submarine cables in the world's oceans can be enforced in national courts or in the International Tribunal for the Law of the Sea, shown in session in Hamburg, Germany. *Source: Stephan Wallocha.*

CABLES AS CRITICAL INFRASTRUCTURE

An emerging trend is for states to treat international cables in national maritime zones as critical infrastructure that deserves strong protection to complement traditional international cable law. In that vein, Australia, consistent with international law, has legislated to protect its vital cable links by creating seabed protection zones that extend out to 2,000 m water depth. Bottom trawling and other potentially destructive fishing practices, as well as anchoring, are prohibited inside these zones. Three international cables carry around 99 per cent of Australia's voice and data traffic and in 2002 were worth more than AU$5 billion a year to the country's economy (Telecommunications and Other Legislation Amendment (Protection of Submarine Cables and Other Measures) Act 2005; proposed regulations for submarine cables off Sydney, New South Wales (August 2006)). New Zealand has also enacted legislation that established no-fishing and no-anchoring zones around cables (Submarine Cable and Pipeline Protection Act (1966)). The trend is expected to continue because most nations depend on cables for participating in the global economy and for national security, e.g. the United States relies on cables for over 95 per cent of its international voice and data traffic, only 7 per cent of which could be carried by satellites if the cables were disrupted (Burnett, 2006). These developments sometimes go hand in hand with conservation, as restrictions on trawling to prevent cable damage can also provide direct benefits for biodiversity by protecting vulnerable seabed ecosystems and species such as corals and sponges (CBD, 2003).

Since UNCLOS, the parties to the UNESCO Convention on Underwater Cultural Heritage (2001) agreed to exempt cables from that treaty because of the specific provisions of UNCLOS and the agreement of the parties that cable laying and maintenance posed no threat to underwater cultural heritage.

There are numerous international conventions that build on the UNCLOS framework to further specify requirements for ocean uses such as international shipping or fisheries, but not for submarine cables. Other treaties elaborate on what states should generally do to protect and preserve the marine environment and, as embodied in the 1992 Convention on Biological Diversity (CBD), to conserve and sustainably use marine biodiversity. All of these conventions function in accordance with the UNCLOS framework, both within and beyond national jurisdiction. However, there are no conventions that further elaborate the legal framework for cables established by UNCLOS and the earlier Cable Convention.

The laying and maintenance of telecommunications cables is a reasonable use of the sea, and in 159 years of use, there has been no irreversible environmental impact. UNCLOS and state practice have provided adequate governance for international cables outside of national waters, and state practice increasingly recognizes the importance of protecting cables from activities that could damage them. The corresponding benefits of cable protection zones for biodiversity conservation have also been recognized. Yet increasing use of the oceans and seabed is likely to result in more conflicts between users (Figure 4.2). This may require future changes in the existing international legal regime. Careful planning may also be necessary to avoid adverse impacts on vulnerable seafloor ecosystems and biodiversity. Consistent with past practice and recognizing the importance of cables to the world's infrastructure, any change to the existing international law requires express provisions in an international treaty.

5. Environmental impacts

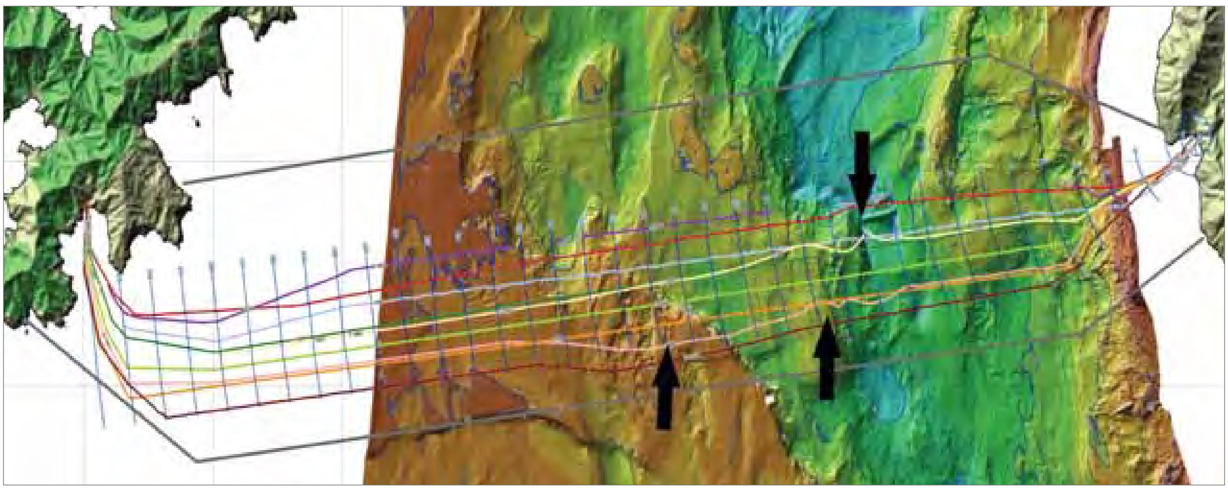
The total length of fibre-optic cables in the world's oceans is c.1 million km (J. Annals, Global Marine Systems Ltd, pers. comm., 2007). In terms of physical size, a modern cable is small (Chapter 2). The deep-ocean type has a diameter of 17–20 mm and its counterpart on the continental shelf and adjacent upper slope is typically 28–50 mm diameter because of the addition of protective armouring. Despite this small footprint, fibre-optic cables may still interact with the benthic environment. This chapter begins with an overview of the procedures for evaluating those interactions via the environmental impact assessment (EIA) process. This is followed by a synopsis of those environmental interactions of cables laid on and into the seabed, using the peer-reviewed science literature supported by open-file and published reports. The chapter concludes with some general considerations regarding cables and the environment.

ENVIRONMENTAL IMPACT ASSESSMENTS

For some countries, domestic law and regulations require an analysis of the project's effects on the natural environment. The report that is subsequently produced is commonly referred to as an environmental impact assessment (EIA). The breadth of content, level of detail and time required to undertake an EIA in relation to a proposed submarine cable project varies considerably from country to country. Nevertheless, the principle of assessing a project's effect on the environment is well established in Europe, Australasia, North America and parts of Asia and Africa.

The purpose of an assessment is to ensure that any environmental effects of cable laying and maintenance are taken into account before authorization is provided to lay a cable on the seabed (e.g. Hong Kong Environmental Protection Department, 2002; Monterey Bay National Marine Sanctuary, 2005; North American Submarine Cable Association, 2008). However, the extent to which a permit application requires an EIA depends on the regulatory process. It can range from the provision of relevant technical information and a statement of compliance with environmental accreditation, to a brief environmental review, to a comprehensive analysis that includes formal public and/or governmental consultation. Schedules for completing an assessment range from a few weeks to a year or longer. This depends on the quantity and quality of data needed, the level of documentation and consultation required, and the presence of sensitive environmental resources within the project's bounds.

Figure 5.1: Telecommunications and power cables laid on the seabed surface of Cook Strait, New Zealand, because the presence of rock and the constant movement of sediment by powerful tidal flows make it impractical to bury them. Protection is afforded by a legal cable protection zone (boundaries are grey lines on multibeam image). Even so, fibre-optic cables were displaced (arrows) by illegal fishing prior to full-time boat patrols of the zone, when such incidents ceased. *Source: Transpower New Zealand, Seaworks and NIWA.*



A formal EIA typically has five components:

1. description of the proposed operation;
2. description of the receiving environment (covering all relevant physical, geological, biological and anthropogenic/socio-economic factors);
3. evaluation of potential effects on the environment;
4. assessment of mitigating measures needed to reduce any effects to an environmentally acceptable level (i.e. spatial or temporal limitations, replacement, re-establishment or restoration of affected environments);
5. assessment of any monitoring measures needed to ensure that the extent of an effect (mitigated or otherwise) is maintained at an acceptable level.

This documentation is usually followed by a non-technical summary, which is a 'reader-friendly' synopsis for general circulation in a consultation process. As well as evaluation of existing data, an EIA may require field surveys that involve seabed mapping and sampling of sediments, rocks, fauna, flora and biochemistry (Chapter 3).

EIAs for cable operations are rare and are generally limited to a coastal state's territorial sea. The European Union EIA Directive currently does not explicitly impose an EIA requirement on cable-laying projects. That, of course, does not discount the possibility of an EIA being required as a result of a submarine cable planning application. Indeed, such applications are most likely to be routinely reviewed by the appropriate authority.

CABLES ON THE SEABED

Modern cables are usually buried into the seabed at water depths down to c.1,500 m as a protective measure against human activities (Chapters 3 and 7). However, some shallow-water cables may be placed on the seabed in areas unsuitable for burial, e.g. rock or highly mobile sand (Figure 5.1). For water depths greater than c.1,500 m, deployment on the seabed is the preferred option (Chapter 3).

Surveys

Cable route surveys rely primarily on acoustics-based echo-sounding, sonar and seismic systems. These focus on the seabed surface and, where burial is concerned, the few metres of sediment below the seabed. Accordingly, high-frequency low-energy acoustic systems are used to provide the necessary precision and detail to define a suitable route. Given our incomplete knowledge of the different responses of marine animals to different sources of noise (National Research Council, 2003), cable survey equipment is regarded as posing only a minor risk to the environment (SCAR, 2002) compared to prolonged high-energy mid-range sonar systems, which may be associated with strandings of some whale species (Fernandez *et al.*, 2005) and are the subject of ongoing research (Claridge, 2007).

Physical interactions

Surface-laid cables may physically interact with the seabed under natural or human influences. Continental shelves are typically exposed to wave and current action, including tidal flows that move sediment and result in the burial, exposure or even undermining of a cable (Figure 5.1; Carter and Lewis, 1995; Carter *et al.*, 1991). Where undermining is significant, the suspended cable can vibrate or strum under the water motions. Such actions may abrade the rocks supporting the suspension and the cable itself. Observed suspensions off California indicate that rock abrasion occurs mainly in the zone of frequent wave activity in water depths of less than c.20 m (Kogan *et al.*, 2003, 2006); abrasion marks ranged from 6 to 45 cm wide. Where the suspensions are long lived, they can be colonized by encrusting marine biota (Figure 5.2) that can biologically cement the cable to the rock suspension points.

Cables undergo self-burial that is either temporary or permanent. Where routes traverse fields of mobile sand waves, burial takes place as the sand-wave crest passes across the cable. Exhumation may follow with the passage of the sand-wave trough (Allan, 2000). Temporary burial

Figure 5.2: Surface-laid submarine cable, which has served as a substrate for the growth of epifauna. *Source: Nigel Irvine.*

also occurs nearshore, where 'fair-weather' accumulation of sand may be interrupted by storm-forced waves and currents that erode the substrate to expose a previously buried cable (Carter and Lewis, 1995). In zones of high sediment accumulation, cables can be rapidly buried by depositing sediment or simply settle into a soft substrate. Off California, for example, about half of a 95 km-long scientific coaxial cable was covered by sediment in the eight years following its surface installation (Kogan *et al.*, 2003).

Bottom trawl fishing and ships' anchoring can displace and/or damage cables (NOAA, 2005). To protect against such mishaps, cables are routinely buried beneath the seabed (Chapters 3 and 7). Where burial is impractical, a cable protection zone may be enforced whereby all potentially damaging human activities are prohibited (Figure 5.1; e.g. ACMA, 2007; Transpower and Ministry of Transport, 2008). Such measures are only as good as their enforcement, which may entail constant surveillance, including vessel patrols and electronic monitoring of all ship movements. Dialogue with other seabed users, along with public education regarding the importance of submarine cables, is also an effective protection measure (Chapter 7).

Benthic biota

Any interaction of cables with seabed life may be evaluated by assessing and monitoring the biota before and after cable installation (Andrulewicz *et al.*, 2003) or, in the case of installed cables, by comparing the biota at sites near and distant from a cable (Grannis, 2001; Kogan *et al.*, 2003). In addition, there are reports of epifauna and epiflora that live on the cables themselves (Figure 5.2; Ralph and Squires, 1962; Levings and McDaniel, 1974).

Overall, those studies demonstrate that cables have no or minimal impact on the resident biota. On the basis of 42 hours of video footage, the comprehensive study of Kogan *et al.* (2003, 2006) showed no statistical difference in the abundance and distribution of 17 animal groups living on the seabed within 1 m and 100 m of a surface-laid coaxial scientific cable. Likewise, 138 sediment cores with an infauna of mainly polychaete worms, nematodes and amphipods showed that the infauna was statistically indistinguishable whether near or distant from the cable. The main difference associated with the cable was that it provided a hard substrate for the attachment of anemones (Actiniaria). These organisms were abundant where the cable traversed soft sediment that normally would be unsuitable for such animals (Figure 5.3). Fishes, especially flat fishes, were more common close to the cable at two observational sites where small patches of shell-rich sediment had formed, probably in response to localized turbulence produced by current flow over the cable.

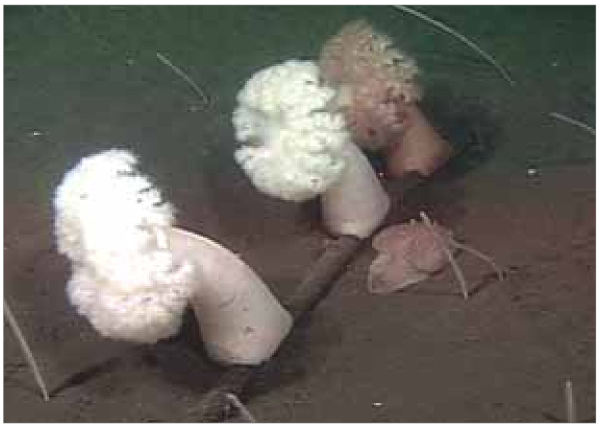


Figure 5.3: The exposed ATOC/Pioneer Seamount cable with attached anemones (*Metridium farcimen*) at c.140 m water depth. The cable provides a hard substrate on an otherwise soft seabed. The thin, erect organisms are sea pens (*Halipteris* sp.), and the mollusc *Pleurobranchaea californica* is next to the 3.2 cm wide cable. *Source: Monterey Bay Aquarium Research Institute (MBARI).*

Marine mammals and fish

Records extending from 1877 to 1955 reveal that 16 faults in submarine telegraph cables were caused by whales (Heezen, 1957; Heezen and Johnson, 1969). Thirteen of the faults were attributed to sperm whales, which were identified from their remains entwined in the cables. The remaining faults were caused by a humpback, killer and an unknown whale species. In most instances, entanglements occurred at sites where cables had been repaired at the edge of the continental shelf or on the adjacent continental slope in water depths down to 1,135 m. However, whale entanglements have nowadays ceased completely. In a recent review of 5,740 cable faults recorded for the period 1959 to 2006 (Wood and Carter, 2008), not one whale entanglement was noted (Figure 5.4). This cessation occurred in the mid-1950s during the transition from telegraph to coaxial cables, which was followed in the 1980s by the change to fibre-optic systems.

The absence of entanglements since the telegraph era reflects the following developments in cable design and laying:

- advances in design, especially the achievement of torsional balance, lessened the tendency of coaxial and fibre-optic cables to self-coil on the seabed;
- accurate seabed surveys, coupled with improved vessel handling and laying techniques, reduced suspensions and loops by laying cables under tension while following the seabed topography and avoiding excessively rough rocky substrates;

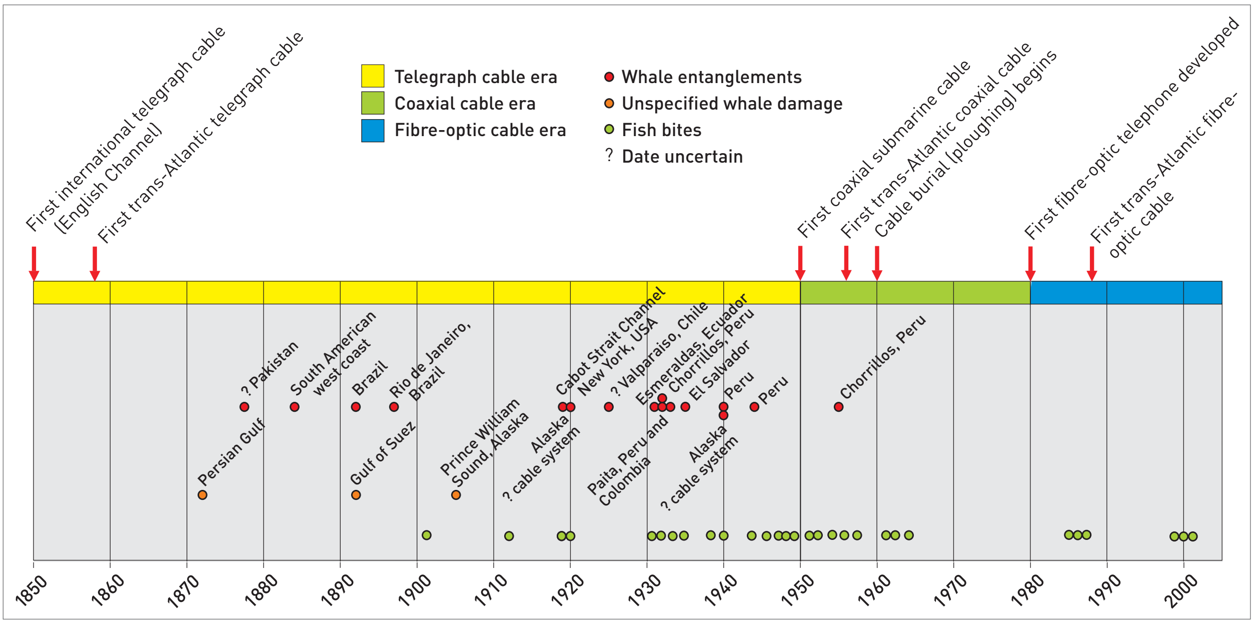


Figure 5.4: Interaction of whales and fish with submarine cables over time. The cessation of whale entanglements coincided with the improved design and laying techniques of the coaxial and fibre-optic eras. In contrast, fish bites (including those of sharks) have continued. *Source: Wood and Carter (2008) and IEEE Journal of Oceanic Engineering.*

- burial of cables into the seabed on the continental shelf and slope down to c.1,500 m water depth, which is the typical maximum diving limit of sperm whales (Watkins *et al.*, 2002);
- fault repair techniques that are designed to minimize slack cable and, if the repaired section is on the continental shelf or slope, burial beneath the seabed, usually with the assistance of an ROV.

Is the cessation of whale entanglements since 1959 possibly a consequence of non-reporting? This is unlikely because:

- whale entanglements prior to 1959 were reported in the scientific literature (Heezen, 1957; Heezen and Johnson, 1969);
- interactions with other marine animals since 1959 have been reported (ICPC, 1988; Marra, 1989);
- cable repairs are undertaken by a few specialized maintenance groups contracted to many cable owners and operators, and are therefore required to operate at high standards, which would reduce the chance of non-reporting;
- an event such as a whale capture is unlikely to escape media attention when electronic communication is so freely available, even at sea.

Fish, including sharks, have a long history of biting cables as identified from teeth embedded in cable sheathings (Figures 5.4 and 5.5). Barracuda, shallow- and deep-water sharks and others have been identified as causes of cable failure (ICPC, 1988; Marra, 1989). Bites tend to penetrate the cable insulation, allowing the power conductor to ground with seawater. Attacks on telegraph cables took place mainly on the continental shelf and continued into the coaxial era until c.1964. Thereafter, attacks occurred at greater depths, presumably in response to the burial of coaxial and fibre-optic cables on the shelf and slope. Coaxial and fibre-optic cables have attracted the attention of sharks and other fish. The best-documented case comes from the Canary Islands (Marra, 1989), where the first deep-ocean fibre-optic cable failed on four occasions as a result of shark attacks in water depths of 1,060–1,900 m (Figure 5.5). Reasons for the attacks are uncertain, but sharks may be encouraged by electromagnetic fields from a suspended cable strumming in currents. However, when tested at sea and in the laboratory, no clear link between attacks, electromagnetic fields and strumming could be established. This lack of correlation may reflect differences between the behaviour of the deep-water sharks responsible for the bites and that of the shallow-water species used in the experiments. Whatever the cause, cables have been redesigned to improve their protection against fish biting.

Leaching from cables

Modern deep-water fibre-optic cables are composed of several pairs of hair-like glass fibres, a copper power conductor and steel wire strength member, which are all sheathed in high-density polyethylene. Where extra protection is required, as for areas of rocky seabed or strong wave and current action, additional steel wire armour is added (Chapter 2). No anti-fouling agents are used (Emu Ltd, 2004). Of these materials, cable-grade polyethylene is essentially inert in the ocean. Processes such as oxidation, hydrolysis (chemical breakdown in water) and mineralization are extremely slow; the total conversion of polyethylene to carbon dioxide and water will take centuries (Andrady, 2000). The effects of ultraviolet light (UV-B), the main cause of degradation in most plastics, are minimized through the use of light-stabilized materials, burial into the seabed and the natural reduction in light penetration through the upper ocean, where the photic zone rarely extends beyond 150 m depth. Any mechanical breakdown of a cable's plastic sheathing to fine-grained particles on the energetic continental shelf – a potential hazard for marine life (Allsop *et al.*, 2006 and references therein) – is minimized by armouring and burial.

With respect to other cable components, data on their behaviour in seawater are sparse, with the exception of a study under way at Southampton University, UK (Collins, 2007). Various types of fibre-optic cable were immersed in containers with 5 litres of seawater, which was tested for copper, iron and zinc – potential leachates from the conductors and galvanized steel armour. Of these elements only zinc passed into the seawater, yielding concentrations of less than 6 parts per million (ppm) for intact cables and less than 11 ppm for cut cables with exposed wire armour ends. The amount of leaching declined after c.10 days. Bearing in mind that tests were carried out in a small, finite volume of seawater, zinc leachate in the natural environment would be less due to dilution by large volumes of moving seawater. Furthermore, zinc is a naturally occurring element in the ocean, with concentrations in fish and shellfish ranging from 3 to 900 ppm (Lenntech, 2007).

CABLES INTO THE SEABED

Installation of cables into the seabed can disturb the benthic environment. Compared to other offshore activities such as bottom trawling, ship anchoring and dredging, disturbance related to cable burial is limited in its extent, and is a non-repetitive procedure, unless a cable is damaged (Chapter 3). The decommissioning and recovery of a buried system may also result in benthic disturbance, but again it is of limited extent and relatively infrequent, reflecting the 20–25 year design life of a fibre-optic cable. The following discussion examines the type and extent of seabed disturbance associated with cable installation, maintenance and decommissioning, followed by a brief overview of seabed recovery after disturbance.

Seabed disturbance

Route clearance

Prior to installation, any debris is cleared from a cable route by deployment of a ship-towed grapnel (NOAA, 2005; NSR Environmental Consultants, 2002). This tool penetrates 0.5–1.0 m into soft sediment and is generally not used in rocky areas. In accord with modern practice, the location of the grapnel is carefully monitored to ensure that burial follows the grapnel route as closely as possible so that the cable is installed in a debris-free zone.

Ploughing

As a plough passes across the seabed, the share opens a furrow, inserts the cable and allows sediment to fall back, thereby filling the fissure (Allan, 1998). However, the precise nature of this disturbance will vary with substrate type, depth of burial and plough type (Hoshina and Featherstone, 2001; Jonkergrouw, 2001; Mole *et al.*, 1997; Turner *et al.*, 2005). In nearshore zones including tidal flats, special ploughs are available to lessen disturbance to, for example, eelgrass and seagrass beds (Ecoplan, 2003). Disturbance is also minimized by drilling conduits through which a cable may pass beneath biologically sensitive coastal areas (Austin *et al.*, 2004). On the continental shelf, burial to c.1 m depth in soft to firm sediment typically leaves a ploughed strip, c.0.3 m wide, in which the cable is entirely covered. However, burial in consolidated substrates may result in only partial closure of the furrow, with displaced sediment deposited at the furrow margins (NOAA, 2005). The skids that support the plough can also leave their footprint on the seabed, particularly in zones of soft sediment (Chapter 3). Potential effects are increased sediment compaction and the disruption of marine fauna. Overall, the disturbance strip produced by the plough-share and skids in direct contact with the seabed ranges from c.2 m to c.8 m wide, depending on plough size.

Figure 5.5: The crocodile shark (*Pseudocarcharias kamoharai*) is a small species that grows to just over 1 m long. On the basis of teeth embedded in the Canary Islands fibre-optic cable, it was found to be a main instigator of the bite-related faults. *Source: National Marine Fisheries Service, NOAA.*

Jetting

This method is used to bury cables that are already laid. Some systems use a combination of ploughing and jetting for burial but, in general, jetting is favoured for deep parts of a route where steep slopes or very soft sediment are unfavourable for ploughing (Hoshina and Featherstone, 2001; Jonkergrouw, 2001). It is also used to rebury repaired sections. Modern post-lay burial relies on an ROV that is equipped with jets to liquefy the sediment below the cable, allowing it to sink to a specified depth (Chapter 3). The width of disturbance zones associated with jetting (liquefaction and coarse sediment redeposition) is typically about 5 m (Ecology and Environment, 2001), but fine-grained silt and clay may be dispersed further afield in plumes of turbid water. Organisms directly within the zone of liquefaction can be damaged or displaced, whereas biota near the jetting zone may receive the resuspended sediment (NOAA, 2005). Any effect on and recovery of the biota will depend on a suite of variables including the amount and particle size of the suspended sediment, ambient current and wave conditions, seabed topography, the nature of the benthic biota and the frequency of natural disturbances (see *Seabed recovery*).

Cable repairs

Around 70 per cent of all cable failures associated with external aggression are caused by fishing and shipping activities in water depths shallower than 200 m (Kordahi and Shapiro, 2004). Accordingly, cables are buried for protection, an action which, together with an increased awareness of cables by other seabed users, has produced a marked fall in the number of faults per 1,000 km of cable. Faults related to component failure have also decreased in response to improved cable system design (Featherstone *et al.*, 2001). Nevertheless, faults still occur and require repair. For buried cables, the repair procedure relies on towing a grapnel across the path of the cable, cutting the cable and retrieving both ends. Onboard the repair ship, a new section may be inserted or 'spliced' to replace the damaged cable. The repaired section is re-laid on the seabed at right angles to the original route so as to minimize slack produced by insertion of the splice (Drew and Hopper, 1996). The repair is then reburied by a jet-equipped ROV (e.g. Mole *et al.*, 1997). Where water depths permit, ROVs may also be used to retrieve damaged cables both on and below the seabed. As this technique is likely to require no or few grapnel runs, seabed disturbance is reduced.

Cable removal

As cables reach the end of their design life or become redundant due to technological advances, their removal from the seabed may be considered. In the case of a buried cable, its removal may result in disturbance, the extent of which has been assessed for offshore UK by Emu Ltd (2004). In essence, as a cable is pulled from the seabed it disturbs the sediments and associated benthic fauna. The degree of disturbance is closely related to the type of substrate, with soft sandy and muddy sediments suffering little or no impact, whereas consolidated substrates, such as stiff clay and chalk, may create fine-scale rough topography from fragments of consolidated material ejected during cable extraction. For bedrock, a cable is usually laid on the rocky surface if outcrops cannot be avoided. In that context, the cable may support an epifauna which would be lost during a recovery procedure. It may then be deemed prudent to leave the cable in place in order to preserve the epifauna.

How much do submarine cables affect the environment?

A sense of context

Disturbances and impacts caused by cable laying and repairs must be viewed in the context of the frequency and extent of these activities. Clearance of debris from a path proposed for cable burial is usually followed within days to weeks by actual burial. Unless a cable fault develops, the seabed may not be disturbed again within the system's design life. Furthermore, the one-off disturbance associated with cable placement is restricted mainly to a strip of seabed less than 5–8 m wide. For comparison, bottom trawl and dredge fishing operations are repetitive and more extensive (e.g. National Research Council, 2002; UNEP, 2006). A single bottom trawl can be tens of metres wide, sweep substantial areas of seabed in a single operation and is likely to be repeated over a year at the same site. As noted by NOAA (2005), a single impact, such as a cable burial, is preferred to continuous, multiple or recurring impacts.

Seabed recovery

Seabed disturbance related to cable operations most commonly occurs in the burial zone from 0 to c.1,500 m water depth. This is also the main range of disturbance resulting from human activities as well as natural forces such as storm waves and currents, etc. (UNEP, 2006; Nittrouer *et al.*, 2007). The time taken for the seabed to recover depends on the natural dynamics of the various environments and the type of disturbance. Much of our knowledge of seabed recovery is based on studies of areas disturbed by fishing or large natural perturbations (e.g. National Research Council, 2002; Kroeger *et al.*, 2006 and references therein) with additional information provided by several cable-specific studies (e.g. Andrulewicz *et al.*, 2003; Grannis, 2001; NOAA, 2005).

Coastal zone

For coastal wetlands and inter-tidal zones, the use of various techniques to meet different environmental conditions has helped to reduce disturbance. A specially designed, low-impact vibrating plough was used to bury a cable through salt marshes along the Frisian coast, Germany. A post-lay monitoring survey recorded the re-establishment of salt marsh vegetation within one to two years and full recovery at most monitoring sites within five years (Ecoplan, 2003). In Australia, cables crossing seagrass beds were placed in narrow slit trenches (40 cm wide) that were later replanted with seagrass removed from the route prior to installation (Molino-Stewart Consultancy, 2007). A similar technique was used for eelgrass beds in Puget Sound where cables were also installed in conduits drilled under the beds to minimize disturbance (Austin *et al.*, 2004). Soft sediment communities in artificially disturbed muddy mangrove flats recovered in two to seven months depending on the intensity of the disturbance (Dernie *et al.*, 2003). With respect to high-energy sandy coasts, any physical disturbance is usually removed within days to weeks through natural wave and current action (e.g. CEE, 2006; Carter and Lewis, 1995).

Continental shelf and slope

The continental shelf has a range of substrates and habitats that reflect:

- the amount of sediment discharged from rivers and produced directly in the ocean and seabed through biological growth;
- wave and current action that erodes, disperses and deposits sediment;
- the local geology (e.g. Nittrouer *et al.*, 2007).

Of course, these influences are themselves ultimately controlled by the climate, regional oceanography and tectonic framework. With respect to unconsolidated sediment, the amount of wave energy required to mobilize it decreases with water depth. Thus, on the inner continental shelf (typically less than 30 m deep), sand is frequently moved by swell in the presence of local currents. Sediment movement is less frequent on the middle shelf (c.30 to 70 m depth), occurring mainly during storms when swell and current activity intensifies. Finally, sediment movement on the outer shelf (c.70 m to the shelf edge at an average depth of c.130 m) is infrequent, being controlled mainly by the passage of major storms. However, movement may be more frequent at the shelf edge *per se*, where the steepened topography intensifies local currents and causes internal waves (i.e. waves formed along density surfaces under the ocean surface) to break like a normal wave on a beach.

This generalized picture of shelf behaviour is influenced and sometimes over-ridden by local conditions. For instance, the powerful tides in the North Sea, Straits of Messina, Bass Strait and Cook Strait, frequently move sediment at most shelf depths. Whatever the forcing mechanism, physical restoration of the seabed is most rapid on those shelves with a substantial supply of sediment and moderate to high wave or current action. Thus any cable-related disturbance of sandy substrates on the inner shelf is usually rectified within days to months (CEE, 2006; DeAlteris *et al.*, 1999; NOAA, 2007). Likewise, the benthic communities also recover quickly because they have natural adaptive behaviours gained from an environment subject to frequent change. Bolam and Rees (2003), for instance, show that benthic macrofaunal communities in energetic zones recovered within nine months following the dumping of dredge spoil.

Where possible, cable routes avoid zones of rocky reef because of operational difficulties in protecting cables on hard substrates and potential disturbance of reef ecosystems (e.g. Ecology and Environment, 2001; Science Applications International, 2000).

On the middle shelf (c.30–70 m depth), zones of disturbance are likely to remain longer due to less frequent wave and current activity (e.g. NOAA, 2005). However, if local currents are active, sediment movement will restore equilibrium, as observed in the Baltic Sea where a cable trench collected sand to the point that, one year after laying, any physical dislocation of the seabed was erased (Andrulewicz *et al.*, 2003). Furthermore, the post-lay inspection failed to detect significant changes in the composition, abundance and biomass of benthic animals. In the case of muddy substrates, cable-related disturbances may persist longer than in mobile sand settings. In Stellwagen National Marine Sanctuary off Massachusetts, USA, slow sedimentation had not completely infilled a cable trench one year after ploughing (Grannis, 2001). However, there was no detectable effect on the epifauna, which appears to have recovered in the one-year period. Where the cable trench passed through an area of active bottom fishing grounds, the epifauna was more abundant within the trench; a feature that was attributed to fishing-induced resuspension of fine sediment within the trench to expose gravel fragments that provided substrates for epifaunal colonization. A similar response was noted in a cable trench in Olympic National Marine Sanctuary off Washington State, USA (NOAA, 2005), where exposed consolidated sediment attracted an epifauna which, in this case, differed from the benthos in undisturbed sediment.

The speed at which a trench infills depends on:

- its depth of incision;
- the sediment supply and wave or current action to carry the material to the trench, which tends to act as a sediment sink;
- the degree of sediment consolidation, with soft sediments tending to respond readily to wave and

current action whereas consolidated materials will be more resistant.

Continental shelves receiving large amounts of river mud and sand, such as those bordering the Pacific Ocean (Milliman and Syvitski, 1992), can expect several millimetres to centimetres of sediment to deposit each year. This appears to be the case on the Californian shelf, where repeated surveys of a cable trench have shown persistent accumulation and burial over four years (California Coastal Commission 2005, 2007).

On the outer shelf and upper slope (more than 70 m deep), increasing water depth and distance from shore mean that burial disturbance remains longer due to reduced water movements and sediment supply, also bearing in mind that trenches in resistant sediments will persist longer than those in unconsolidated materials (NOAA, 2005). The exceptions are very narrow shelves, where river discharges can extend over much of the shelf, and the continental shelf edge, where tidal and other currents may intensify to actively move sediment. Thus similar principles apply: mobile sediments and associated faunas will recover more rapidly than counterparts in quiet, stable settings.

CABLE PLACEMENT AND ECOLOGICALLY SIGNIFICANT AREAS

The last 15 years have witnessed substantial advances in our knowledge and understanding of deep-ocean ecosystems. International research initiatives are revealing hitherto unknown or poorly known habitats and ecosystems (Ausubel, 1999; Freiwald *et al.*, 2004; UNEP, 2005, 2006). Currently under the spotlight are seamounts, cold-water coral communities, hydrothermal vents such as those found along the volcanic mid-ocean ridges, deep-ocean trenches, submarine canyons and the lower continental slope, amongst others.

Figure 5.6: Deep-water coral thicket on Chatham Rise, New Zealand. *Source: Dr M. Clark, National Institute of Water and Atmosphere (NIWA).*

To gain an insight into the nature, role and importance of these habitats and ecosystems, deep-sea or cold-water corals are instructive as they were recently the subject of a major review (Freiwald *et al.*, 2004). Located in water depths of 40–1,000 m or more, cold-water corals occur in all the major oceans. To date, most have been found in the North Atlantic – a feature that probably reflects the intensive research and exploration efforts in that region rather than it being a preferred habitat. While their full extent is unknown, recent studies suggest that the area occupied by cold-water corals may rival or exceed the coverage of tropical reefs. Off Norway alone, cold-water reefs cover c.2,000 km^2, and on Blake Plateau, southeast of the United States, an estimated 40,000 reefs may be present (Paull *et al.*, 2000). Compared to tropical coral reefs with their massive structures and multiple species composition (up to c.800), cold-water reefs are created by only a few species (c.6), and their so-called 'reef' structure is often in the form of dense thickets that develop on rocky outcrops, sediment mounds and even coral debris (Figure 5.6). Furthermore, they are slow growing, with rates of 4–25 mm per year compared to rates of up to 150 mm per year for tropical forms.

While a full appreciation and understanding of the ecological role of these 'reef' communities has yet to be realized, they are known to provide habitats and nursery grounds for fish and other marine organisms. As a result, reefs are targets for bottom trawl fishing that can cause substantial damage. In order to conserve cold-water corals and other potentially vulnerable deep-water habitats, many countries have created (or are in the process of establishing) protected areas or closures where trawls and other bottom-contact fishing gear are prohibited (Hourigan, 2008). When extensive trawl damage was documented for the Darwin Mounds off northwest Scotland (Masson *et al.*, 2002; Wheeler *et al.*, 2004), the European Commission imposed an emergency measure in 2003 and one year later permanently prohibited the use of bottom fishing trawls and gear on the Mounds and across 1,380 km^2 of the surrounding seabed. The Darwin Mounds are now designated as an offshore marine protected area, the first in the United Kingdom and part of a developing network that is planned to extend throughout the marine waters of the European Union. The need for more research and (in parallel) for more management and protection is also reflected in the recurring themes at International Deep-sea Coral Symposia (ISDCS, 2008). These included:

- improved identification and understanding of cold-water coral reefs and the need for nationally consistent management plans;
- recognition and accommodation of seabed users,

including implementation of effective policing of marine protected areas;
- management decisions and policy for corals, conservation and human impacts.

In general terms, these themes highlight the need to use and protect the marine environment sustainably, especially in international waters beyond the jurisdiction of coastal states. In the case of submarine cables, the United Nations Convention on the Law of the Sea (UNCLOS) prescribes the freedom to lay, maintain and repair cables outside territorial seas, but these are not necessarily inconsistent with the need to protect deep-ocean habitats and ecosystems, which is also reflected in UNCLOS:

- cable deployment in the deep ocean, i.e. laying of a 17–20 mm diameter tube on the surface of the ocean floor, has a minor if not negligible one-off impact;
- cable repairs can result in substrate disturbance. However, cable failures in deep water are relatively rare and are mainly caused by major natural events such as the 2006 Taiwan earthquake and submarine landslide (Introduction). Cable repairs resulting from human and natural agents in water depths greater than 1,200 m are c.5 per cent and c.7 per cent respectively of all repairs (Featherstone *et al.*, 2001; Kordahi and Shapiro, 2004).

In addition, the submarine cable industry, together with environmental regulators, attempts to reduce or avoid any impact on vulnerable deep-water ecosystems by:

- utilizing modern seabed mapping and navigation systems that allow identification of benthic habitats in unprecedented detail and accuracy (e.g. Masson *et al.*, 2002; Pickrill and Todd, 2003). Together with modern cable-laying techniques, it is now possible to deploy cables to avoid ecologically and biologically sensitive areas;
- avoiding the deployment of cables on or through habitats such as seamounts, submarine canyons and hydrothermal vents, which are also unsuitable as cable routes due to the risk of natural hazards (Chapter 6). For example, canyons are often swept by powerful currents that may abrade or break cables (Krause *et al.*, 1970; Shepherd and Marshall, 1969); seamounts can be volcanically active and subject to landslides and hydrothermal venting.

CABLE PROTECTION ZONES AND MARINE RESERVES

As coastal states increase protection of their submarine cable infrastructure, it has been mooted that designated cable protection zones may act as *de facto* marine reserves

Figure 5.7: Cable protection zone for the New Zealand terminal of the Southern Cross and other international submarine cables. Such protection zones have the potential to act as *de facto* marine reserves. *Source: Telecom New Zealand.*

or sanctuaries (Froude and Smith, 2004). To gauge the reserve potential of such zones, a pilot study was made of exploitable fish species inside and outside the Southern Cross cable protection zone off New Zealand (Figure 5.7; Shears and Usmar, 2006). The authors found no statistical difference in species in or out of the zone, a result that was attributed to the short existence of the zone (four years) and illegal fishing. Furthermore, a zone must offer favourable habitats for marine species. In the case of the fish populations in or near the Southern Cross protection zone, fish preferred reef habitats rather than soft sediment substrates. Although results were inconclusive, the success of established marine reserves and sanctuaries suggests that cable protection zones with suitable habitats may help to maintain and improve biodiversity and species abundance, but this concept has yet to be proven.

6. Natural hazards

LEAVING THEIR MARK ON THE SEABED

The ocean encompasses a suite of dynamic environments that extend from the coast to the abyss. All are exposed to natural hazards, which are defined here as *naturally occurring physical phenomena caused by rapid- or slow-onset events, influenced by atmospheric, oceanic and geological forces that operate on timescales of hours to millennia* (modified from UNESCO, 2006). Such phenomena include weather-related disturbances, earthquakes, volcanic eruptions and, in the longer term, climate change. And all may directly or indirectly affect the safety of submarine cables.

The continental shelf and coast have a higher incidence of natural hazards due to the frequency of meteorological disturbances, as well as less frequent events such as tsunamis and earthquakes, all of which are overprinted on longer-term effects associated with tectonic and climatic change (e.g. Nittrouer, 1999; Gomez *et al*., 2004). As a result, coasts are exposed to flooding and erosion by surging seas and waves. The adjoining seabed may be scoured by currents and waves, or inundated by sediment as in the case of shelves fed by major rivers (Nittrouer *et al*., 2007). Some disturbances of the seabed can occur daily, as in tide-dominated settings (e.g. Carter and Lewis, 1995), or with the frequency of severe storms, which may strike once or more per year depending on the effects of climatic cycles such as the 3–8 year El Niño-Southern Oscillation or the 20–40 year Atlantic Multi-decadal Oscillation (NOAA, 2006).

The continental slope connects the shelf edge (average depth c.130 m) with the deep ocean at 1,000 m or more (Figure 6.1). Because of the slope's depth, the influence of storms is generally less than on the shelf. However, the slope is prone to gravitational forces. Sediment destabilized by earthquakes, tsunamis or severe storms moves down-slope as landslides that range from frequent small-volume (less than 1 km^3) displacements to rare giant slides of up to 20,000 km^3 (Figure 6.2; also Hampton *et al*., 1996; Collot *et al*., 2001). En route, slides may transform into more fluid debris flows or turbidity currents capable of travelling hundreds to thousands of kilometres (e.g. Krause *et al*., 1970; Piper *et al*., 1999).

Such catastrophic events leave their imprint in the form of landslide scars, zones of jumbled sediment masses, rough seabed topography (Figure 6.2) and, where turbidity currents are active, steep-sided submarine canyons. As well as down-slope movement of sediment, the continental slope acts as a boundary that guides currents and sediment along its flank.

The slope descends to the deep ocean – a nondescript term that belies a diversity of landforms and associated environments, including seamounts (many of which are

Figure 6.1: A generalized continental margin outlining the main depth-related zones and some of the processes that shape them. HST = high systems track deposited when sea level rises and encroaches shorewards; LST = low systems track when sea level lowers and retreats seaward. *Source: MARGINS Source to Sink Program, Lamont Doherty Geological Observatory.*

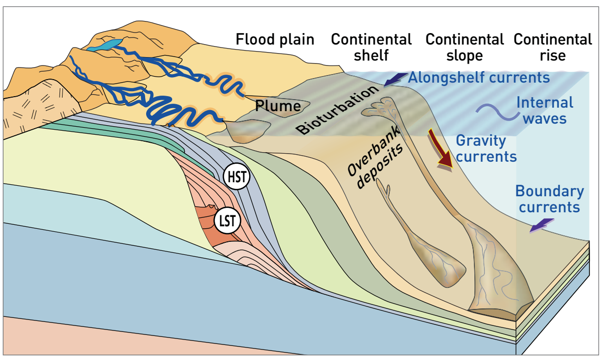
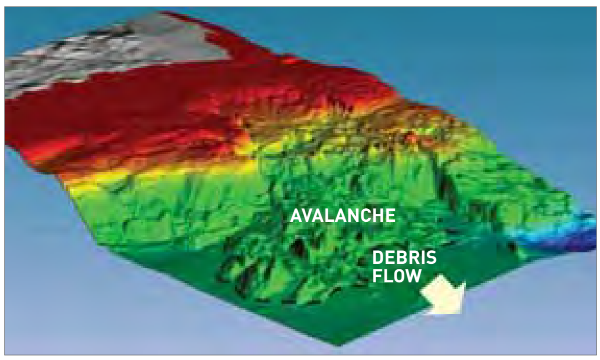


Figure 6.2: A giant submarine landslide (3,750 km^3 volume) comprising a blocky debris avalanche and a more fluid debris flow. This feature formed off New Zealand at the boundary between the colliding Pacific and Australian tectonic plates. *Source: Drs K. Lewis and G. Lamarche, NIWA.*



submarine volcanoes), mountain chains, plateaux, rises, fans and vast plains. There are also features that extend below the general ocean floor. Trenches, the deepest features on Earth, plunge several kilometres below the abyssal floor. Submarine channels may emanate from canyons incised into the continental slope, to wend their way across the ocean floor for distances sometimes exceeding 1,000 km. Each of these settings comes with its own hazards. Seamounts may be subject to volcanic activity that can form lava flows, hot-water vents, landslides and turbidity currents. Other steep-sided landforms may also be prone to landslides or erosion by currents that have intensified against marked topographic relief.

Contrary to the adage that 'still waters run deep', abyssal ocean currents can scour and transport sediment in water depths down to at least 6,000 m (Figure 6.3). Furthermore, these currents can be quite variable, with periods of steady flow punctuated by rapid turbulent pulses associated with the passage of large eddies. These are the aptly named 'abyssal storms' (Hollister and McCave, 1984).

As well as varying with depth, natural hazards differ with geography, reflecting Earth's wide range of geological, meteorological and climatic conditions. While storm-driven hazards are universal, their character and frequency are governed by local conditions. For instance, the very warm ocean temperatures of the Gulf of Mexico are a key factor contributing to the formation of hurricanes that sweep the region. Earthquakes and associated submarine landslides are also widespread, but they are most common where tectonic plates actively collide with one another, for example off Taiwan (Soh *et al.*, 2004) and New Zealand (Collot *et al.*, 2001), which are parts of the Pacific 'Ring of Fire'.

IMPACTS ON SUBMARINE CABLES

Between 65 and 75 per cent of all fibre-optic cable faults occur in water depths shallower than 200 m, and result mainly from fishing and shipping activities (Figure 6.4; Kordahi and Shapiro, 2004). By comparison, failures caused by natural hazards make up less than 10 per cent of all faults (Shapiro *et al.*, 1997). However, when focusing on deep-water cables, at least 31 per cent of faults can be traced to natural phenomena, with a further 14 per cent resulting from fish bites (Chapter 5) and 28 per cent attributed to unknown causes (Summers, 2001).

Storms strengthen current and wave action and hence increase their potential to affect cables on the continental shelf. Storm-forced movement of sand and gravel may abrade surface-laid cables (Carter, 1987) or cause suspensions in zones of moving sand waves (Allan, 2000) and on mixed substrates of rock and mobile sand. Cables laid on rock may respond to wave activity (Kogan *et al.*, 2006), resulting in abrasion, chafe and fatigue. Yet despite the

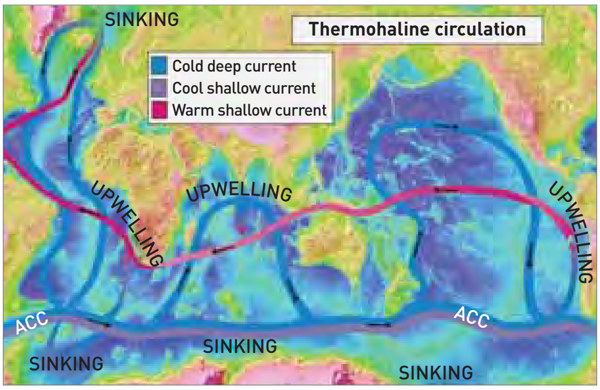
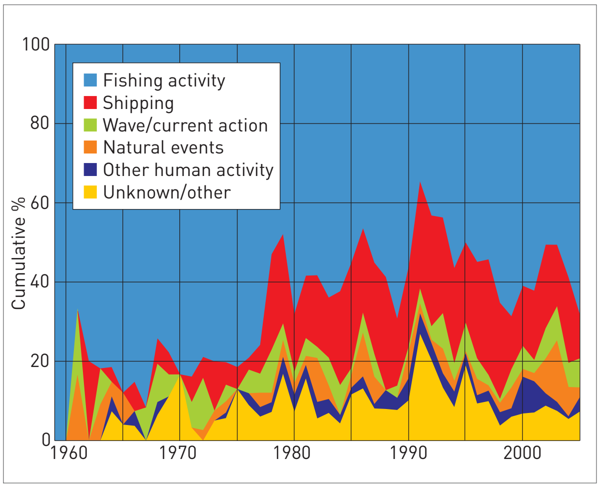


Figure 6.3: Outline of the thermohaline circulation, whose deep waters are driven by dense water sinking in the North Atlantic and Antarctica. The currents circulate around the main ocean basins before gradually returning to the surface and flowing northwards as warm surface currents under the influence of winds. The ACC is the Antarctic Circumpolar Current, which reinforces and modifies the thermohaline circulation in southern latitudes. *Source: B. Manighetti and NIWA.*

dynamic nature of the continental shelf, cable failures caused by natural processes are (i) minor compared to those caused by human activities and (ii) apparently reducing in number (Kordahi and Shapiro, 2004). This decline probably relates to improved cable design, installation techniques and protection measures.

Figure 6.4: Types of cable faults recorded between 1959 and 2000. The data emphasize the dominance of faults caused by fishing and shipping activities, which typically cause damage in water depths shallower than 200 m. *Source: Wood and Carter (2008), IEEE Journal of Oceanic Engineering.*



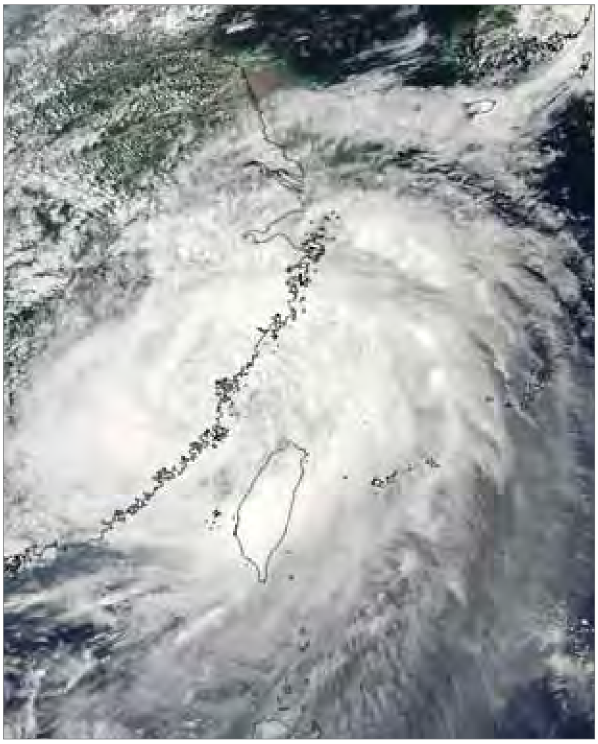


Figure 6.5: Typhoon Morakot struck Taiwan over 5–11 August 2009, when 3 m of rain fell in the central mountains, causing rivers to flood and carry large volumes of sediment to the ocean. So much sediment was discharged that several submarine landslides and associated sediment-laden 'turbidity currents' formed and broke a succession of cables off eastern and southern Taiwan as well as the nearby Philippines. While records of such events are insufficient to identify trends, the enhanced precipitation of Typhoon Morakot is consistent with warmer regional air and ocean temperatures. *Source: MODIS Rapid Response, NOAA.*

Cables can be damaged during hurricane, cyclone and typhoon attack (e.g. Cable and Wireless, 2004). However, most reports are from media sources that lack technical information on the precise nature and cause of cable damage. This was not the case for Hurricane Iwa (1982), whose impacts were recorded by ocean-current sensors on the continental slope off Oahu, Hawaii (Dengler *et al.*, 1984). Current speeds of up to 200 cm/s (7.2 km/hr) were measured during the hurricane, and were followed by several submarine landslides which in turn transformed into the highly mobile turbidity currents. These moved down slope at 300 cm/s (11 km/hr) or more and damaged six cables. Subsequent repair and recovery operations revealed tensional cable breaks and abrasion. One cable section was unrecoverable, suggesting it was deeply buried by sediment carried down by landslides and/or turbidity currents. Most recently, the 2009 Typhoon Morakot generated sediment-laden flows that broke at least nine cables off Taiwan in water depths down to more than 4,000 m and over 300 km from the coastal area where the flows formed (Figure 6.5).

Earthquake-triggered landslides and turbidity currents are well-documented hazards. Since the classic study of Heezen and Ewing (1952), which recorded the severance of submarine cables by landslides and turbidity currents set off by the 1929 Grand Banks earthquake (Box 6.1), similar cases have been observed around the world, especially in earthquake-prone regions (e.g. Heezen and Ewing, 1952, 1955; Houtz and Wellman, 1962; Krause *et al.*, 1970; Soh *et al.*, 2004). Krause *et al.* (1970) also demonstrated the long distances and great depths covered by cable-damaging turbidity currents. In this instance, slides were triggered by an earthquake, probably near the Markham River delta off Papua New Guinea, and the resultant turbidity currents disrupted cables at least 280 km away in water depths of over 6,600 m. From the elapsed time between the earthquake and cable breaks, current speeds of 30–50 km/hr were derived. More recently, cables were damaged off (i) Algeria, following the 2003 Boumerdes earthquake (magnitude 6.8), when landslides and turbidity currents damaged six cables to disrupt all submarine networks in the Mediterranean region (Joseph and Hussong, 2003; Cattaneo *et al.*, 2006) and (ii) southern Taiwan, in 2006, when nine cables broke under an earthquake-triggered flow (Renesys Corporation, 2007; Hsu *et al.*, 2009) (Introduction).

Tsunami or seismic sea waves may disrupt services, especially at coasts susceptible to wave attack. Following the tsunami generated by the Andaman-Sumatra giant earthquake on 26 December 2004, land-based telecommunications networks were damaged in coastal Malaysia and South Africa, and there is one possible case of a submarine cable off South Africa being damaged by tsunami debris washed offshore (informal media sources; Strand and Masek, 2005).

Another cause of damage to cables is the formation of suspensions (Summers, 2001). As noted earlier, currents and waves on the continental shelf cause suspensions to sway, which may result in abrasion, chafe and fatigue. However, such effects also occur in the deep sea where cables traverse zones of strong flows. Off Iceland, for example, failure of the CANTAT-3 system has been attributed to cable movement in zones of rough topography during the passage of deep currents associated with the global thermohaline circulation (Figure 6.3; Malmberg, 2004). There, flows may reach maximum speeds of 31cm/s (1.1 km/hr) in water depths of 2,500–4,000 m.

Volcanic eruptions, like earthquakes, can trigger landslides and turbidity currents, but they also have their own brand of hazard associated with lava and volcanic debris flows. Yet despite the dramatic nature of eruptions, reports of associated cable damage are rare – a feature that may simply reflect an avoidance of submarine volcanoes by cable route planners. However, some habitable active volcanic islands, e.g. the Antilles and Hawaiian islands, rely on cables for communication. In May 1902, the eruptions of Mount Pelée, Martinique and La Soufrière, St Vincent, both in the Antilles Islands, were accompanied by a loss of submarine cable contact. The cause and location of the fault(s) are unknown, but Pararas-Carayannis (2006) speculates that the breakage may have resulted from a debris avalanche shaken from the sides of Mount Pelée.

CLIMATE CHANGE

In 2007, the Intergovernmental Panel on Climate Change provided projections of environmental responses to climate change through the 21st century (IPCC, 2007). The report, based on the peer-reviewed research of hundreds of scientists world-wide, is an exhaustive analysis of the world's climate – past, present and future. Since that report, new research has further refined or revised the earlier projections.

Some of the observed trends of relevance to submarine cables are as follows:

- Between 1961 and 2003, global average rise in sea level was 1.8 mm/yr, whereas from 1993 to the present the average rate is 3.1 mm/yr (University of Colorado, 2009; Chapter 8). Most sea level rise initially resulted from thermal expansion of the ocean, but more recent observations point to increasing contributions from the melting of ice sheets and glaciers (e.g. Steig *et al.*, 2009).
- The ocean has warmed to around 3,000 m depth. This vast store of heat will extend the effects of warming long after any stabilization of greenhouse gas emissions.
- The intensity of hurricanes appears to have increased since c.1970, but there is no clear trend in the numbers of these major wind storms.
- Changes have been observed in westerly wind belts, winter storm tracks, waves and weather-forced sea levels such as storm surges. These changes are projected to continue.
- Regional changes in precipitation are likely to occur and influence the flood delivery of river sediment to the continental shelf. The cable-damaging flood of Typhoon Morakot may be a harbinger of this projected trend.
- Ocean salinity (salt content) at middle to high latitudes has decreased due to increased precipitation and input of ice melt-water. This will alter the density of the upper ocean and its ability to sink and form deep currents, thus potentially affecting the global thermohaline circulation (Figure 6.3). Such a scenario is suggested by models, but is unsupported by observations, which reveal a strong natural variability in the circulation system that presently masks any long-term trends.

At present, we can only surmise any impact of climate change on submarine cables. Rising sea level may heighten the risk of erosion and flooding of coastal cable facilities, especially in regions subject to hurricanes and other intense storms. These will not only attack the coast, but also influence the stability of the continental shelf seabed via the formation of eroding currents and waves. As a result, cables laid on the seabed may be exposed to more abrasion or suspensions, although buried cables will be afforded some protection. More severe storms will increase the risk of submarine landslides and turbidity currents. A window into the future may be the disruption of the Southeast Asian cable network off Taiwan on 26 December 2006 (USGS, 2006; Hsu *et al.*, 2009). The already high river input of sediment to the ocean off Taiwan can increase three to fourfold when typhoons scour the landscape that has been destabilized by seismic and human activities (Dadson *et al.*, 2004; Webster *et al.*, 2005). As a result, thick deposits of mud and sand form on the seabed. These are ripe for disruption, as happened during 2006 (Hsu *et al.*, 2009). Regional changes in wind and rainfall will impact mainly on cables in coastal and shelf environments. For instance, increased windiness, as modelled for the middle latitudes of Oceania, may invigorate waves and ocean surface currents, thus increasing their capacity to shift seabed sediment. Large floods may

BOX 6.1: LEARNING FROM CABLE FAILURES

On 18 November 1929, a magnitude 7.2 earthquake shook the continental slope bordering the Grand Banks off Newfoundland. Submarine telegraph cables within c.100 km of the earthquake epicentre were cut instantly by a series of submarine landslides (Heezen and Ewing, 1952; Piper *et al.*, 1985, 1999). In turn, the slides formed a turbidity current that carried c.200 km^3 of sand and mud to water depths of at least 4,500 m (Nisbet and Piper, 1998). En route, the turbidity current broke more cables, but this time in sequence. From the timing of the breaks, a current speed of 65 km/hr was estimated. Although a disaster, the data it generated provided one of the first observations on how dynamic the deep ocean can be.

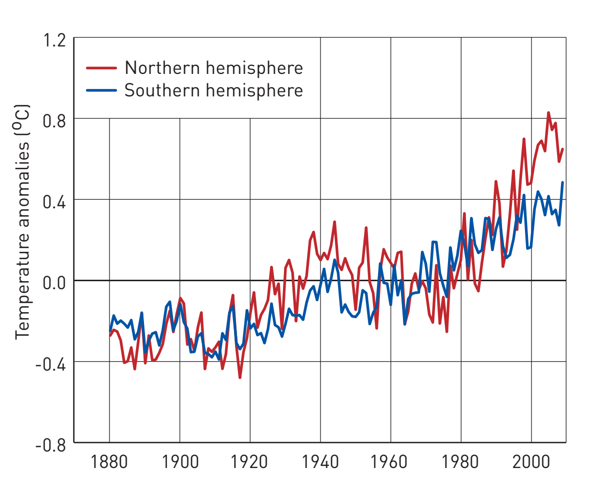


Figure 6.6: Observed temperatures for the northern and southern hemispheres, showing differences between the land-dominant north and ocean-dominant south, plus the strong temperature variability through time, which is superimposed on a long-term rising trend. *Source: Data from Goddard Institute for Space Studies, NASA.*

enhance siltation over cables or even form seabed-hugging mud flows with the potential to damage cables (e.g. Milliman and Kao, 2005).

It is important to appreciate that the ocean's reaction to global warming varies world-wide, reflecting the myriad of local and regional settings. For instance, most of the surface ocean has warmed in a patchy way by 0.1 to 1.0ºC, but some sectors of the mid-latitude southern hemisphere have cooled by -0.1 to -0.5ºC over the same period (NASA, 2006). This spatial variability is accompanied by strong variations over time. Natural cycles such as the El Niño-Southern Oscillation usually override long-term trends, but when these fluctuations are averaged out, the overall rise of temperature and sea level is readily apparent (Figure 6.6; Chapter 8). Thus, any evaluation of the potential effects of present global warming on cable systems must take into account local and regional conditions. An example is the North Atlantic, where the sinking of surface water as part of the global thermohaline circulation (Figure 6.3) lowers regional sea level by c.71 cm compared to the North Pacific (Hu *et al.*, 2009). Should the sinking of surface water slow or stop, this would cause a further rise in sea level on top of that caused by ice melting and thermal expansion.

7. Submarine cables and other maritime activities

INTRODUCTION

Every day, thousands of fishing vessels, merchant ships, oil rigs, dredgers, and recreational and research vessels ply the world's oceans. In most cases, their crews are unaware of the thousands of kilometres of submarine cables that lie on and under the seabed, carrying telephone calls and internet data that are a vital part of our world.

The cables, however, are sometimes affected by these activities. Every year, around 100–150 cases of cable damage are reported. Although some damage is from natural causes (Chapter 6), most is caused by humans (e.g. Shapiro *et al.*, 1997). When we consider the global scope and intensity of fishing, maritime transportation, hydrocarbon extraction, marine research, dredging and dumping, this is not surprising.

Although interaction between cables and human activities may seem inevitable, there are many reasons and ways to minimize it. A cable failure can cause severe disruption of international communications. In July 2005, such a break interrupted the majority of voice and data transmission into and out of Pakistan (Khan, 2005). Restoration of communications by satellite was insufficient to handle the traffic volume. The effects were felt by businesses, government and the general public of Pakistan for more than 10 days before the link was restored.

In some cases, if a vessel snags its fishing gear or anchor on a cable (Figure 7.1), vessel stability and crew safety can be affected. In spite of extensive warnings from cable companies, there are still occasional cases of fishermen hauling cables to the deck and cutting them, risking damage and injury not only from the weight and tension on the cable, but also from the electricity used to power the repeaters (Chapter 2).

Virtually every cable failure carries a high cost for restoration of service and repair, which must eventually be passed on to users of telecommunications services. Cable ships are kept on standby around the world, ready to respond at short notice, sail to the site of the damage and conduct repairs under all of the challenging conditions the ocean can offer (Lightwave, 2005; Sourcewire, 2000).

Fortunately, the cable sector and other mariners have found ways to cooperate and reduce cable damage. Virtually all of the ocean users capable of damaging cables also depend on the international communications they provide. This chapter explores the interactions between cables and other maritime activities, and the ways found to share the seabed in harmony and with respect.

CABLE DAMAGE

Cable damage comes in many forms. When damage is severe enough to affect transmission, it is considered a fault. One type of fault is a complete break, when a cable

Figure 7.1: Bottom trawler with trawl door (detail inset) snagging cable. *Source: ICPC Ltd.*

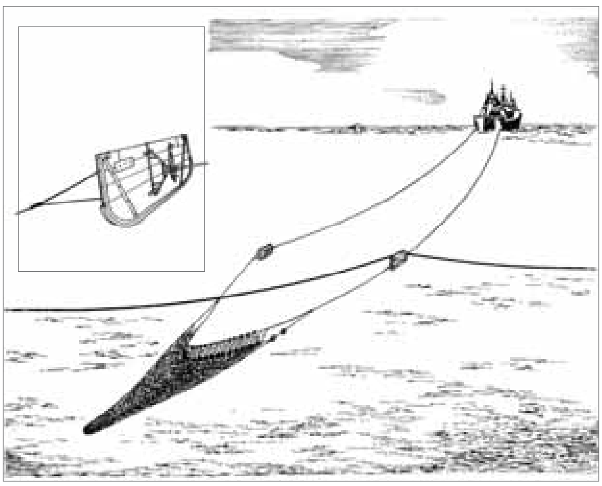


Figure 7.2: Cable damaged by fishing gear. A grapnel intended to retrieve fish traps from 1,800 m depth damaged the insulation and fibres on this cable. *Source: Tyco Telecommunications (US) Inc.*

Figure 7.3: Global pattern of external aggression cable faults, 1959–2006. *Source: Tyco Telecommunications (US) Inc.*

is pulled apart or severed. In such a case, the damage obviously affects both the optical fibres carrying communications and the copper conductor carrying the electrical current required to power the signal-boosting repeaters used on long-haul cable systems.

The modern submarine telecommunications cable has an outside diameter of c.17–50 mm, depending on the type of cable and armour (Chapter 2). The breaking strength of such cables ranges from a few tonnes to more than 40 tonnes for the double-armoured types. However, a cable may be rendered inoperable by forces smaller than those needed to sever it.

If a hard object in contact with a cable penetrates the armour and insulation to expose the copper conductor that carries electrical current (Figure 7.2), the usual result is that electrical current flows to the sea to form a shunt fault. In this case, the optical fibres may remain intact and capable of carrying signals, but the repeaters beyond the shunt may lack power and the cable may stop working. Sometimes, the voltage of the electrical power feed equipment at the ends of the cable can be balanced so that the repeaters on each side of the shunt continue to function, and the cable remains in service for a short time until a repair ship arrives. Shunt faults can result from fishing gear striking a cable or abrasion on the seabed, amongst a number of causes. In other cases, such as crushing, bending or pulling, the optical fibres themselves may be damaged. An optical fault results in loss of communication on one or more fibres. When a fishing trawl, anchor or other equipment snags or hooks a cable, it may exert enough force to pull the cable apart. Whatever the cause of the fault, it normally triggers an immediate alarm in the monitoring equipment, which runs constantly in the terminal stations on shore.

NUMBERS AND CAUSES OF CABLE FAULTS

The ICPC and several private organizations maintain records of cable faults. To date, there is no central global database of all fault records, so it is difficult to know exactly how many faults occur in a given year. However, based on records spanning several decades, it may be estimated that c.100–150 cable faults occur annually world-wide. Figure 7.3 indicates the distribution of faults caused by external forces (external aggression) including seabed movement and abrasion. These patterns were taken from a global database of 2,162 cable faults going back to 1959. It is clear that most faults occur on the continental shelf, near land in water depths of less than 100 m. This is to be expected, since the vast majority of human activities that involve seabed contact take place in relatively shallow waters. The remaining faults occur across a wide range of depths, including oceanic areas more than 4,000 m deep.

When a fault alarm sounds, in some cases an air or sea patrol is dispatched immediately to determine the cause. However, in most cases the cause must be investigated by other means. Fault causes are often grouped into the following categories: external human aggression, external natural aggression, component failure and unknown, e.g. Featherstone *et al.* (2001). External human aggression causes more faults than any other category, with fishing accounting for nearly half of all reported faults (Figure 7.4). Anchoring is the second major cause of faults, with dredging, drilling, seabed abrasion and earthquakes also causing significant numbers. However, natural hazards, including seabed abrasion, account for less than 10 per cent of all faults (Chapter 6).

Although cable systems are designed to last for at least 25 years, some components fail on rare occasions. In spite of harsh conditions of pressure and temperature, they have proved remarkably reliable, with some cables maintaining service for several decades. A recent analysis of fault causes found that less than 5 per cent of reported faults were caused by component failure (Kordahi and Shapiro, 2004). Moreover, component fault rates appear to have been falling in recent years, a fact not reflected in the summary chart (Figure 7.4), which includes data from the past five decades.

MARITIME ACTIVITIES AND CABLE FAULTS

To reduce interactions between cables and other maritime activities, some cable companies conduct extensive studies to understand these interactions. A focus on fishing is common since this is the greatest cause of damage. The goals are often to understand what areas are fished with which types of gear, and how deeply different types of gear penetrate the seabed. With this information, a cable company can more effectively plan cable routes, armouring and burial, and communicate with mariners engaged in the activities most likely to damage cables.

FISHING/CABLE INTERACTIONS

Bottom trawling

Bottom fishing is widespread on many of the continental shelves and adjacent continental slopes, and can extend to depths of c.1,500 m and more (e.g. Fishing News International, 1995; Freiwald *et al.*, 2004). Considering the thousands of fishing vessels working these shelves, and the hundreds of cables present, it is striking that interactions are relatively infrequent. Most fishing vessels never interact with cables, and many cables operate for years without faults. However, the 50–100 fishing faults experienced annually have substantial effects, disrupting communications and impacting costs (Drew and Hopper, 1996; Grosclaude, 2004).

Many different bottom fishing techniques interact with cables. This discussion will focus on the bottom trawl, because it is one of the most common types of commercial fishing gear and has a long history of cable interaction. A bottom otter trawl is a cone-shaped assembly of lines and netting that is dragged along the seabed behind a vessel (Figure 7.1). Trawl doors, also called otterboards, are steel (or steel and wooden) panels rigged ahead of the net on each side. They provide weight to keep the trawl in contact with the seabed and generate horizontal spreading force to keep the net mouth open. Otterboard weight may range from less than 100 kg per panel on the smallest trawlers to over 8 tonnes on the largest. The line along the bottom of the net is often rigged with chains, rollers, steel bobbins or rubber discs. This gear is designed to maintain contact with the seabed and stir the top few centimetres of sediment in order to capture fish and shellfish living on or just above the bottom. Estimated and observed values for seabed penetration of bottom trawls in sand and mud are typically in the range of 5–20 cm (Lokkeborg, 2005; Shapiro *et al.*, 1997; Stevenson *et al.*, 2003), but under unusual conditions such as very soft mud, uneven seabed or a rigging failure, a trawl door may dive 50 cm or more into the sediment for a short period. Fishermen try to avoid deep seabed penetration because it increases costs for fuel and gear damage without increasing catches. Rising fuel prices and pressure from the environmental community have contributed to recent trends toward development of gear with lighter seabed contact. It is worth noting that fishing gear snags on seabed obstacles are very common, and the vast majority do not involve cables.

Contact between cables and fishing gear

Several organizations have conducted extensive studies of trawl interactions with cables (Aitken, 1977; Drew and Hopper, 1996). Trawling is believed to be among the fishing methods that cause the most cable damage. This is partly

Figure 7.4: Proportion of cable faults by cause, from a database of 2,162 records spanning 1959–2006. *Source: Tyco Telecommunications (US) Inc.*

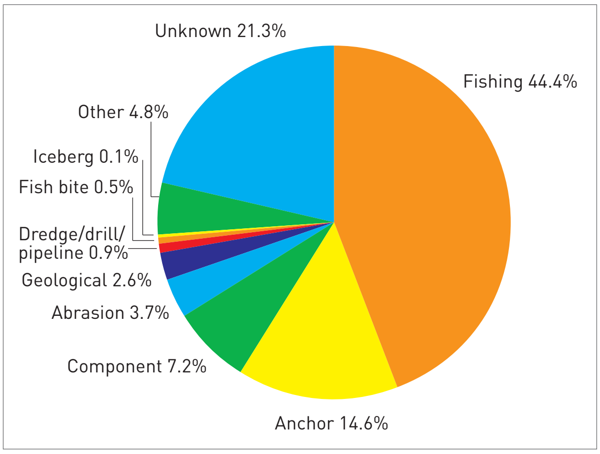


Figure 7.5: Fibre-optic cable with exterior sheathing recently damaged, presumably by fishing gear, to expose the bright steel armour, Cook Strait, New Zealand. *Source: Transpower New Zealand and Seaworks.*

because it is a widespread practice on most continental shelves, and partly because it is a mobile fishing method in which each operation may cover large areas of seabed (Lokkeborg, 2005). Research indicates that when a trawl crosses a communications cable lying on the seabed, more than 90 per cent of such crossings do not result in cable damage (Wilson, 2006). Trawls are designed to pass over seabed obstacles, and most cables in trawling depths are armoured. Cable burial and protective covers also provide greater protection and lower fault rates.

When a trawl passes over a submarine cable, a number of different outcomes are possible. As mentioned earlier, there may be no apparent contact at all. Many modern cables are buried more than 60 cm into the sediment from shore down to water depths of up to 1,500 m, so contact with normal fishing gear is highly unlikely. Even with cables lying on the bottom, trawl contact with the seabed may be light enough for the gear to pass over the cable with no discernible contact. Firmer contact may occur if a heavy trawl door, ground gear or even mid-water equipment lands on, or scrapes across, a cable lying on rocks or other hard bottom. During such contact, the armour may provide enough protection to avoid damage (Figure 7.5). Alternatively, a sharp corner of the fishing gear may penetrate the armour and insulation, causing a shunt fault, or bend or crush the glass fibres to cause an optical fault.

If a piece of fishing gear or anchor actually hooks or snags a cable, the likelihood of damage is far greater. Cable damage by bending, crushing and stretching can occur long before the cable breaks. This is one reason why cable companies discourage mariners from using anchors, grapnels or other equipment to drag for lost or unmarked gear near cables. In many areas, normal fishing gear may present almost no risk, but as soon as a grapnel is deployed to retrieve lost gear, the risk becomes extreme.

During installation in risk areas, every attempt is made to protect modern cables, either through burial into the seabed or by laying them flat on the seabed. Cable engineers constantly try to provide enough slack in a cable to let it conform to the seabed without leaving the cable loose enough for its inherent torsion to cause loops and kinks. This normally results in cables remaining in some permanent tension after installation. Consequently, in rocky or uneven seabed or on steep slopes, parts of a cable may be suspended above seabed depressions. If a piece of fishing gear contacts a suspension, a snag is more likely to result.

Cables can be more susceptible to damage in deeper waters. As water depth increases, cable burial generally becomes more difficult because of uneven seabed, steep slopes and the limitations of burial tools. Heavily armoured cable is harder to deploy in very deep water, so cables in deep water tend to carry less armour. A striking example of deep-water cable vulnerability is seen in interactions between cables and static fishing gear such as pots used for fish and shellfish. In shallow water, relatively few faults are believed to be caused by such static gear. Most shallow-water fish pots are light, and at these depths cables are armoured and generally buried. In deep water this situation is reversed – the static fishing gear is much heavier, often carrying large anchors, while the cables tend to have less armour and reduced burial depth. In some deep-water areas it also appears more common for fishermen to drag grapnels to retrieve static gear, and this greatly increases the risk. In recent years a number of faults have been caused by fishing activities using static gear in water depths of 500–1,800 m.

Fortunately for cables, most bottom fishing occurs in water depths of less than 100 m. The costs and risks associated with such fishing tend to increase with depth. With depletion of coastal resources, development of fishing technology and markets for new species, the 1980s and 1990s saw major increases in deep-water fishing (e.g. Pauly *et al.*, 2003). In a few areas, bottom trawling has extended to 1,500–1,800 m depths and bottom longline fishing with baited hooks may go even deeper. However, at such depths it appears that there are few areas with abundant fish populations of commercial value apart from those associated with elevated topography such as seamounts (Clark *et al.*, 2000). These features are routinely avoided in routing submarine cables, which may be a factor contributing to lower numbers of fishing and cable interactions in deeper waters.

During cable installation, there are rare instances of other types of interactions between cables and fishing gear suspended in the water column. In temperate and tropical oceans, fishermen catch tuna, swordfish and other species with mid-water longlines suspended from buoys. These longlines may range in length from a few hundred metres to over 100 kilometres (Beverly *et al.*, 2003), and they can be difficult to detect. If a lightweight cable is inadvertently laid over such a line, damage to both line and cable is likely. For this reason, cable companies generally try to notify all vessels in the area of cable installation, and clear the cable route before installation proceeds. In a similar fashion, faults have been caused by cables inadvertently installed over or near fish aggregating devices (FADs). A FAD is a buoy or raft, normally anchored, which serves to attract fish that live in mid-water or near the surface. Fishermen using this gear periodically visit it to fish with hooks or nets. Some FADs are identified by substantial marker buoys, but others are less conspicuous. If a lightweight cable is laid over the buoy line of a FAD, that line can easily chafe through the cable. Moreover, when the buoy line of a FAD parts, the anchored portion of that line may be difficult or impossible to retrieve. The abandoned buoyant line may remain suspended in the water column and present a long-term hazard to the installation of lightweight cables.

RISKS TO FISHERMEN AND VESSELS

When a cable is faulted, the cable company commonly receives no notice from the mariners involved and it is unclear whether those mariners are even aware of the interaction. In some cases the repair ship will find anchors or fishing gear snagged on the cable. Although many fishing and cable interactions appear to occur without negative effects on fishermen and vessels (and in some cases without their knowledge), there is danger associated with catching cables.

When gear fouls a cable, the gear may be damaged or lost completely. Any catches contained in nets are likely to be lost. If a fisherman tries to lift the cable to free his gear, the danger may increase. After an initial amount of slack is taken up, the load on the gear may rise dramatically, exceeding the capacity of the vessel's winches and causing damage. This can also affect a vessel's stability and, in extreme cases, risk capsizing. If fishermen succeed in bringing an active cable on deck, there is also a risk of electrocution (Figure 7.6).

OTHER CAUSES OF CABLE DAMAGE

After fishing activity, the most common cause of cable faults is vessel anchors. A 5,000-tonne vessel with a 4-tonne anchor may be expected to penetrate soft sediment to a depth of 5 m (Shapiro *et al.*, 1997). If such an anchor lands on a cable or drags and hooks a cable, a fault is likely. For smaller vessels, the pulling force on a snagged anchor may exceed the weight of the anchor by a wide margin. Such force may approach the breaking strength of the anchor line, the capacity of the anchor winch, or the buoyant force on a small vessel. Engineers avoid planning cable routes in or near charted anchorage areas, but vessels may also anchor in uncharted zones. Anchor faults tend to be most concentrated near busy ports, though on occasion they also occur over widespread areas.

Cable faults are occasionally caused by dredging associated with beach replenishment, sand or mineral extraction, etc. Other offshore activities such as petroleum extraction, pipeline construction, scientific research and dumping all lead to occasional cable breaks. Many of these may be avoided when the mariners involved consult charts showing cable routes, or request information from cable companies, but due to the intensity of marine activities (Figure 7.7) on a global scale there are still frequent faults.

MITIGATING FISHING AND CABLE INTERACTIONS

Over time, cable companies and other marine interests have found ways to mitigate their operational interactions. Careful planning of new cable routes is an essential first step. Charted anchorages and dredge areas are avoided. Maritime authorities and permitting processes may help. In many cases, industries such as fishing and merchant marine associations are consulted directly. These can often offer detailed information about local risks and potentially safer cable routes. However, despite cable planners' best and extensive efforts, it is not always possible to gather complete information on all uncharted areas where vessels may anchor, dredge, fish or conduct other activities.

Charts, notices to mariners and fishermen

If fishermen and other mariners are informed about the importance and locations of cables, in many cases they will

Figure 7.6: Beam trawler with gear snagged on cable (arrow). Snags cause trouble for fishermen, cable companies and users of communications services. *Source: Tyco Telecommunications (US) Inc.*

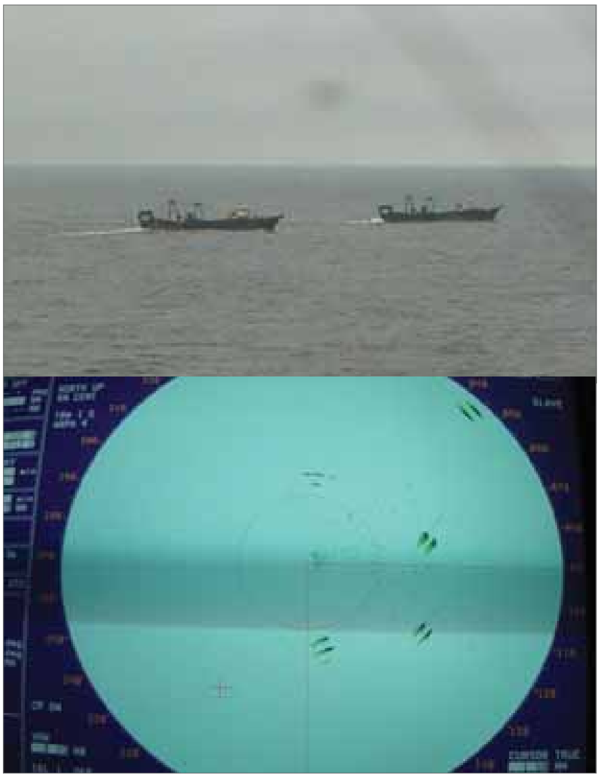


Figure 7.7: Pair trawlers observed and seen on the radar of a cable ship in the East China Sea. Avoiding and repairing cable faults can be difficult with this intensity of fishing effort. *Source: Tyco Telecommunications (US) Inc.*

take measures to avoid damage. An essential first step in informing mariners is publication in official notices to mariners and nautical charts, which are distributed by hydrographic and other authorities in various countries, e.g. ACMA (2007). However, there are limitations on this distribution system for some groups of mariners, e.g. coastal fishermen using small vessels who may not keep charts onboard. The period immediately after installation may also be difficult because distribution depends on the frequency of issue of the nautical charts and other notices in the local jurisdiction. In recent years, the trend towards electronic charts raises the possibility of more rapid publication of new cable information.

Many companies distribute additional information such as chartlets, brochures, leaflets or flyers showing cable routes and cable company contact information, highlighting the importance of avoiding damage to the communications infrastructure (e.g. Transpower and Ministry of Transport, 2008). This unofficial information distribution in some regions extends to distribution of electronic files for plotting cable routes on fishermen's navigation systems. It may begin before cable installation starts, depicting planned cable routes and advising mariners of upcoming installation activities. Representatives of cable companies sometimes attend fishermen's meetings and trade shows, or work through nautical suppliers to distribute such information.

Fishing and cable working groups

In some areas, the longstanding dialogue between cable companies and fishermen has been formalized into committees that exchange information and develop guidelines for recommended practices. These have developed new channels for information distribution, and in some cases developed guidelines for fishing more safely in areas where cables are present (OFCC, 2007; UKCPC, 2009). Among the issues they sometimes address is the use of 'cable-friendly' fishing gear – trawl doors and other gear built without sharp edges or notches that could snag cables. All parties have benefited from the understanding and working relationships that have developed from such groups.

8. The changing face of the deep: a glimpse into the future

The ocean is in a constant state of flux as it responds to a range of natural forces that operate on time scales of hours (weather) to millions of years (continental drift). But the ocean is now out of its 'comfort zone' as it faces unprecedented pressure from increasing human activities offshore and the effects of modern climate change (Halpern *et al.*, 2008; IPCC, 2007). Those pressures, along with a rapidly growing knowledge of the oceans, have fuelled a greater awareness of the marine environment and the problems it faces. This, in turn, has instigated efforts to conserve and protect marine resources, ecosystems and biodiversity (e.g. Freiwald *et al.*, 2004; Ministry of Fisheries, 2007). So what does the future hold, especially in the context of submarine telecommunications? Niels Bohr noted that 'Prediction is very difficult, especially about the future', but given the current state of the ocean (Halpern *et al.*, 2008), it is important to at least reflect on the future, guided by current trends and model simulations of change.

HUMAN ACTIVITIES

Fishing

As outlined previously, bottom trawl fisheries pose the greatest threat to submarine cables. During the 1980s, these fisheries extended into deep water in response to reduced stocks on the continental shelf (Smith, 2007b). Now, trawl fisheries can operate in water depths to 1,500 m and more, especially over submarine elevations such as seamounts and ridges. Future trends are unclear, but in some regions fishing effort and extent have waned due to:

- 'boom and bust' cycles, as illustrated by the orange roughy boom, when catches in the South Indian Ocean peaked at 39,000 tonnes for the year 2000, to be followed by a dramatic reduction to under 5,000 tonnes just two years later (Smith, 2007b);
- environmental degradation (Figure 8.1) coupled with declining fish stocks and by-catch issues, which have led to the closure of fishing areas and restrictions on gear type, e.g. areas off the United States are closed to protect benthic ecosystems (National Research Council, 2002; Pacific Fishery Management Council, 2005);
- the rising cost of fuel, which has been mooted as a market-driven control on energy-intensive deep-sea fisheries (Pauly *et al.*, 2003).

Figure 8.1: Trawl scars on the Chatham Rise, Southwest Pacific Ocean. *Source: Dr Malcolm Clark, NIWA.*

Any reduction in bottom trawl fishing should potentially lessen the threat to the cable network. However, actual benefits to the network will depend on the nature, timing and location of any reduced effort. For example, large areas of the exclusive economic zone off the western United States, including all areas deeper than 1,280 m (700 fathoms), have been closed to bottom trawl gear (Pacific Fishery Management Council, 2005). This legislative act could be expected to have an immediate benefit because the closure is regulated and takes in a major submarine cable route. In contrast, some regions could witness increased fishing effort as conservation and protection

Figure 8.2: As the size and numbers of merchant vessels have increased, so has the risk of damage to submarine cables, as shown by a faulted cable (arrows) entangled with a ship's anchor. *Source: unknown.*

measures take effect and some fish species recover, e.g. NOAA (2009). Another fisheries development has been a fivefold growth in aquaculture, to a point where half the fish and shellfish consumed by humans now comes from farms, the remainder coming from fish caught in the wild (Naylor *et al.*, 2009). Continued growth of aquacultural farms is likely to add to the congestion of coastal seas.

Figure 8.3: The future is here: offshore wind farm, Kentish Flats, United Kingdom. *Source: ELSAM, Denmark.*

Shipping

After fishing, shipping activities, particularly anchoring (Figure 8.2), are the main threat to cable security. Over the last 12 years there has been a general increase in the number of ships and tonnage of the world merchant fleet (Institute of Shipping Economics and Logistics, 2005, 2007). In 2005, there were 39,932 vessels with a total tonnage of 880 million dwt (dead-weight tonnes). At the start of 2007, the fleet had grown to 42,872 ships with a total tonnage exceeding 1 billion dwt, the first time that threshold had been passed. Thus, merchant ships have become more numerous and, on average, heavier. In 2007, the fleet consisted of tankers (41 per cent), bulk carriers (36 per cent) and container ships (13 per cent), with the remainder being general cargo and passenger vessels.

Increased shipping may heighten the risk to the submarine network. Such an assessment needs to account for both those trade routes where vessel traffic has changed and the relationship of those routes to cable locations. A case in point is the rapid growth of the Chinese steel industry, which has been accompanied by growth in the bulk carrier fleet required to transport iron ore, mainly from Australia (40 per cent), India (28 per cent) and Brazil (19 per cent). Thus, cables on the continental shelves that are traversed by those shipping lanes are potentially exposed to more risk.

Renewable energy generation

Many countries are focusing on the generation of renewable energy as they seek to meet growing demand, establish secure supplies and reduce emissions of greenhouse gases. Wind farms, in particular, have become a familiar sight in coastal seas, especially off Europe (Figure 8.3). By comparison, wave- and current-powered systems are largely in the developmental stage, apart from scattered operational schemes such as the long-established La Rance tidal barrage in France (University of Strathclyde, 2002), a commercial wave generation plant installed off northern Portugal in 2006 (World Business Council for Sustainable Development, 2006) and current-driven turbines in the East River, New York, which deliver power to the local grid (Verdant Power, 2007). The outlook is for a significant expansion of offshore renewable energy schemes. Wind generation is projected to increase its operating capacity fourfold to 4.5 GW in the next five years (Douglas-Westwood, 2008). Most of this expansion will occur in Europe, where the United Kingdom is projected to replace Denmark as the leader in offshore wind generation through the proposed installation of large wind farms in the Thames Estuary (1,000 MW) and Bristol Channel (1,500 MW) (e.g. London Array, 2007).

Mineral and hydrocarbon exploitation

World oil and gas supplies are considered inadequate (Smith, 2007a), and a common thread through forecasts is that demand will surpass supplies of conventional oil in the next few decades (e.g. Bentley, 2002). To help address this imbalance, further exploration and production may come from offshore, and indeed growth in this sector is expected until at least 2011 (International Energy Agency, 2006). This growth may be linked to increased production from existing offshore fields and the discovery of new fields in deep waters beyond the continental shelf (Kelly, 1999). New hydrocarbon sources are also under investigation with the spotlight on sub-seabed deposits of gas hydrate – an ice-like form of methane found widely beneath the continental margin (Kennett *et al.*, 2003). These deposits have been researched at ocean and coastal sites, but as yet they have not been tapped commercially (e.g. Dallimore and Collett, 2005).

Offshore mining of non-hydrocarbon minerals is a long-established practice that typically has been dominated by the extraction of sand and gravel for aggregate (Glasby, 1982). Deposits bearing gold, tin, zircon, iron, titanium, phosphate and diamonds, amongst other minerals, have also been exploited. Considerable research has been devoted to polymetallic nodules which, along with manganese and iron, contain potentially economic concentrations of copper, nickel and cobalt. These widespread deep-ocean deposits have yet to be mined commercially. Nevertheless, with an eye on declining onshore mineral resources, several government agencies and companies have formally identified exploration and prospecting areas, especially in the central Pacific and Indian oceans. These large areas are mainly in international waters, meaning that any activity is regulated by the International Seabed Authority established in 1994 under the auspices of UNCLOS (International Seabed Authority, 2009).

Associated with offshore hydrocarbon production is the potential use of depleted oil and gas reservoirs to store carbon dioxide. Sequestration is currently under way in the Norwegian sector of the North Sea, where carbon dioxide from the Sleipner West hydrocarbon field is injected into a sandstone formation 1,000 m below the seabed (Figure 8.4; Statoil, 2004). In a recent analysis of available technologies to help reduce emissions of carbon dioxide, sub-seabed sequestration was a considered option (Pacala and Sokolow, 2005). However, in order to store 1 billion tonnes of carbon annually by 2054, the authors estimated that c.3,500 Sleipner-like fields would be required. If this option were implemented it could impact on cables through the

Figure 8.4: Sleipner West, the site of carbon dioxide storage in sub-seabed geological formations. *Source: Norsk Hydro.*

development of new sequestering sites, re-establishment of abandoned oil and gas wells, and increased ship traffic or submarine pipelines to transfer captured carbon dioxide to the storage sites.

Ocean observatories

The last five years have been a period of growth for ocean observatories (ESONET, 2002; Joint Oceanographic Institutions, 2008; Ocean Sites, 2009). An internet-based survey reveals that the number of observatories has doubled since 2005. Presently, over 110 observatories are either operational or in development. Monitoring the ocean's interior, beyond the gaze of satellites, is a response to better identify its many environments, their living and non-living components, their functions, and their reactions to natural and human-related forces.

Observatories range from temporary, simple coastal moorings that measure a limited number of parameters such as water temperature, salinity (salt content) and current velocities to complex, permanent deep-ocean systems capable of taking a myriad of physical, biological, chemical and geophysical measurements, as well as conducting a range of experiments.

The most advanced of the large, permanent (20–25 year design life) observatories is the recently commissioned NEPTUNE system situated on the continental margin and adjacent deep-ocean floor off British Columbia, Canada (Figure 8.5; NEPTUNE, 2009). By 2008, 800 km of fibre-optic cable had been installed. This provides the communications and power to operate instruments and to transmit data back to Vancouver Island in real time, where it is made available to the scientific community and public. Several *nodes* were

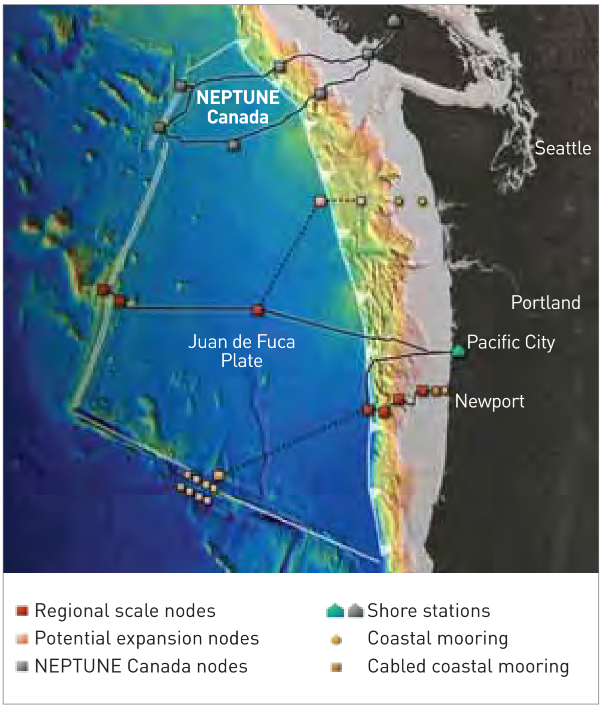
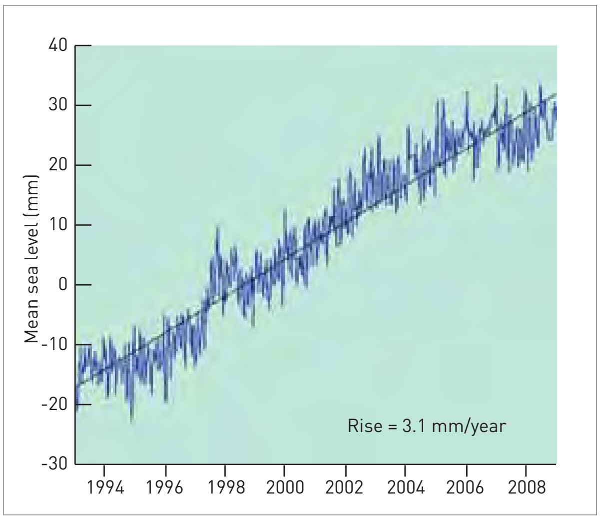


Figure 8.5: The recently installed NEPTUNE Canada cabled observatory with key monitoring and experimental sites or *nodes* (large grey squares). The proposed cabled observatory to the south is part of the US Ocean Observatories Initiative (OOI). *Source: Regional Scale Nodes and Center for Visualization, University of Washington.*

Figure 8.6: Despite variability in time and place, global mean sea level is on the rise in response to thermal expansion of the ocean coupled with increasing amounts of melt water from glaciers and polar ice sheets. *Source: Data from University of Colorado.*



installed along the cable in 2009 (Figure 8.5). These car-sized units are akin to large junction boxes that receive plug-in sensors and other instrument packages. The great flexibility of this *plug-in-and-play* approach allows NEPTUNE to conduct experiments and monitor the wide range of environments extending from the upper ocean to below the seabed. The nodes, connecting cables and sensors are placed in areas that traditionally have been avoided by submarine telecommunications cables, including active hydrothermal vents, submarine volcanoes, areas of seismic risk and rugged ocean floor. In that context, such instrumentation needs to be located precisely in order to optimize its sensitivity, as well as to avoid any impact on the surrounding environment and other sensors nearby.

Climate change

The ocean is now responding to the present phase of climate change as outlined in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) and more recent research (e.g. Domingues *et al.*, 2008; Velicogna, 2009). Rising sea level, more intense storms, extremes of precipitation and drought, changes in the position and strength of zonal winds such as the Roaring Forties, together with effects on ocean currents, all have the potential to impinge directly on the cable network as outlined in Chapter 6. Some changes, such as rising sea level and changing weather patterns, are already under way and are likely to be with us for some time – a situation that has resulted from warming of the ocean interior (e.g. Gille, 2002; IPCC, 2007), creating a vast reservoir of heat that will continue to influence climate even if major reductions in greenhouse gas emissions are achieved.

A more specific analysis of potential hazards posed by climate change must account for its strong temporal variability. Sea level rise will vary depending on the site and local climate. In Auckland, New Zealand, sea level fluctuates in response to El Niño-La Niña cycles and the Interdecadal Pacific Oscillation (Goring and Bell, 1999). Despite such oscillations in that sea level record and others, an overall rising trend is unmistakable (Figure 8.6).

Similarly, the ocean's responses to warmer conditions will vary with location. If future El Niño phases become more intense, those cables off western-facing coasts in the Pacific region could be up against increased winds and storms which, together with rising sea level, have the potential to exacerbate wave and current erosion of the seabed and coast. In regions of high sediment input, such as the tectonically active Pacific Rim (Milliman and Syvitski, 1992), the combination of climate and tectonic activity has already taken its toll on submarine telecommunications. The destructive sub-sea landslide and turbidity currents that accompanied the 2006 Hengchun earthquake off Taiwan were the result of a continuing tectonic-climatic cycle of earthquake destabilization of the terrestrial landscape (Dadson *et al.*, 2004), erosion of the landscape by storms and typhoons (Milliman and Kao, 2005) and the discharge of huge volumes of sediment to the ocean (Liu *et al.*, 2008), where thick deposits of sediment are formed and later destabilized by earthquakes to generate cable-damaging landslides and turbidity currents.

Marine protected areas

Awareness of human and natural stresses on the marine environment has led governments to promote and establish various types of marine protected areas (MPAs). One of the pioneers was Australia, which set up the Great Barrier Reef Marine Park in 1975 to provide environmental protection for the reef while allowing but regulating activities such as fishing, shipping and tourism (Australian Government, 2008; Doy, 2008). In Europe, the intergovernmental OSPAR Convention seeks to protect and sustainably manage a large sector of the Northeast Atlantic Ocean (OSPAR, 2009). At the national level, the United Kingdom continues to establish MPAs such as the Special Areas of Conservation (UK Marine Special Areas of Conservation, 2009). Likewise, the United States has afforded protection status to numerous areas off its mainland and island territories (Marine Protected Areas Center, 2009).

Most MPAs are located in coastal waters, but attention is turning further offshore, including international waters, in order to protect biodiversity and ecosystems such as cold-water coral communities. This was embodied in the recent European Union Marine Strategy Framework Directive (European Commission, 2008), which is aimed at protecting the European marine environment in concert with a desire to achieve the full economic potential of oceans and seas.

Activities such as ocean surveys can be restricted in MPAs, especially if intrusive methods are proposed. Even if a survey is possible, there can be restrictions placed on cable-laying activities. Thus, cable planners take due regard and, where possible, avoid areas that are designated as environmentally sensitive, e.g. warm-water coral reefs, cold-water coral communities and seagrass meadows. Knowledge of MPAs and sensitive benthic ecosystems is essential. Increasingly, information is appearing in the published literature and internet-based databases, which include maps of threatened and/or declining species and habitats, e.g. World Database on Marine Protected Areas (2009); Marine Protected Areas Center (2009); OSPAR (2009).

Ostensibly, any expansion of marine protected areas could be viewed as a further restriction on the passage of international cables. However, cables and marine protected areas may not be mutually exclusive. A surface-laid cable, beyond the depth of wave and current disturbance, has a minimum impact on the benthic environment (Figure 8.7; also Kogan *et al.*, 2006).

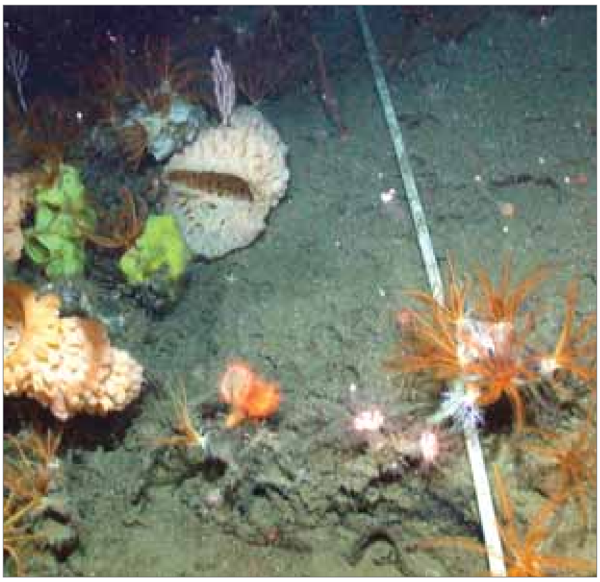


Figure 8.7: The ATOC scientific cable on Pioneer Seamount next to brightly coloured sponges, soft corals and feathery crinoids. *Source: 2003 Monterey Bay Aquarium and Research Institute (MBARI).*

Marine spatial planning

As our presence continues to grow offshore, governmental and non-governmental agencies seek to regulate this expansion through marine spatial planning (MSP) (Douvere and Ehler, 2008). In essence, MSP is a public process that aims to better organize human activities in marine areas to ultimately achieve ecological, economic and social objectives in an open and planned manner (Douvere and Ehler, 2009). Outside waters of national jurisdiction, however, there is no consensus on how such a system might work and what national or international legal regimes and institutions would be required for governance.

Two of several recurring themes for the establishment of successful MSP regimes are the need for good scientific information and the involvement of stakeholders. The exchange of information, mutual education and cooperation are essential for effective sharing of the seabed.

CONCLUDING COMMENTS

The submarine telecommunications network is an integral part of modern society. Since its establishment in the telegraph era, the network has extended around the planet. Historically, the highest communications traffic was between developed nations. However, that has changed. The network has rapidly expanded to connect most nations. East

African nations, for instance, are served by at least two major cable systems with more to follow within a year (e.g. EASSY, 2009; SEACOM, 2009). Southeast Asia is now a major telecommunications hub with the larger nations having substantial holdings in global cable companies. India is also a major cable owner and enjoys a high degree of connectivity, which in part reflects its position as a key centre for outsourcing services (Bardhan and Kroll, 2003).

The development of the fibre-optic highway as part of the world's *critical infrastructure* (Lacroix *et al.*, 2002) comes at a time of heightened awareness of the increasing pressures faced by the ocean. As outlined in this report, the weight of evidence shows that the environmental impact of fibre-optic cables is neutral to minor. In the deep ocean (more than c.1,000–1,500 m depth), which encompasses over 80 per cent of cable routes, any effect is limited to the placement of a non-toxic, 17–20 mm diameter tube on the ocean floor. The seabed may be disturbed periodically for repairs, but disturbance is localized and infrequent, as deep-ocean repairs account for less than 15 per cent of all cable faults (Kordahi and Shapiro, 2004). In the coastal ocean (less than c.1,000–1,500 m depth), fault repairs resulting from damage caused by fishing and anchoring, plus the need to bury cables for protection, disturb the seabed. However, studies cited in this report, including the OSPAR (2008) review on submarine *power* cables, conclude that disturbance is temporary, localized and infrequent.

As marine research continues to grow, it is highlighting hitherto poorly known benthic communities as well as discovering new ones. A prime example is cold-water coral communities, whose distribution, faunal composition and potential function have only recently come to light. By integrating such knowledge with that expressed in *Submarine Cables and the Oceans – Connecting the World,* the foundation is laid for a balanced approach to ocean use, its conservation and protection.

Glossary

Archipelago and archipelagic waters – an archipelago is a group of islands, including parts of islands, interconnecting waters and other natural features, which are so closely interrelated that they form a geographical, economic and political entity. In general terms, the associated archipelagic waters are those enclosed by a series of baselines that join the outermost points of the outermost islands in an archipelago. Such baselines are more specifically described under UNCLOS.

Armour – normally galvanized steel wires (of circular cross-section) laid around the core of the cable to provide both tensile strength and protection from external damage.

Atlantic Multidecadal Oscillation – a 20–40 year natural variability in the temperature of the North Atlantic Ocean surface, which may affect the formation of hurricanes.

Benthic community – an association of organisms living on, under or close to the ocean floor.

Bight – a U-shaped loop of cable or rope. Often refers to the single U-shaped loop of cable payed out from a cable ship as a final splice, or to the U-shaped loop of cable exiting the cable tank in which a repeater is positioned.

Biomass – the total mass of living material in a sample, population or specific area.

Biota – a collective term for the types of animals and plants present in a specific area or region at a given time.

Bottom otter trawl – a cone-shaped net attached by trawl lines to a fishing vessel and dragged across the ocean floor.

Branching unit (BU) – a sub-sea unit used at the point where a fibre-optic cable system splits into two legs, i.e. the fibres are split and may go to two terminals or to other branching units. Some branching units have the capability of switching the fibres from one leg to another.

Burial assessment survey (BAS) – a survey of the seabed to determine the likely success of any type of burial operation and to assist in the appropriate selection of cable armouring. Different combinations of tools may be used to constitute a BAS. For instance, it may be invasive and continuous, such as a mini-plough or grapnel-shaped tool. Alternatively, sampling can be carried out at discrete sites using techniques such as cone penetrometer tests (CPTs), or by sediment coring. Geophysical methods, such as resistivity or seismic reflection, can be used, or any combination of the above.

Cable network – a regional to global grouping of interconnected submarine cables, including repeaters and landing stations. A network provides redundancy in the event of a cable failure, in which instance voice and data traffic can be re-routed via intact parts of the network.

Cable protection zone – a defined area, usually identified on official marine charts, where submarine cables are afforded legal protection supported by various policing measures. Cable protection zones extending beyond territorial seas, normally 12 nautical miles, are generally not recognized under international law.

Cable route survey – a marine survey operation to obtain all the necessary information to design and engineer a cost-effective and reliable submarine cable system. Following receipt of the survey report, the installation cable route is optimized on the basis of data obtained on the seabed bathymetry (depth contours etc.), character, sediment thickness, marine life and other useful information such as currents, temperatures and prevailing weather conditions. The survey determines whether cable burial is required or indeed possible. A cable route survey is a prerequisite to laying a submarine cable and is integral to the freedom to lay and maintain international submarine cables under UNCLOS.

Cable vessel (also cable ship) – a vessel purpose-built or modified to lay and repair submarine cables. When engaged in such operations, the cable vessel displays special insignia or 'shapes' and navigation lights to alert other vessels to its restricted manoeuvrability as required by international law.

Census of Marine Life (COML) – a global network of researchers, representing more than 80 nations, engaged in a 10-year assessment and interpretation of the diversity, distribution and abundance of life in the oceans. The world's first comprehensive census is scheduled for release in 2010.

Climate change – a change in the state of the climate that can be identified by changes in the mean and/or variability of climatic properties (e.g. temperature, rainfall, wind) that persist for decades or longer.

Cold-water corals – a group of benthic anthozoans, commonly with a skeleton of calcium carbonate, which exist as individuals or form colonies. Unlike tropical corals, cold-water corals have no light-dependent algae and inhabit water depths to over 1,000 m in water temperatures of 4–13ºC.

Component failure – whereby a constituent part of a cable fails and produces a fault. Failures of this type account for c.7 per cent of all cable faults.

Continental shelf – a zone, adjacent to a continent or island, which extends from the coast as a gently sloping plain (c.0.1º) to the shelf edge, where the seabed steepens to form the continental slope. The average depth of the shelf edge is c.135 m. The precise limits of a nation's legal continental shelf boundary claim beyond the EEZ are determined in accordance with criteria set forth in UNCLOS, but in no case shall extend beyond 350 nautical miles from the coastal state's coastal baseline.

Continental slope – a zone of relatively steep seabed (c.3-6º), extending from the shelf edge to the deep ocean. The slope is often incised by submarine canyons and/or landslides.

Convention on Biological Diversity – a convention established in 1993 to conserve biological biodiversity, to ensure the sustainable use of its components, and to share the benefits arising from utilization of genetic resources.

Deep-ocean trench – a long, narrow, steep-sided depression of the ocean floor that includes the deepest parts of the ocean.

Desktop study – a review of published and unpublished information which, in the context of submarine cables, provides an initial assessment of engineering, environmental and legal factors relating to a cable route.

El Niño-Southern Oscillation (ENSO) – describes regional changes in the atmosphere and ocean in the equatorial Pacific that occur on a c.3–7 year cycle.

Environmental impact assessment (EIA) – an evaluation of the potential environmental implications of laying and maintaining a submarine cable. An EIA may be required as part of the permission process for cable installation.

Epifauna – animals that live on surfaces such as the seabed, other organisms and objects including cables.

Epiflora – plants that reside on a surface such as the seabed, other organisms and objects including cables.

Exclusive economic zone (EEZ) – an area beyond and adjacent to the territorial sea that is subject to the specific legal regime established under UNCLOS. The EEZ extends to a maximum of 200 nautical miles from a coastal state's coastal baseline.

External human aggression fault – a cable fault caused by an external force, in this case by human activities such as fishing, anchoring, dredging, drilling etc.

External natural aggression fault – a cable fault caused by external natural forces such as submarine landslides and turbidity currents triggered by earthquakes.

Fish aggregating device (FAD) – various types of artificial float, either drifting or anchored to the seabed, designed to attract pelagic (mid-water-dwelling) fish including tuna and marlin.

Gas hydrate – an ice-like solid formed from a mixture of water and natural gas, usually methane, found in marine sediments. Hydrates are a potential source of hydrocarbon-based energy.

Global positioning system (GPS) – a global navigation system designed to provide accurate positional and navigational information derived from a constellation of 24 to 32 satellites.

Grapnel – a specialized hooked device used to recover submarine cables for repair or removal. Smaller grapnels are used by some fishermen to recover lost fishing gear.

Gutta percha – a natural gum from trees found on the Malay Peninsula and elsewhere; used to insulate submarine cables until the 1930s, when it was replaced by more durable plastics.

High seas – open ocean that is not within the territorial waters or jurisdiction of any particular state. The high seas are open to all states, whether coastal or land-locked. Freedoms of the high seas are exercised under the conditions laid down by UNCLOS and other rules of international law.

Hydrography – the science of measurement of physical aspects of Earth's surface waters, including water properties, flow and boundaries.

Hydrothermal vents – include fissures and fractures from which hot, often mineral-rich waters are expelled, especially along mid-ocean ridges and hotspots. Waters can reach +350ºC, but rapidly cool in the cold ocean, forcing the precipitation of minerals.

Intergovernmental Panel on Climate Change – a science-based panel, set up in 1988 by the World Meteorological Organization and the United Nations Environment Programme, to evaluate the effects and risks of human-influenced climate change.

Internal waves – gravity waves that oscillate within a medium, in contrast to waves that form on the ocean surface. Internal waves may propagate along zones of marked density contrast in the ocean without disturbing the sea surface.

International Tribunal for the Law of the Sea (ITLOS) – an independent judicial body, located in Hamburg, Federal Republic of Germany, established under UNCLOS, to adjudicate disputes arising out of the interpretation and application of the Convention.

Marine protected area – a formally designated area of open or coastal ocean whose natural and cultural resources are protected and managed by legal or other effective means.

Mid-ocean ridges – continuous mountain ranges that have formed along the central reaches of the main oceans. They mark the zones where tectonic plates drift apart to allow magma to upwell and form new volcanic crust/seafloor.

Multibeam systems – a ship-based or towed acoustic mapping system that allows swaths of seabed, up to tens of kilometres wide depending on water depth, to be accurately mapped during a single survey run.

Natural hazard – a naturally occurring physical phenomenon caused by rapid- or slow-onset events under the influence of atmospheric, oceanic or geological forces operating on time scales of hours to millennia.

Notice to mariners – published notifications that advise of changes in navigational aids, new hazards such as shipwrecks, new offshore installations, changes in water depth, submarine cable locations and operations, and other matters. This procedure allows for the constant updating of navigational charts.

Ocean observatories – semi-permanent or permanent observation sites in the ocean, designed to monitor a wide range of environmental parameters. Observatories have many configurations depending on the type of experiments and monitoring to be conducted. The data generated may be recovered by ships, satellite or, in the latest observatories, via submarine fibre-optic cable for transmission to shore-based facilities.

Optical amplifier – uses special fibres and a laser pump to amplify an optical signal. This is done without the optical signal being regenerated by conversion to an electrical signal and converted back into an optical signal (as is the case with optical regenerators). Submarine optical amplifiers are packaged in housings in a manner similar to repeaters and continue to be referred to as repeaters.

Optical fault – a fault caused by damage to the glass optical fibres in a submarine cable.

Otterboards – (also called trawl doors) typically heavy rectangular, oval or curved plates of metal or wood connected by the trawl lines to a fishing vessel and designed to keep the mouth of the net open.

Plough burial – burial of the cable into the seabed for enhanced cable protection. The cable is guided into a self-closing furrow cut by a sea plough towed by a cable ship.

Post-lay inspection (PLI) – an inspection conducted after deployment of a cable on or into the seabed to ensure correct placement and to monitor any subsequent environmental effects.

Post-lay inspection and burial (PLIB) – an operation usually carried out by an ROV in areas of plough burial after the cable installation. The inspection operation confirms the burial depth. If necessary, additional burial (usually by jetting) can be implemented in localized areas, e.g. at 'plough skips' where the plough has been recovered for repair or maintenance.

Remotely operated vehicle (ROV) – an unmanned submersible vehicle used to inspect, bury or exhume cables. They can also be used, *inter alia*, to carry out surveys and inspection of the cable on the seabed. ROVs are usually fitted with cameras and cable tracking equipment, and for burial operations can be fitted with jetting or trenching tools. ROVs are controlled from surface vessels and operate mainly in waters shallower than c.2,000 m.

Renewable energy farms – an integrated suite of devices that generate energy from ocean winds, waves, currents or tides and transfer the electricity to shore via submarine power cables.

Repeater – a submerged housing containing equipment that boosts the telecommunications signal at regular intervals along the cable (Figure 2.5). Each repeater is powered via an electrical current that is fed into the submarine cable system from the shore-based terminal stations. All telecommunications signals lose strength in proportion to the distance travelled, which explains why repeaters are only required on the longer submarine cable routes. The term 'repeater' originated in the telegraph era and has continued in use as a generic term to describe the submerged signal-boosting equipment that has been required in all of the longer submarine cable systems, regardless of the transmission technology used. In a modern fibre-optic submarine cable system, the repeater spacing is typically 70 km.

Sand waves – a condition where the seabed is covered by sand waves whose movement may expose previously buried cable.

Seamount – submarine elevation with the form of a mountain whose size differentiates it from small elevations such as pinnacles, banks and knolls.

Sea plough – see *Plough burial*

Sediment, marine – solid fragmental material, ranging in size from clay particles to boulders, derived from terrestrial or marine sources and distributed by water, wind or ice.

Seismic profiler – see *Sub-bottom profiler*

Shunt fault – occurs when a cable's insulation is damaged or degraded. This exposes the copper conductor carrying electrical current, which passes or 'shorts' into the ocean.

Side-scan sonar – an acoustic technique to map the reflectivity of seabed material to identify potential obstructions on the seabed. Used primarily during surveys prior to ploughing operations. The use of side-scan sonar is helpful in cable repair operations in identifying surface-laid cables and in localizing fault locations.

Strumming – a term used to describe the standing wave vibration set up in unsupported cable during deployment or when in suspension between localized high sectors on the seabed. Strumming is induced by the drag forces generated when water currents flow across the cable in suspension.

Sub-bottom profiler (SBP) – an acoustic method of determining the vertical geological structure of the upper seabed. SBP equipment releases low-power, high-frequency, short pulses of acoustic energy into the water column and measures energy reflected back from the seabed and from layers below the seabed, revealing the differing physical properties of those layers. For cables, this information helps define potential hazards and the availability of sediment suitable for cable burial.

Submarine canyon – a narrow, steep-sided, V-shaped depression, typically incised into the continental shelf and slope.

Submarine channel – a shallow to steep-sided depression that may be fed by one or more submarine canyons. Compared to canyons, channels usually have V- to U-shaped profiles, are often bordered by well-developed levee systems, are longer and extend to greater ocean depths.

Submarine coaxial cable – a telephonic communications system comprising inner and outer copper conductors separated by a polyethylene insulator. This design replaced telegraphic cables in the 1950s, and was later replaced by fibre-optic designs.

Submarine fibre-optic cable – a communications system in which digitized data and voice signals are converted to coded light pulses and transmitted along optical glass fibres. Fibre-optic cables replaced coaxial cables in the 1980s.

Submarine landslides – a general term that encompasses mainly gravity-driven, downward and outward movements of sediment and rock. They frequently occur on, but are not confined to, continental slopes, especially those in seismically active regions.

Submarine telegraphic cable – an earlier communications system in which coded electrical impulses were transmitted through an insulated copper wire conductor.

Submarine telephone cable – see *Submarine coaxial cable*

Suspension – a term used to describe an unsupported length of cable held in a catenary by the residual cable tension at each side of the suspension. Suspended cables can suffer damage at the contact points where abrasion (chafe) can occur and may be subject to strumming.

Tectonic plate – a large, relatively rigid segment of the Earth's crust and upper mantle that moves horizontally and interacts with other plates to produce seismic, volcanic and tectonic activity.

Territorial sea – refers to a state's coastal waters, which extend out to 12 nautical miles from a baseline commonly defined by the mean low water mark. Territorial sea limits and permitted activities in territorial seas are determined in accordance with UNCLOS and international law.

Thermohaline circulation – a world-wide, interconnected system of currents, which are driven mainly by density differences associated with atmospheric cooling or heating of the ocean and the addition or loss of fresh water. Winds also play a prominent role in driving the circulation.

Tsunami – waves of great wavelength, usually generated by earthquakes or submarine landslides; not to be confused with 'tidal waves', which result from astronomical forces on the ocean.

Turbidity current – a dense, sediment-laden current that flows rapidly across the ocean floor, often via submarine canyons and channels. Turbidity currents can be triggered by earthquakes, storms and river floods, and are capable of breaking submarine cables.

United Nations Convention on the Law of the Sea (UNCLOS), 1982 – a convention known as the 'constitution of the world's oceans' that entered into force in 1994. UNCLOS establishes a legal framework to govern all ocean space, its uses and resources. It contains provisions relating to the territorial sea, the contiguous zone, the legal continental shelf, the exclusive economic zone and the high seas. UNCLOS defines freedoms and responsibilities for international submarine cables, navigation and other activities within these zones. It also provides for environmental protection and preservation, marine scientific research, and the development and transfer of marine technology.

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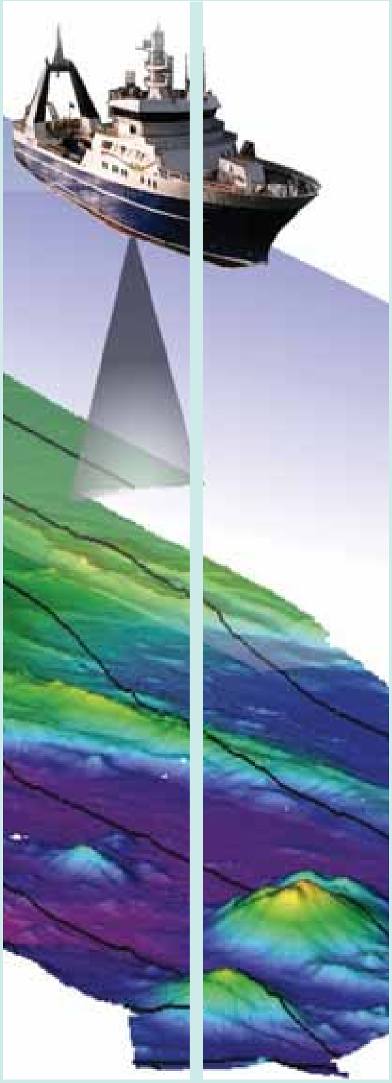

Submarine cables and the oceans: connecting the world

The first submarine cable – a copper-based telegraph cable – was laid across the Channel between the United Kingdom and France in 1850. Since then, submarine cables have literally connected the world. Now, when clicking the 'Send' button on an intercontinental email, it will almost certainly travel via the global network of submarine fibre-optic cables. The establishment of this network over the past two decades, together with the rapid rise of the internet, has revolutionized communications. The significance of that revolution was underscored in 2009 when the pioneer of fibre-optic communications, Professor Charles K. Kao, shared the Nobel Prize for Physics. Today, financial markets, general commerce, education, entertainment or just a simple telephone call are almost totally dependent on the submarine cable network whenever a trans-oceanic connection is required.

The last 20 years have also witnessed a greater human presence in coastal seas and oceans as a growing population seeks more space and resources. Coastal seas in Europe now accommodate wind turbine farms as nations develop clean and secure supplies of renewable energy. Large areas of the deep Pacific and Indian oceans have been marked for future mineral exploration. Even traditional uses of the oceans, such as fishing and shipping, are changing. The number and size of merchant ships have increased, in part to service the rapidly expanding economies of China and India. Aquaculture now accounts for 50 per cent of the fish for human consumption, with the remainder coming from traditional wild fisheries. This ever-increasing human presence offshore has not gone unnoticed. Governments and other organizations are seeking to conserve and protect the marine environment, while mindful that such measures need to be balanced with responsible development in order to meet human needs.

In that context, *Submarine Cables and the Oceans – Connecting the World* is a timely account of an historic use of the oceans, namely as a seabed platform for the submarine telecommunications cable network. This report covers the history and nature of cables, their special status in international law, their interaction with the environment and other ocean users and, finally, the challenges of the future. It is an evidence-based synopsis that aims to improve the quality and availability of information to enhance understanding and cooperation between all stakeholders.

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Tel: +254 (0) 20 7621234
Fax: +254 (0) 20 7623927
Email: uneppub@unep.org
Website: www.unep.org

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UNEP World Conservation Monitoring Centre
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Tel: +44 (0) 1223 277314
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APPENDIX 2

INTERNATIONAL CABLE PROTECTION COMMITTEE, *ABOUT SUBMARINE TELECOMMUNICATIONS CABLES* (OCT. 2011)

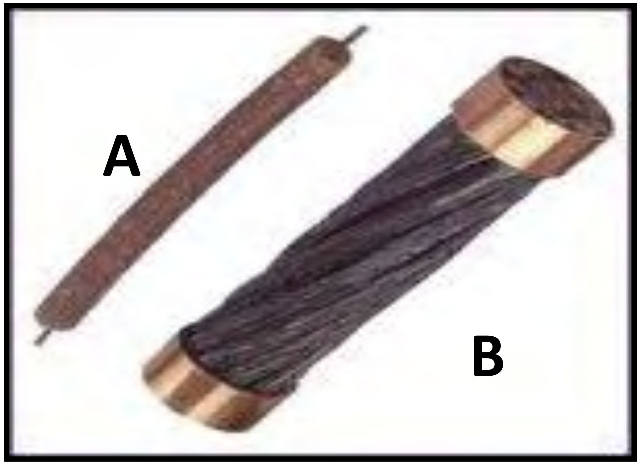
About
Submarine Telecommunications Cables

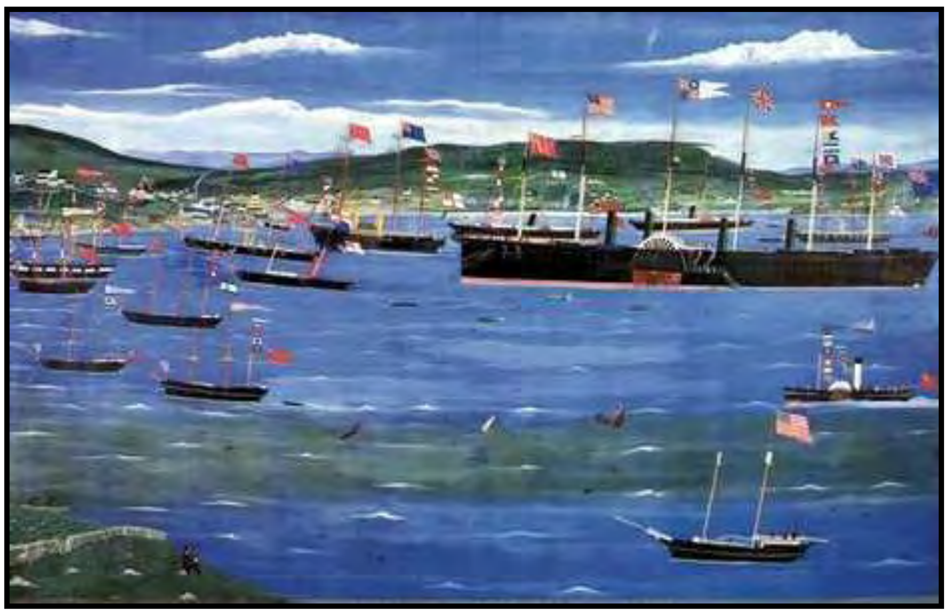
Issue Date: October 2011

Contents

A Brief History – 1

UK-France Cables
A: 1850 B: 1851
Source: BT





Great Eastern off Newfoundland
Source: Cable & Wireless

- 1840: Telegraph cables start to be laid across rivers and harbours, but initially had a limited life
- 1843-1845: Gutta-percha (a type of gum found in a Malaysian tree) was brought to Britain and starts to replace other materials that were used for electrical insulation, thus extending the life of the cable
- 1850: 1st international telegraph cable laid between UK and France, followed by a stronger cable in 1851
- 1858: 1st transatlantic cable laid between Ireland and Newfoundland by *Great Eastern*. This failed after 26 days and another was laid in 1866

A Brief History – 2

- 1884: 1st underwater telephone cable - San Francisco to Oakland
- 1920s: Short-wave radio superseded cables for voice and telex traffic, but capacity limited and affected by atmosphere
- 1956: Invention of repeaters (1940s) and their use in TAT-1, the first transatlantic telephone cable, began an era of rapid and reliable transoceanic communications
- 1961: Beginning of a high quality global network
- 1986: 1st international fibre-optic cable connects Belgium to the UK
- 1988: TAT-8, the 1st transoceanic fibre-optic cable system, connects the USA to the UK and France

Comparing Old and New

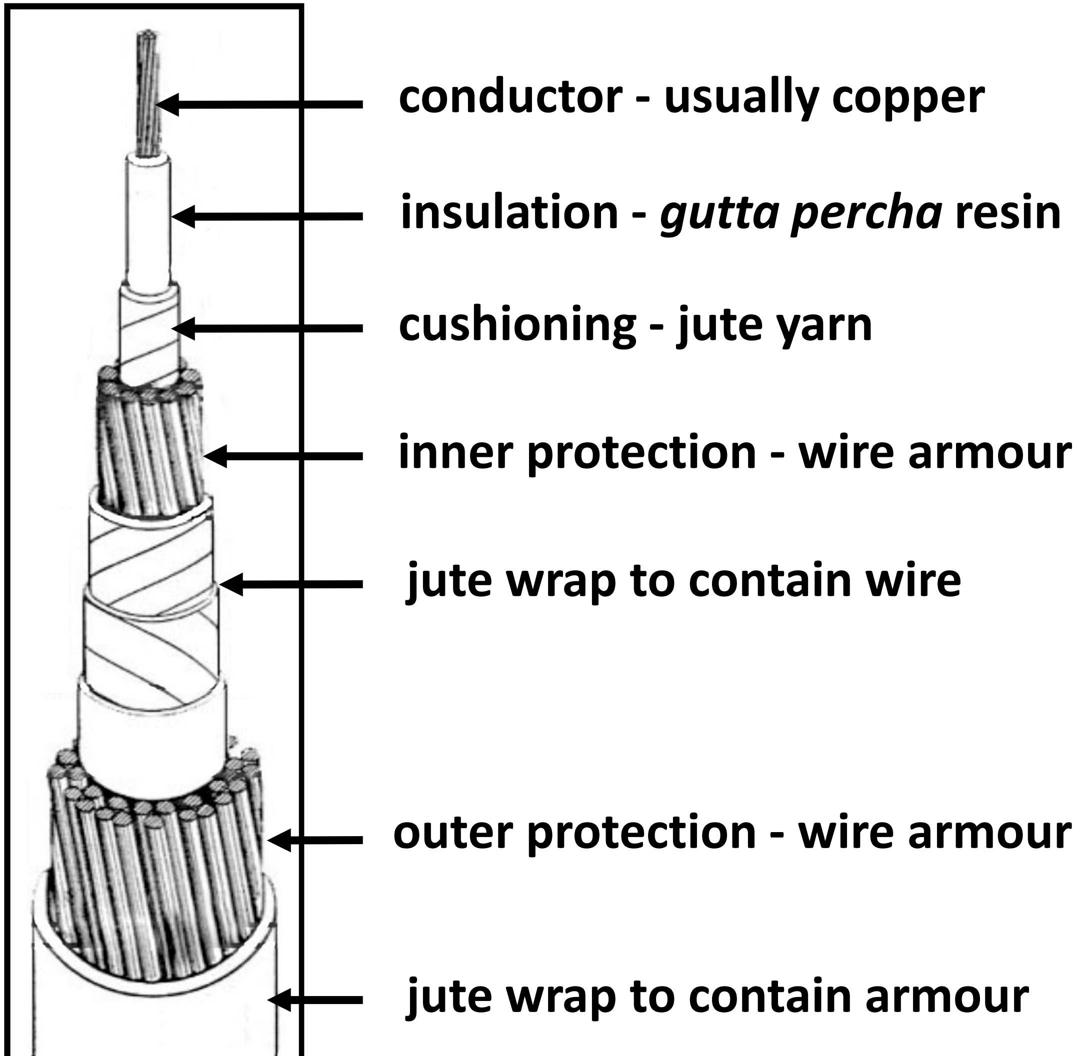
Early Cable Systems:

- **1866: 1st transatlantic cable carried telegraph messages at seven words a minute and cost £20 for 20 words**
- **1948: Telegram cost reduced to 4 pence a word for transmission across the Atlantic**
- **1956: 1st transatlantic telephone cable (TAT-1) initially had capacity of 36 telephone calls at a time. Each call cost US$12 for the first 3 minutes**

Modern Cable Systems:

- **1988: 1st transatlantic fibre-optic cable, TAT-8, carried 40,000 simultaneous phone calls, 10 times that of the last copper-based telephone cable**
- **Today, a single cable can carry millions of telephone calls, together with huge amounts video and internet data**

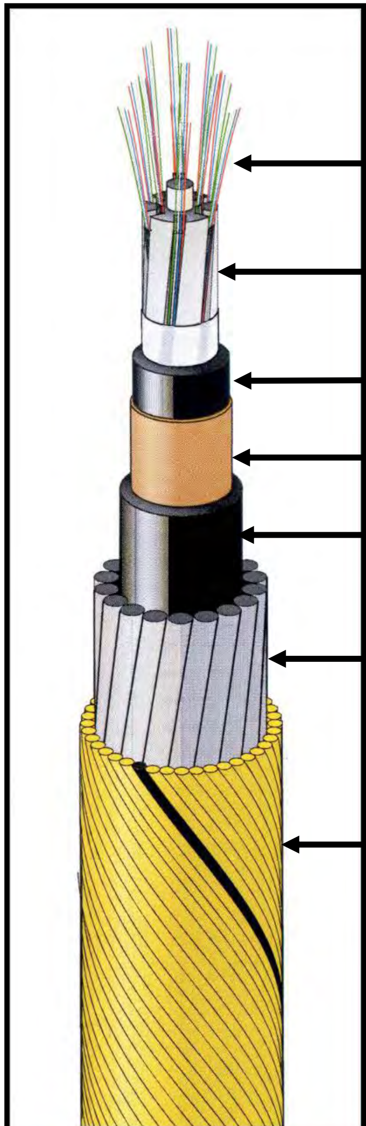
Submarine Cable – Telegraph Era



Harvesting *gutta percha* resin
Source: Porthcurno Telegraph Museum

Atlantic cable 1866
Source: Porthcurno Telegraph Museum

Modern Submarine Cable



Source: Ericsson

optical fibres - silica glass

core for strength and fibre separation - polyethylene/fibreglass

jacket - polyethylene

conductor - copper

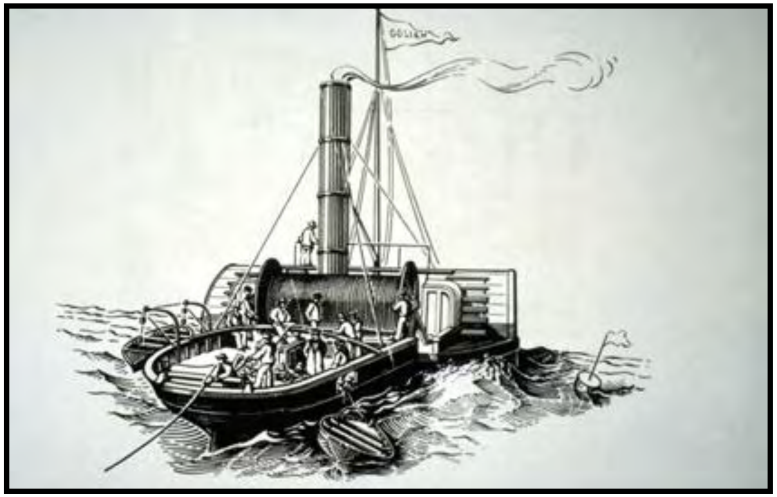
jacket - polyethylene

protective armour - steel wire

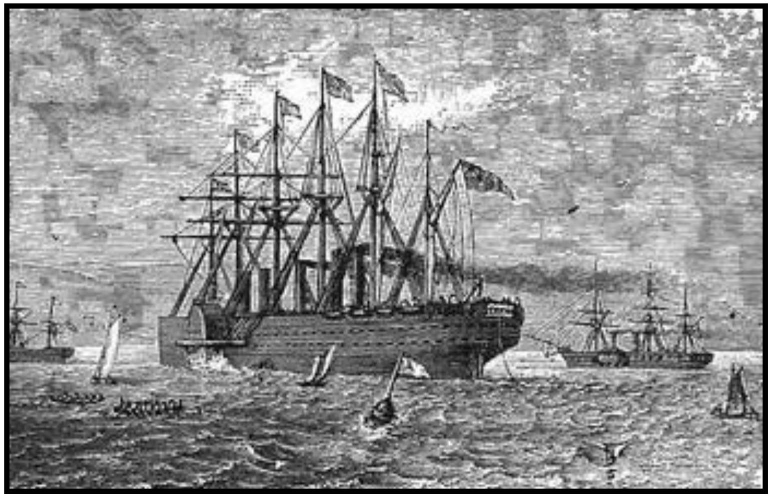
outer protection and wire containment - polypropylene yarn

- Construction varies with manufacturer and seabed conditions
- Cables may have no armour in stable, deep-ocean sites or one or more armour layers for energetic zones, e.g. coastal seas

Early Cable Ships



Goliath: lays 1st international cable, UK-France, 1850-1
Source: Illustrated London News

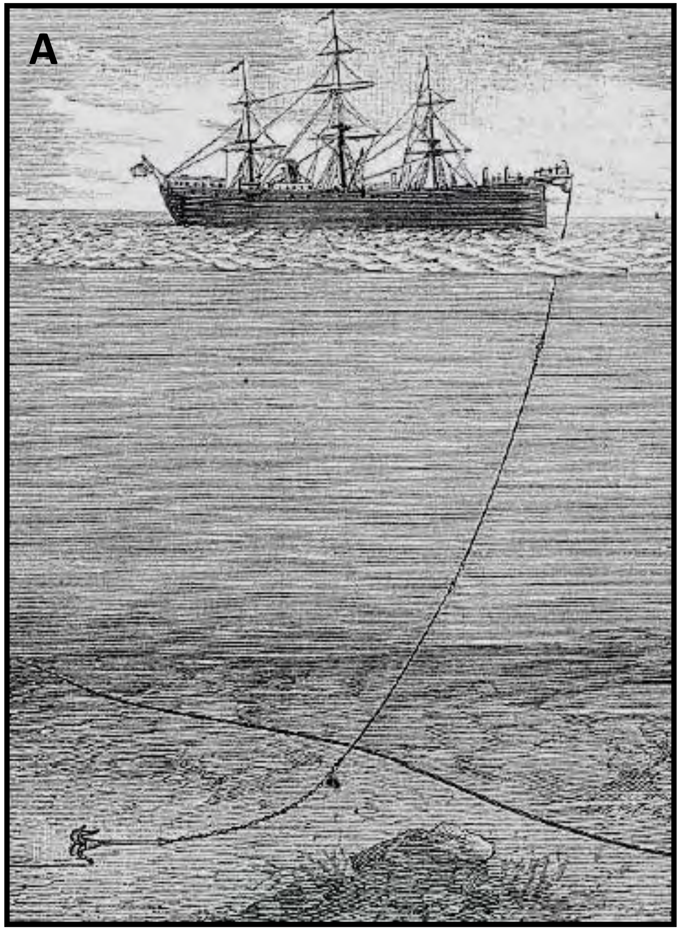


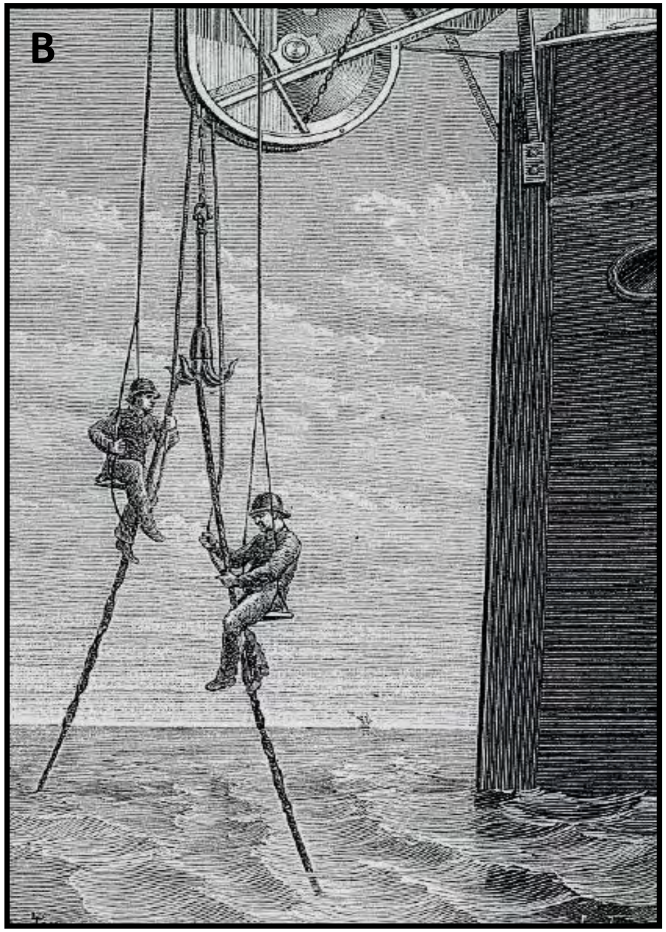
Great Eastern: laying cable off Newfoundland, 1866
Source: Canadian Government

John Pender, named after pioneer cable maker, 1900
Source: Cable & Wireless

Monarch: laid 1st transatlantic telephone cable, 1955/6
Source: www.atlantic-cable.com

Cable Repair in 1888





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

Modern Cable Handling Methods

Bringing the cable ashore
Source: Global Marine Systems

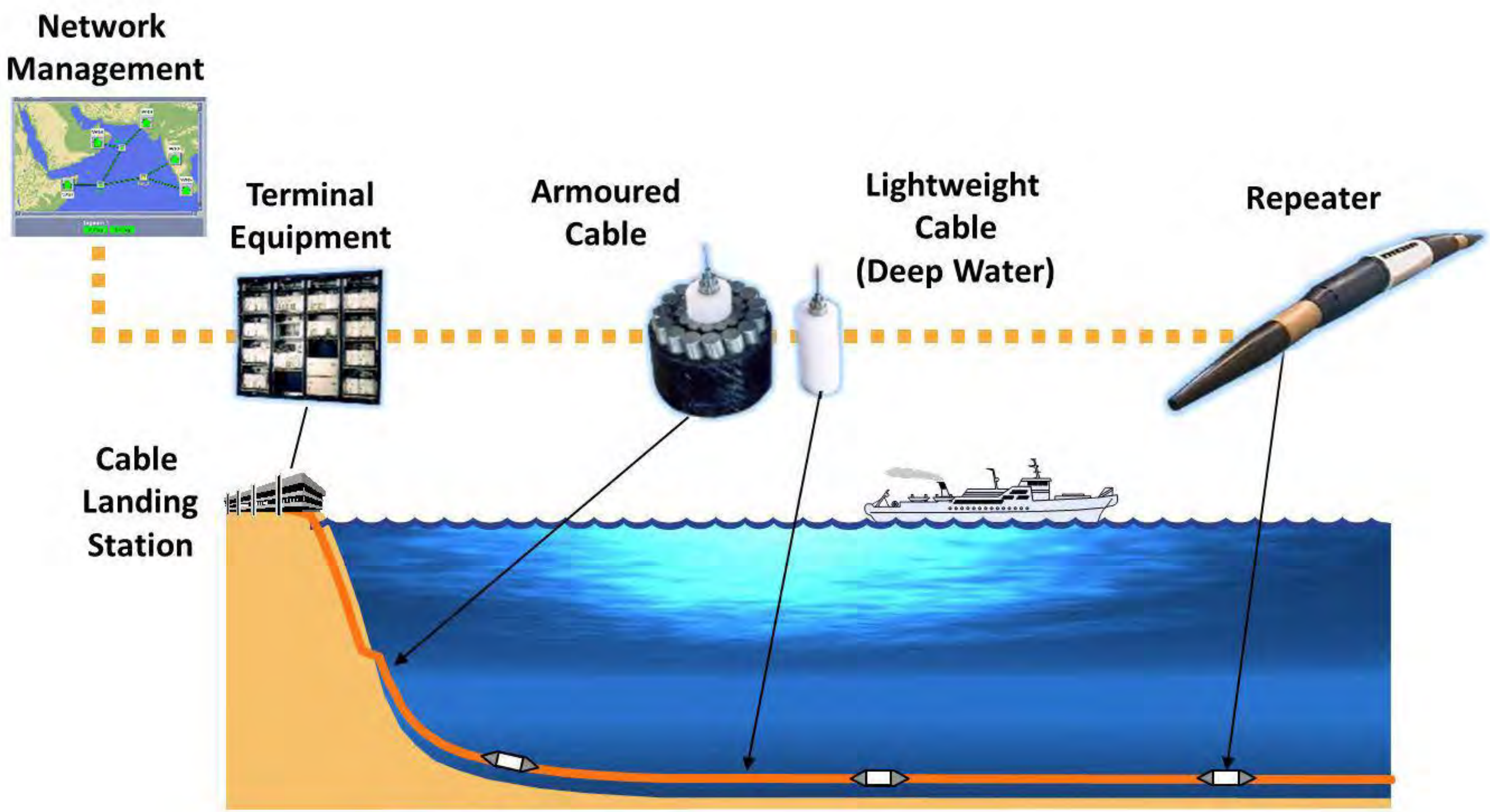
Cable and repeaters inside a cable ship
Source: TE SubCom

ROV used for cable inspection, recovery and burial
Source: TE SubCom

How Submarine Cables Work

- **Fibre-optic submarine cables rely on a property of pure glass fibres whereby light is guided by internal reflection**
- **Because the light signal loses strength en route, repeaters are required at regular intervals to restore it**
- **Repeaters are now based on optical amplifying technology, which requires short lengths of erbium-doped optical fibre to be spliced into the cable system. These are then energized by lasers that cause them to 'lase', thus boosting the incoming light signal**

Typical Submarine Cable System



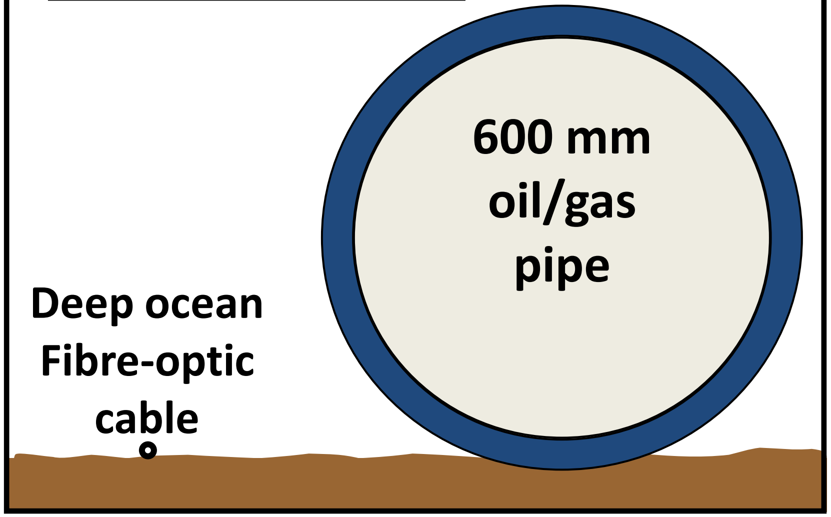
NOT TO SCALE

Source: UK Cable Protection Committee and Alcatel-Lucent Submarine Networks

Cable Size

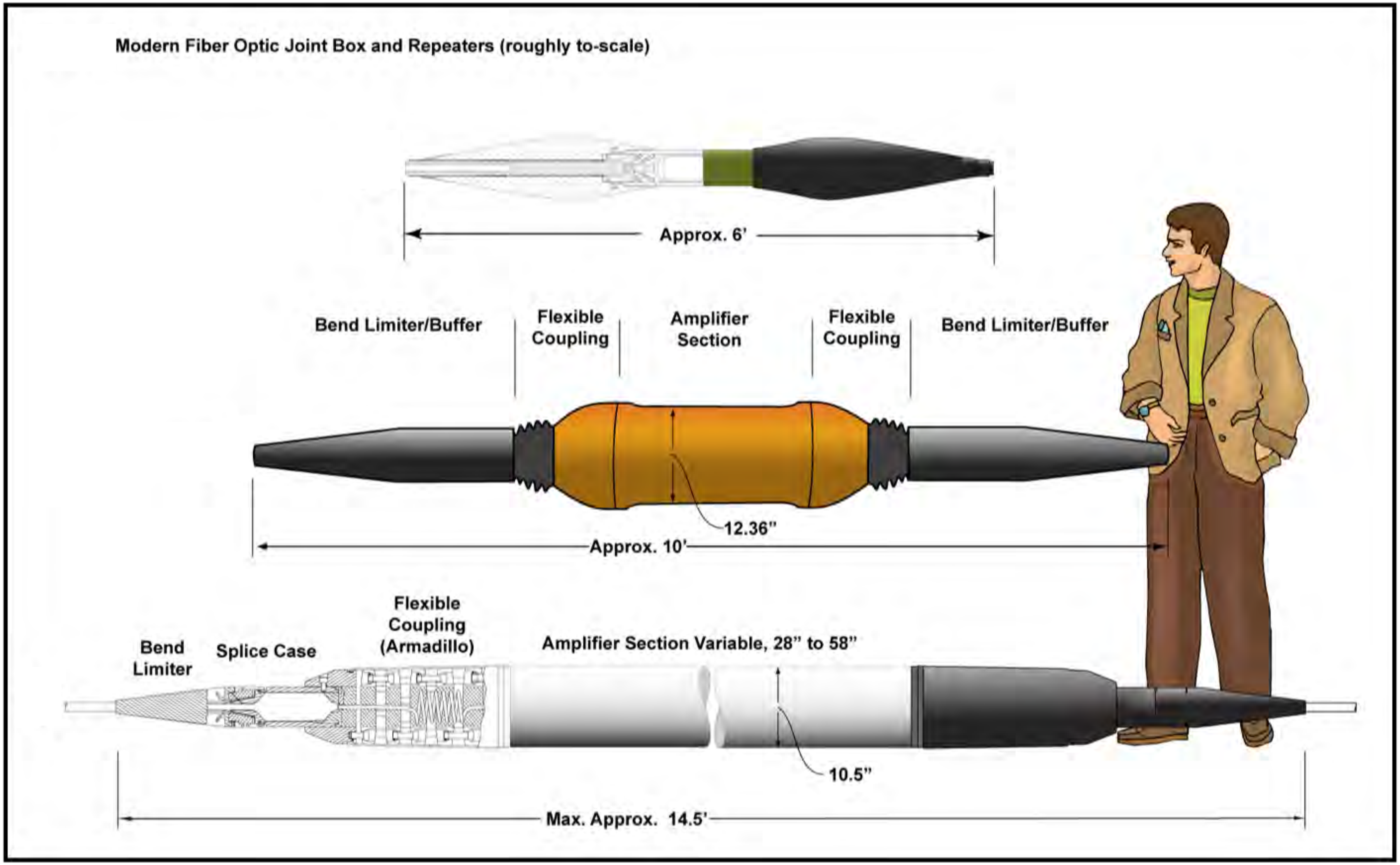
- Cables are small: deep-ocean types, without protective armour, are typically 17-20 mm diameter – the size of a garden hose or beer bottle cap
- Armoured fibre-optic cables may reach 50 mm diameter
- In contrast, submarine oil/gas pipes can reach 900 mm diameter, and fishing trawls typically range over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

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



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

Joint Boxes and Repeaters



Source: Lonnie Hagadorn

Submarine Cables and Satellites

Advantages of cables

- High reliability, capacity and security
- Insignificant delay compared to satellite
- Most cost-effective on major routes, hence rates cheaper than satellites

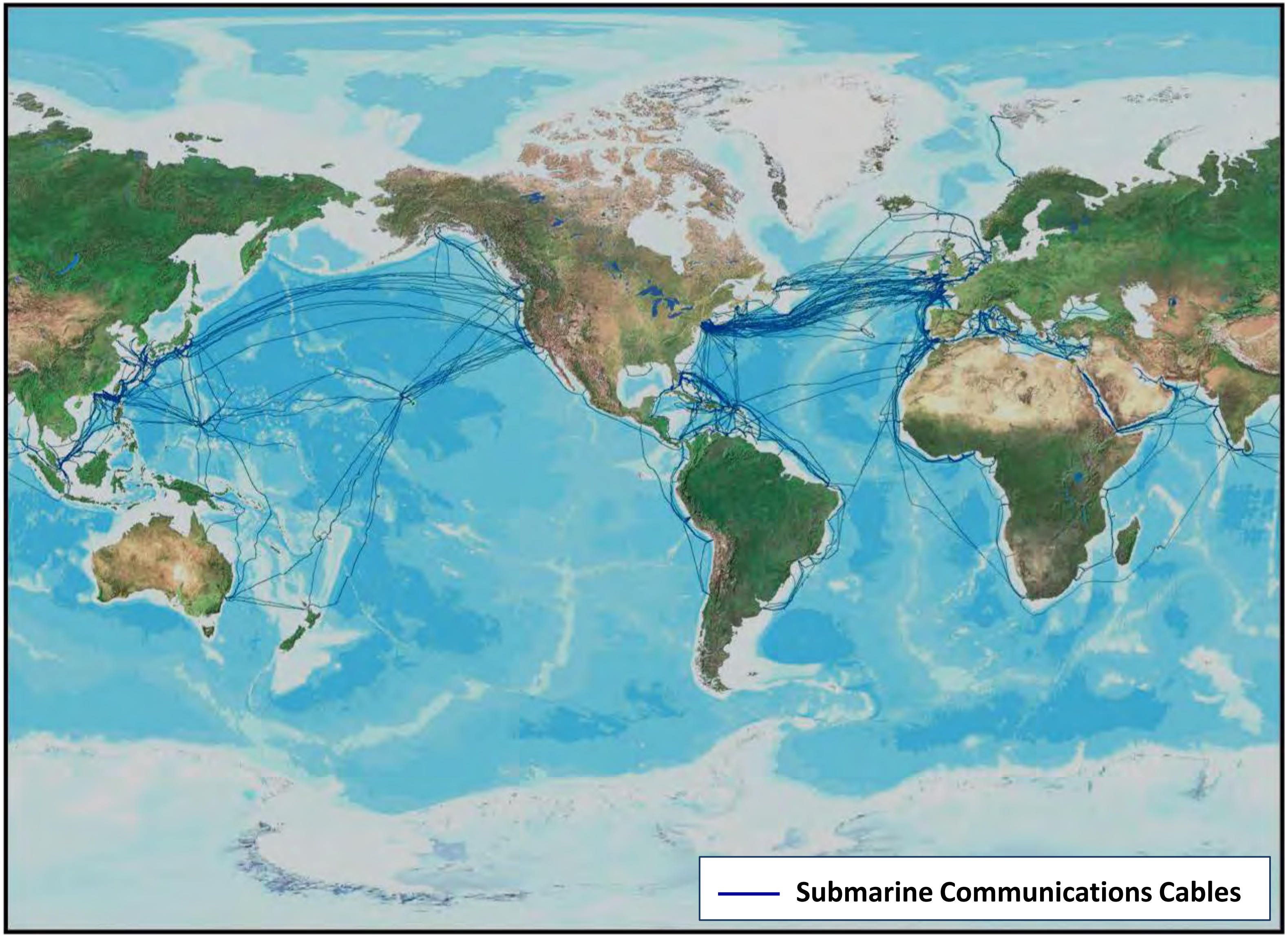
Carry >95% of transoceanic voice and data traffic

Advantages of satellites

- Suitable for regions that are vulnerable to disasters
- Provide wide broadcast coverage, e.g. for TV
- Suitable for minor routes such as links between small island nations

Carry <5% of transoceanic voice and data traffic

Main International Cable Routes



Source: TE SubCom

Coastal Cable Routes

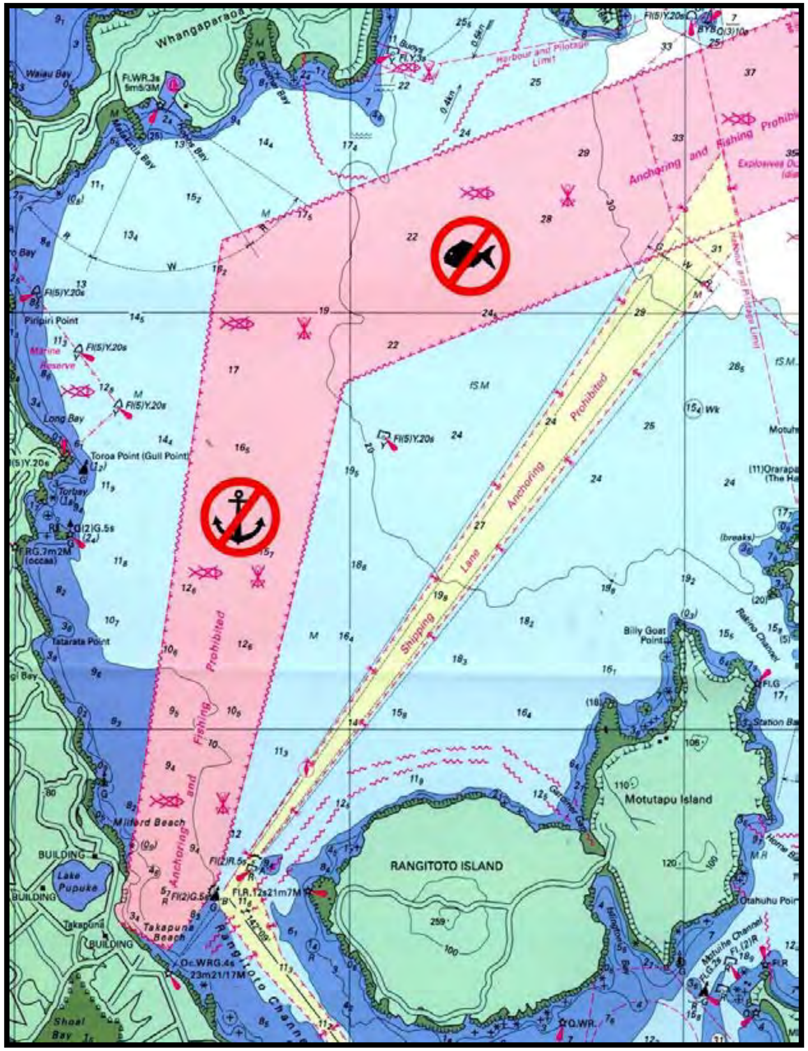


Chart with protection zone for Southern Cross cable terminal in New Zealand. *Source: Telecom NZ*

- **Near the shore, cables need protection from shipping, fishing and other activities**
- **To reduce risk, cables and protection zones are identified on nautical charts**
- **A cable protection zone is a legal entity where activities harmful to cables are banned**
- **Cable burial in water depths up to 2000 m is also a key protective measure**

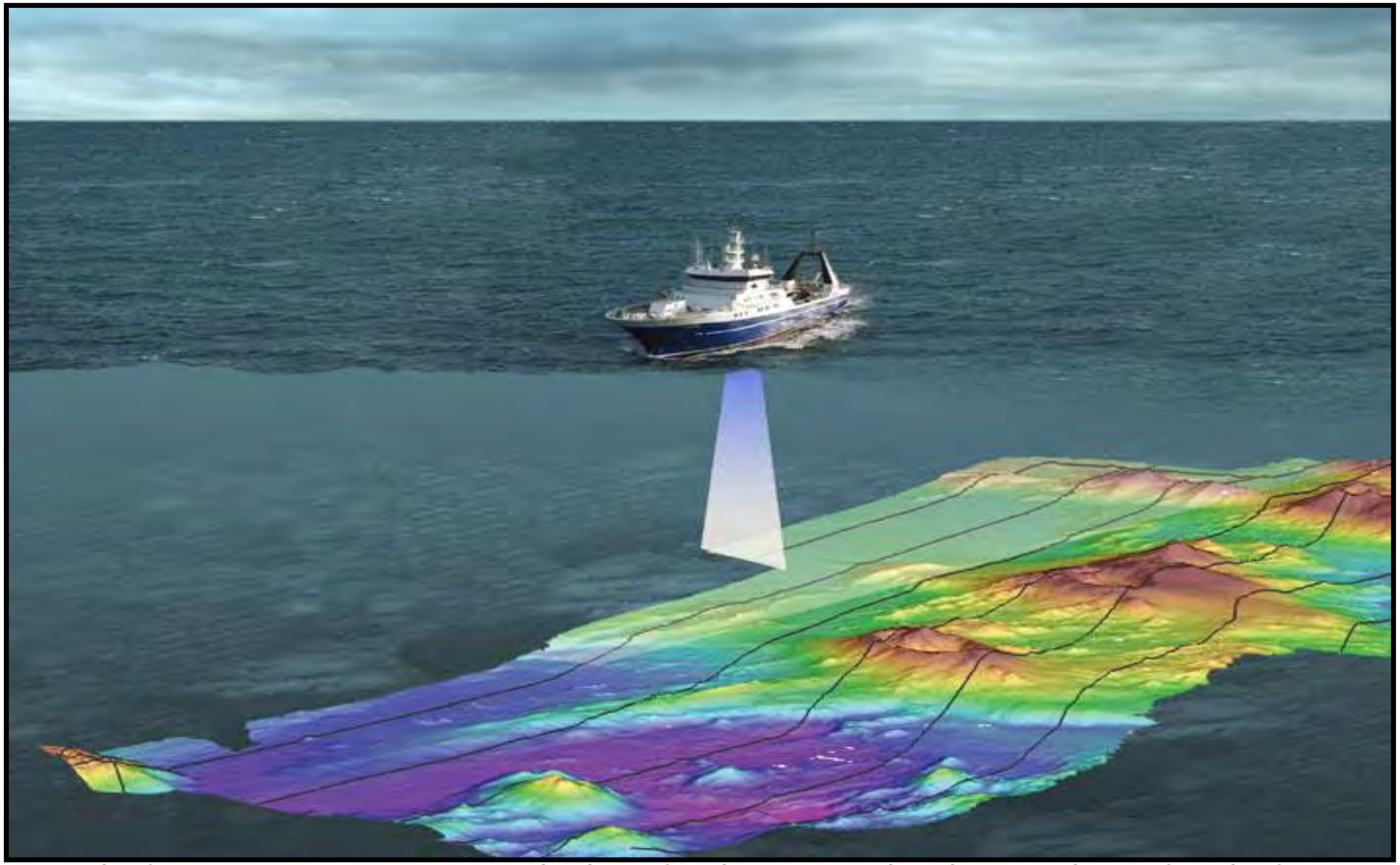
Installing a Submarine Cable

Installing a submarine cable typically involves:

- **Selection of provisional route**
- **Obtaining permission from the relevant authorities**
- **Full survey of route and its final selection**
- **Design cable system to meet conditions of selected route**
- **Laying the cable, including burial in appropriate areas**
- **In some cases, a post-lay inspection may be necessary**
- **Notification of cable position to other marine users**

Cable Route Survey

Cable routes are carefully surveyed and selected to minimize environmental impacts and maximize cable protection

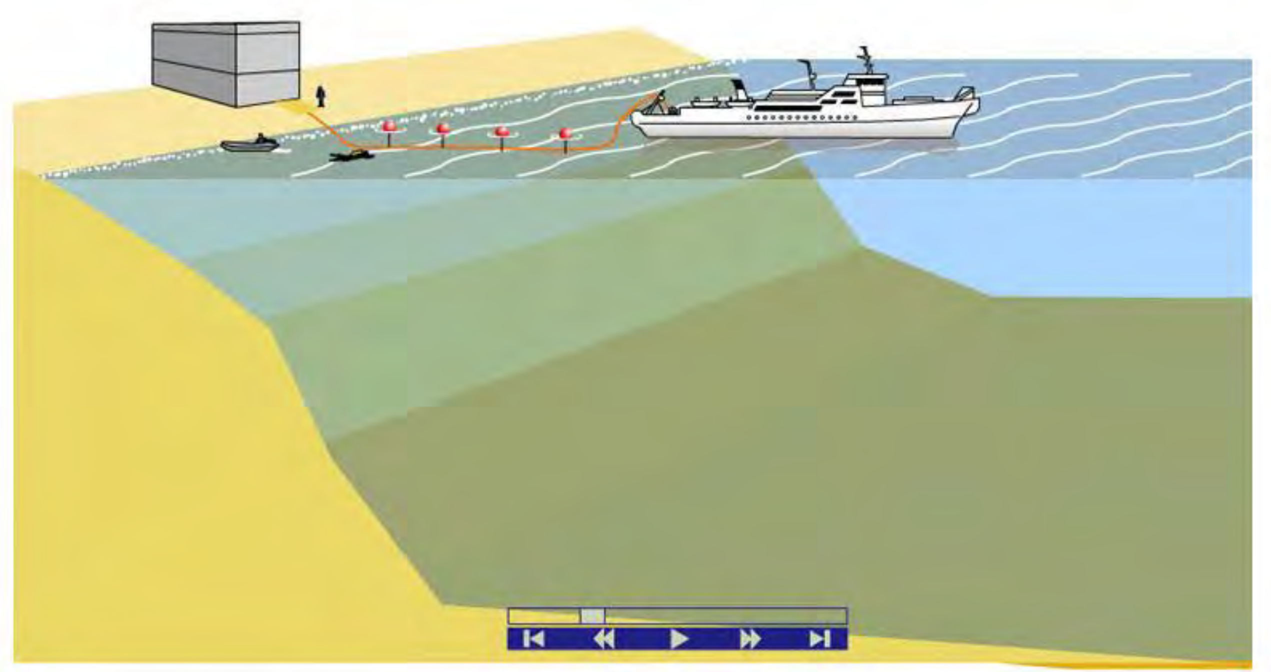


Seabed mapping systems accurately chart depth, topography, slope angles and seabed type

Source: NIWA

Cable Laying

- Guided by the route survey, specially designed ships are used to accurately place cables on or beneath the seabed
- Shallow water laying may be aided by divers ; Deep water laying may involve remotely operated vehicles



Source: Alcatel-Lucent Submarine Networks

Note: Animation of the above is currently only available in the PowerPoint version of this presentation

Cable Burial - 1

- Cables may be buried in a narrow (<1 m wide) trench cut by water jet or plough
- The plough lifts a wedge of sediment so that the cable can be inserted below
- Burial speed depends on cable type and seabed conditions
- For an armoured cable, the burial speed is about 0.2 km/hr

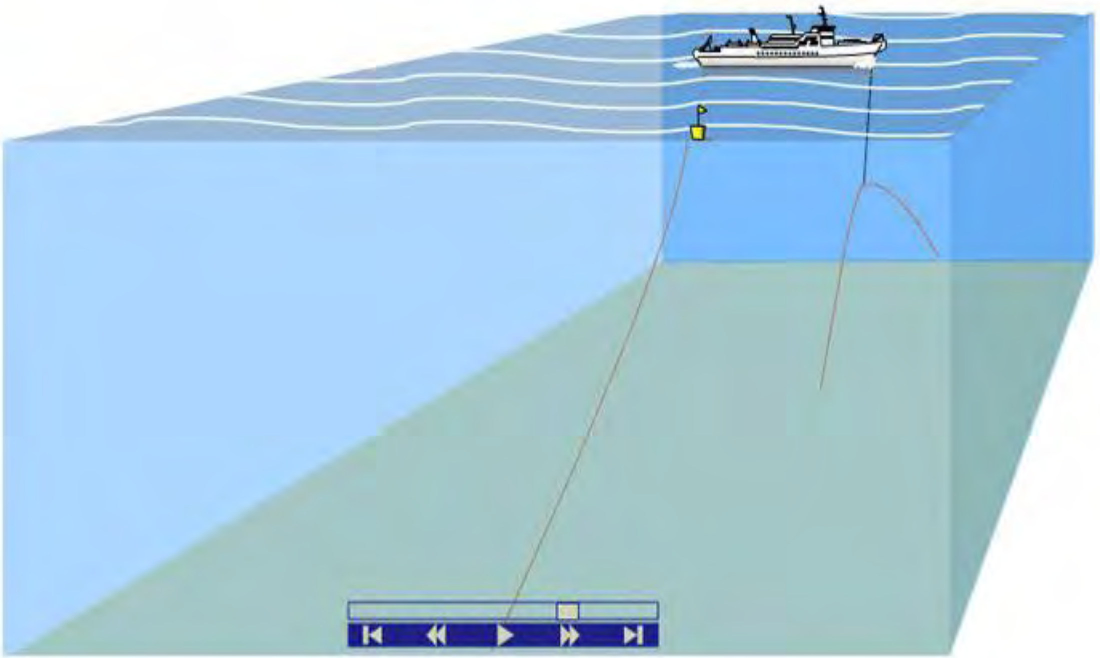
A plough being prepared to start the burial of a cable
Source: Seaworks, NZ

Cable Burial - 2

- Cables are typically buried 1 m and exceptionally up to 10 m beneath the seabed to protect against trawl fishing, ships anchoring and other activities
- Burial may extend from the shore to about 2000 m water depth, which is the present limit of trawl fisheries
- Burial may locally disrupt the seabed along a narrow path and form turbid water. The extent of this is dependent upon burial technique, seabed type and wave/current action
- In the absence of cable-based studies, analysis of seabed disturbance from fishing and other activities suggests that impacts are short-lived (months) where waves/currents are active, but possibly longer-lived in deeper, less turbulent water

Cable Repair

In the event of a fault, the cable has to be recovered from the seabed so that a replacement section can be spliced in:



Source: Alcatel-Lucent Submarine Networks

Note: Animation of the above is currently only available in the PowerPoint version of this presentation

Cables and the Law - 1

Recognizing the value to humanity of international communications, cables are protected by international treaties:

- **The International Convention for the Protection of Submarine Cables (1884)**
- **The Geneva Conventions of the Continental Shelf and High Seas (1958)**
- **United Nations Convention on Law of the Sea (1982)**

Cables and the Law - 2

Modern international law extends the special status of international cables to all uses:

- **Telecommunications**
- **Power**
- **Scientific**
- **Military**

Cables and the Law - 3

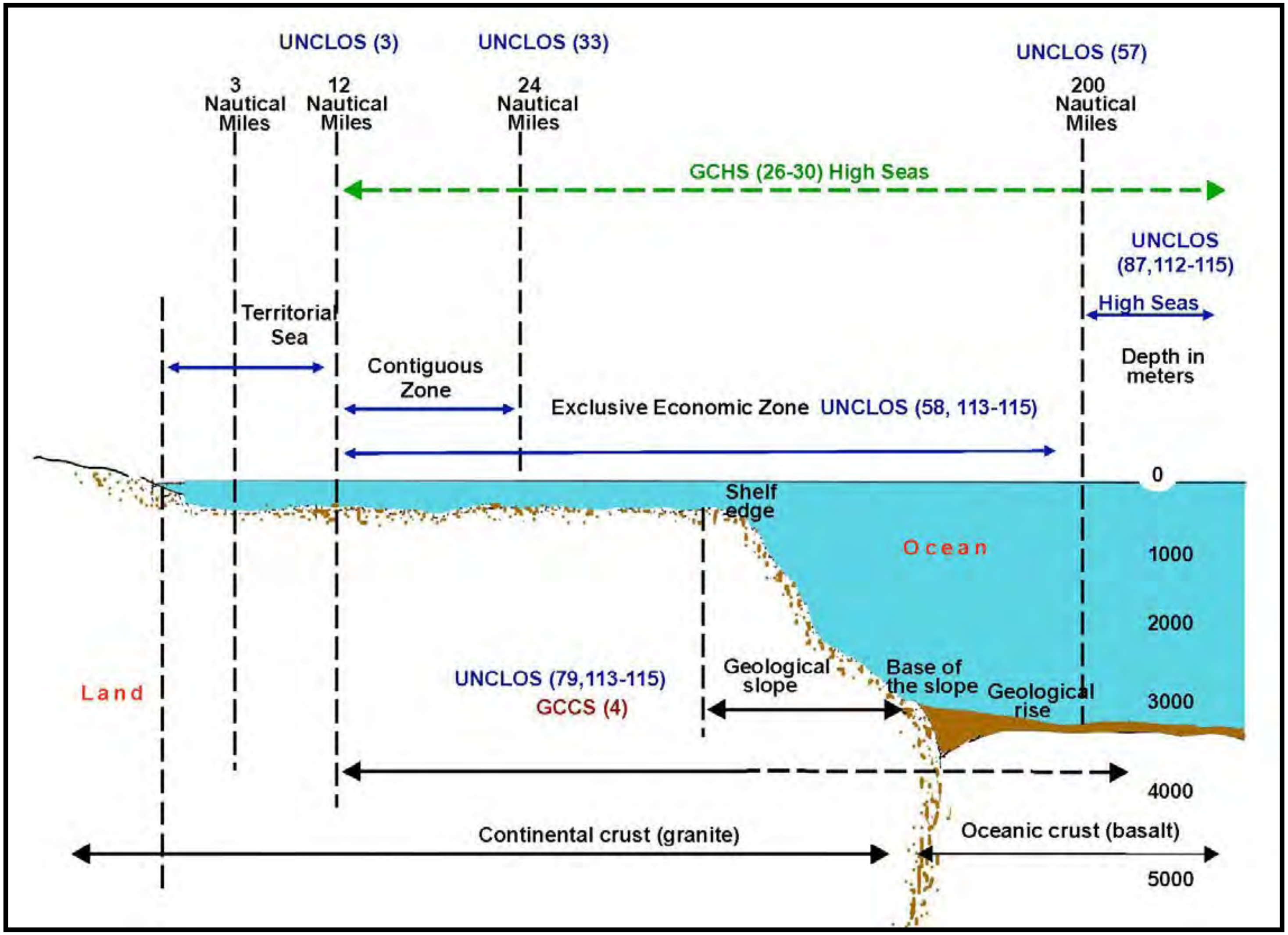
The international treaties establish universal norms:

- Freedom to lay, maintain and repair cables outside of a nation's 12 nautical mile territorial sea
- National obligations to impose criminal and civil penalties for intentional or negligent injury to cables
- Special status for ships laying and repairing cables
- Indemnification for vessels that sacrifice anchors or fishing gear to avoid injury to cables
- Obligations of cables crossing earlier laid cables and pipelines to indemnify repair costs for crossing damage
- Universal access to national courts to enforce treaty obligations

Cables and the Law - 4

The International Tribunal for the Law of the Sea, Hamburg, Germany
Source: Stephan Wallocha

Cables and the Law - 5



Legal boundaries of the ocean from Territorial Seas to Exclusive Economic Zone and onto the High Seas
Note: The numbers in (brackets) refer to treaty articles. ***Source: Doug Burnett***

Cables and the Environment - 1

ATOC/Pioneer Seamount scientific cable with attached anemones (*Metridium farcimen*) at 140 m water depth off California. ***Source: Monterey Bay Aquarium Research Institute***

Cables and the Environment - 2

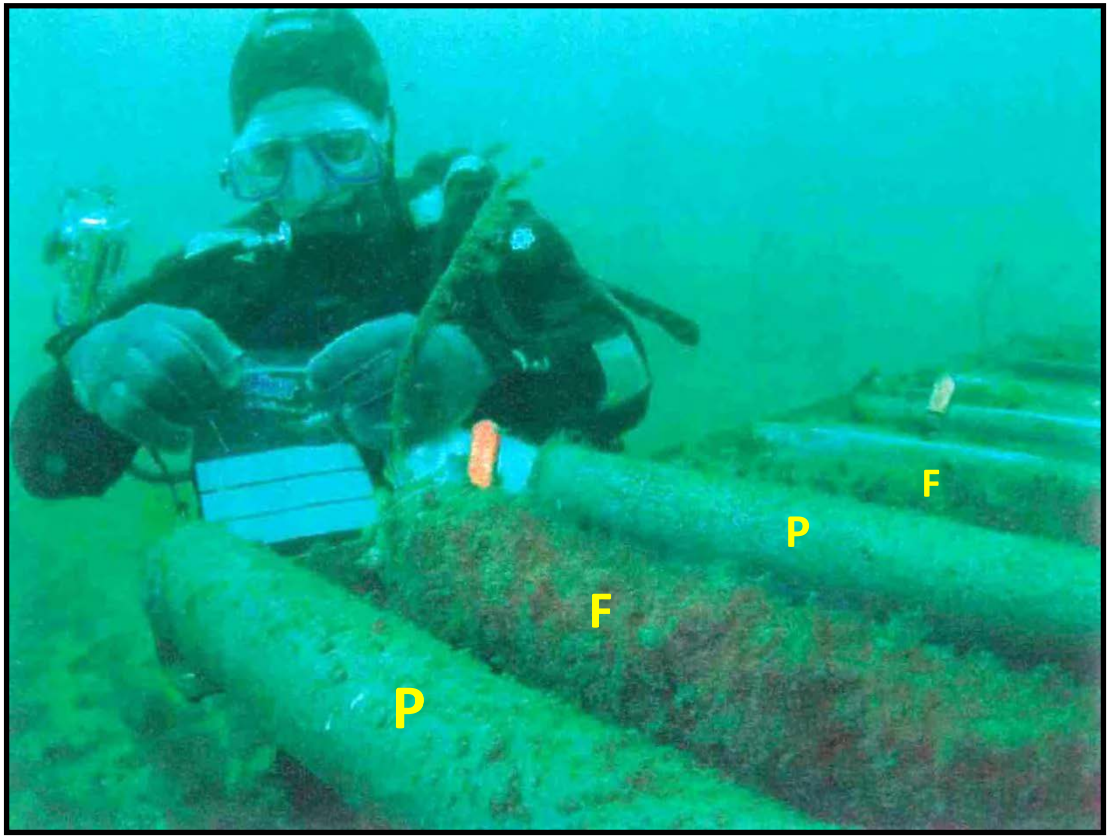
- Properly laid, fibre-optic cables have a neutral to benign impact on marine environment
- A cable's small size means its "footprint" is small, especially compared to submarine pipelines or trawl dredge
- Cables are substrates for marine organisms with recovered cables yielding key specimens for scientific collections

Telecommunications cable with encrusting marine organisms
Source: Glauco Rivera

Cables as Artificial Reefs - 1

Scientific tests undertaken in the UK show that:

- **Cables are fully colonised by marine organisms in 1-2 months depending on conditions**
- **Cables are essentially non-polluting**



Diver checks lengths of fibre-optic cable (F) and plastic pipes (P) that act as controls to check rates of colonisation by marine organisms.
Source: Dr K. Collins, Southampton University

Cables as Artificial Reefs - 2

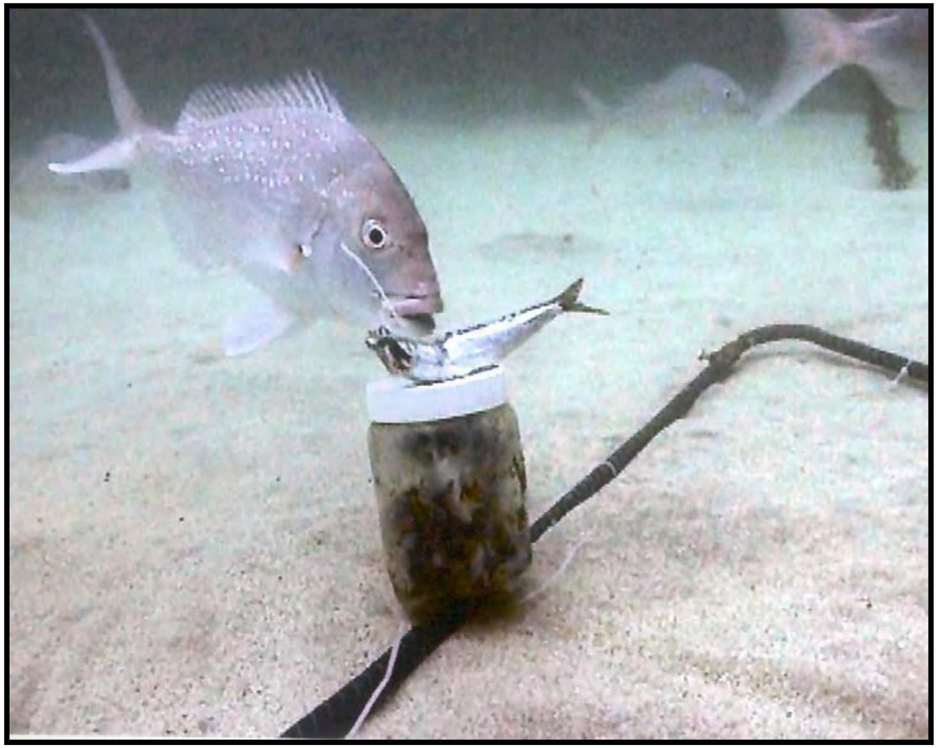
- Coils of cable have been placed off Maryland and New Jersey to form artificial reefs
- These reefs have attracted many marine organisms that range from algae to fish
- To be successful, reefs must be stable, non-toxic, last for 20-30 years and provide habitats

Submarine cable coiled to form an artificial reef on the continental shelf off the US state of Maryland. This picture shows colonisation by starfish, mussels and other organisms that may help biodiversity & fish stocks.

Source: © Compass Light

Cable Protection Zones as Sanctuaries

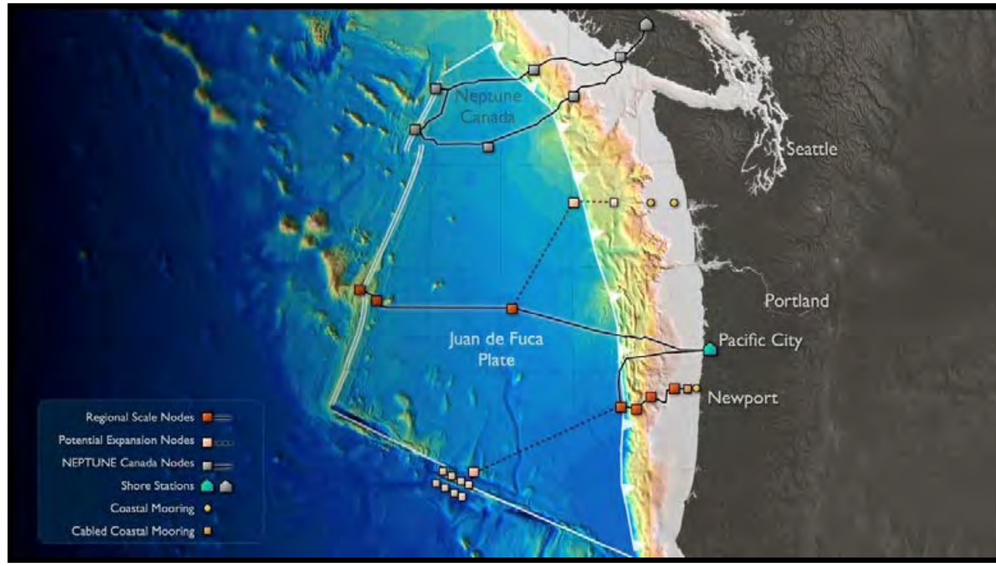
- **Zones that are created to protect submarine cables could act as marine sanctuaries, thus improving biodiversity and fish stocks**
- **An effective zone must contain habitats that are suitable for fish and other marine life, exist long enough for ecosystems to develop and be policed to prevent illegal fishing**

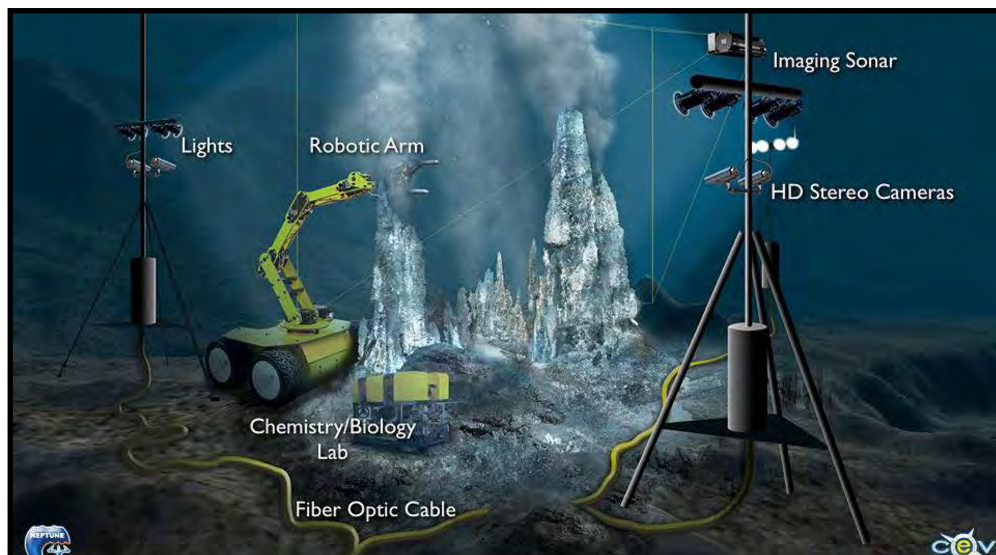


Experiment to count fish to test if a cable protection zone acts as a marine sanctuary.
Source: Leigh Laboratory, University of Auckland

Observing the Ocean

- **Ocean observatories are being developed for the long-term monitoring of the marine environment**
- **Observation sites will be linked via submarine cables that will provide power for equipment and data transfer to shore**
- **Covering many parts of the world, observatories will help detect and warn of natural hazards, measure ocean response to climate change, undertake research and develop technologies**





Observatories off Canada and USA [top] with artist's depiction of proposed activities [bottom] ***Source: Neptune Canada and OOI***

Marine Mammals

Sperm whale begins dive off New Zealand
Source: NIWA

- Published cable fault data show that from 1877 to around 1960, 16 whale entanglements were noted – mainly involving sperm whales
- Since that period there have been no reported incidents of marine mammal entanglements
- This change in part reflects improved materials and laying techniques
- Compared to telegraph cables, modern cables are stronger, laid under tension with less slack, and are often buried below the seabed in water depths down to 2000 m

Fish (including Sharks)

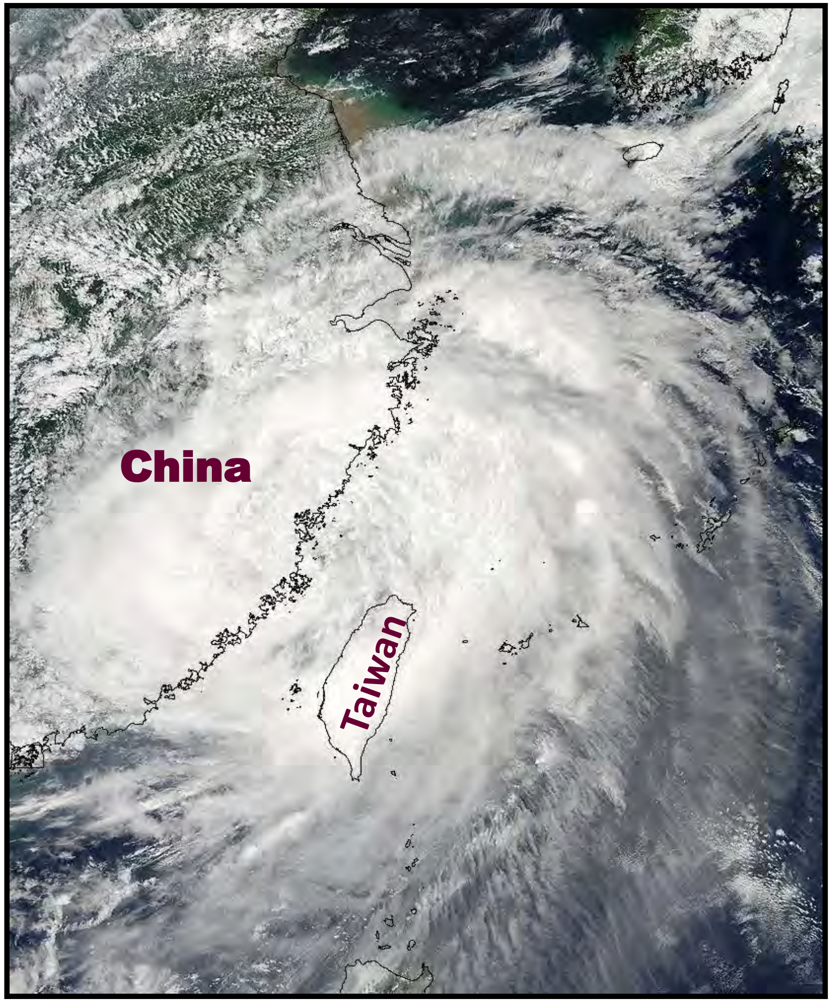
- Faults caused by fish restricted mainly to telegraph cables (pre-1964)
- Attacks could be due to cable smell, colour, motion or electro-magnetic field
- In 1985-1987, a domestic fibre-optic cable installed in the Canary Islands was damaged by sharks in 1-2 km water depth
- These attacks were verified by the presence of shark teeth that were found embedded in the cable
- The cable design was subsequently improved with the inclusion of metal tape sheathing in 1988
- There is no evidence of faults caused by fish (including sharks) on systems that use this improved cable design

Effects of Natural Hazards - 1

- Submarine cables are exposed to natural hazards in all water depths
- In depths to around 1000 m, the main hazards are human activities with natural effects causing under 10% of cable damage incidents
- Natural hazards dominate in water depths greater than 1000 m. These include:
  - Submarine earthquakes, fault lines and related landslides - break or bury cables
  - Density currents - break or bury
  - Currents and waves - abrasion, stress and fatigue
  - Tsunami, storm surge and sea level rise - damage coastal installations
  - Extreme weather (e.g. hurricanes) - break or bury
  - Rarely, icebergs or volcanic activity

Effects of Natural Hazards - 2

- Typhoon Morakot struck Taiwan from 7-11 August 2009, when almost 3 m of rain fell in the central mountains
- This caused rivers to flood and carry vast amounts of sediment to the ocean
- So much sediment was discharged that dense sediment-laden currents formed and flowed across the seabed, breaking several cables en route
- While records of such events are too short to identify trends, the enhanced precipitation of Typhoon Morakot is consistent with warmer air and ocean temperatures

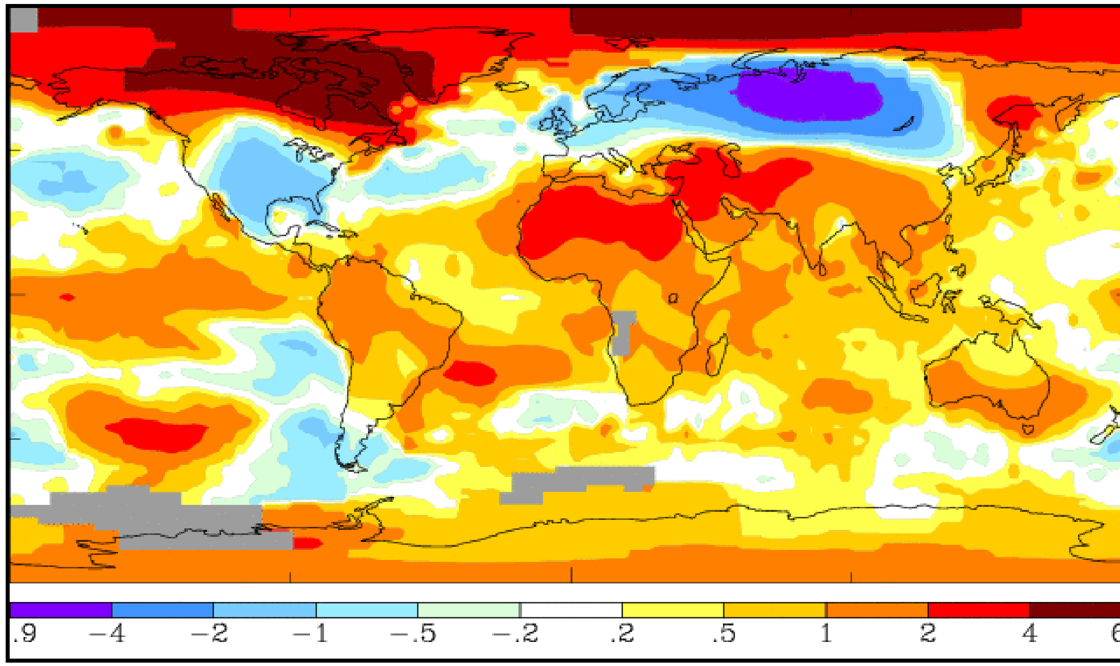


Typhoon Morakot masks Taiwan as it releases a deluge to set off submarine mud flows that broke cables
Source: MODIS Rapid Response, NOAA

Effects of Climate Change

Cables may be exposed to risks arising from global warming, via:

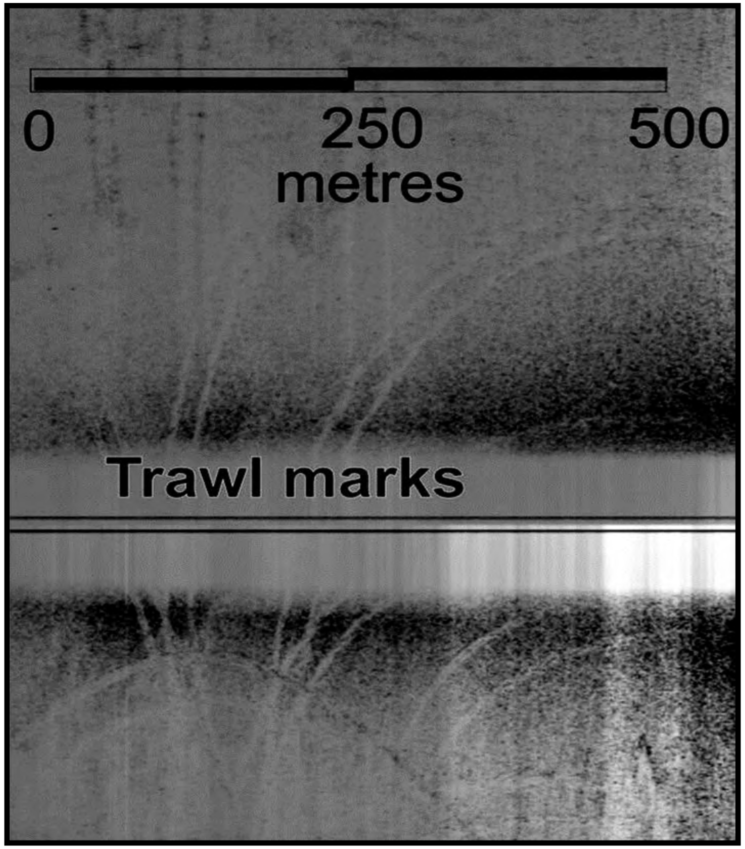
- Rising sea level due to thermal expansion of ocean and melting ice
- Increased windiness and wave/current activity
- More intense storms, rainfall and floods
- Changes in offshore activities, e.g. growth of renewable energy schemes



The global distribution of temperature anomalies for winter 2010. The colder than normal winter in the USA, Europe and Russia is clear, but so is the warmer than average Arctic and much of the Southern Hemisphere. This helped make 2010 the joint warmest year on record. The scale is degrees cooler/warmer than the 1951-1980 average temperature.
Source: Goddard Institute of Space Studies, NASA

Effects of Human Activities

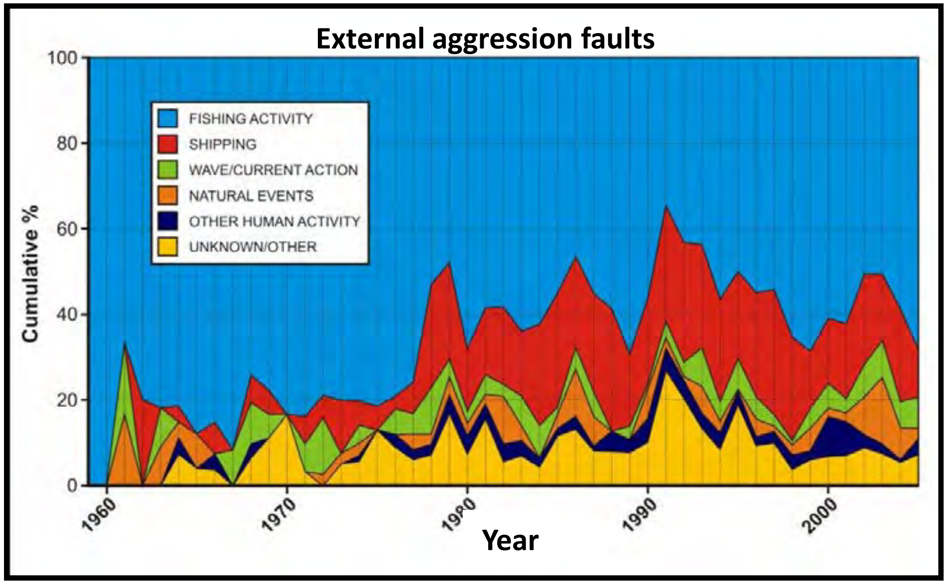
Submarine cables are coming into increasing contact with other seabed users, especially fishing and shipping industries.



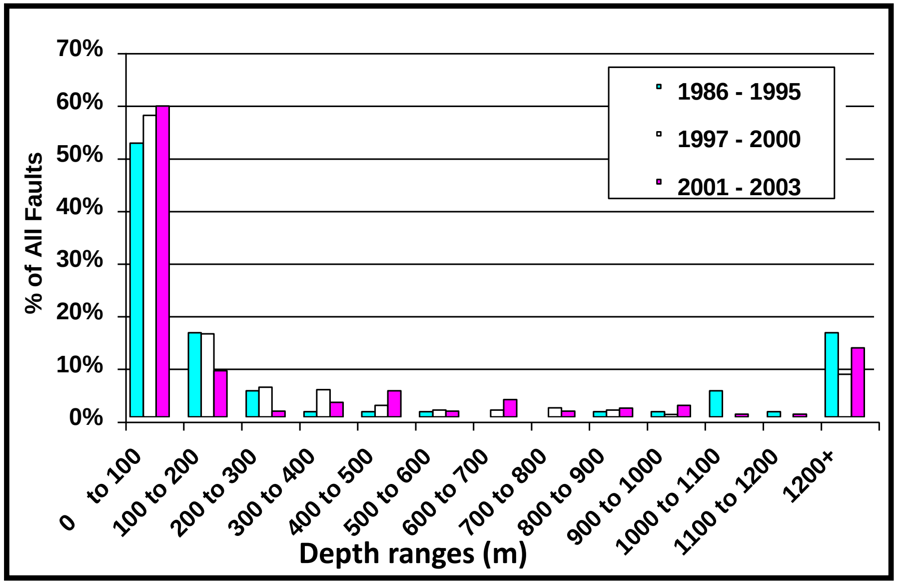
Sonar image of 25m wide trawl scars, Nova Scotian shelf. *Source: A. Orpin, NIWA*

Trawl scars, Chatham Rise
Source: M. Clark, NIWA

Fault Causes



Analysis of faults by type of aggression
Source: M. Wood and L. Carter, IEEE, 2008



Analysis of faults by water depth
Source: Submarine Cable Improvement Group

- Around 70% of all cable faults are caused by fishing and anchoring activities
- Around 12% are caused by natural hazards, e.g. current abrasion or earthquakes
- Most faults are caused by human activities in less than 200 m water depth
- Faults in more than 1000 m water depth are mostly caused by natural events

Cable Damage From Fishing

Illegal fishing in
cable protection zone

Cable snagged and moved by trawl gear

Cable damaged by trawl gear

Sources: Seaworks and Transpower NZ

Cable Faults Worldwide

Global pattern of external aggression cable faults, 1959-2006

Source: TE SubCom

Other Seabed Users

- **Coastal seas are increasingly used for energy projects (wind, tide and wave power), resource extraction and environmental protection (marine sanctuaries, marine protected areas, etc.)**
- **ICPC strongly supports constructive interaction with other seabed users to ensure harmonious access to the coastal seas and ocean**

Offshore wind farm, Middelgrunden, Denmark
Source: © LM Glasfiber

Cables and the Future - 1

"Prediction is very difficult, especially about the future" **- Niels Bohr**

TECHNOLOGY

- **Cable design and operations are constantly evolving. New systems are smaller with greater capacity and reliability**
- **Further development of ocean observatories will rely on new cable technology. This is likely to include integrated environmental sensors and docking modules to enable submarine survey vehicles to download data and recharge**
- **Submarine cables, with sensors to detect chemical and physical changes, are planned for maritime and coastal defenses**

Cables and the Future - 2

ENVIRONMENT

- In some regions of the world, submarine cables are likely to be exposed to more natural hazards related to changing climate
- Climate change may also affect other marine activities such as fishing, with potential impacts on cables
- Measures to preserve biodiversity, ecosystems and resources via various protection zones in national waters and the high seas, may impinge upon cable passage
- The ocean, especially the coastal seas, will be subject to increased human activities due to expansion of renewable energy schemes

Cables and the Future - 3

LEGAL

The ICPC is very concerned about:

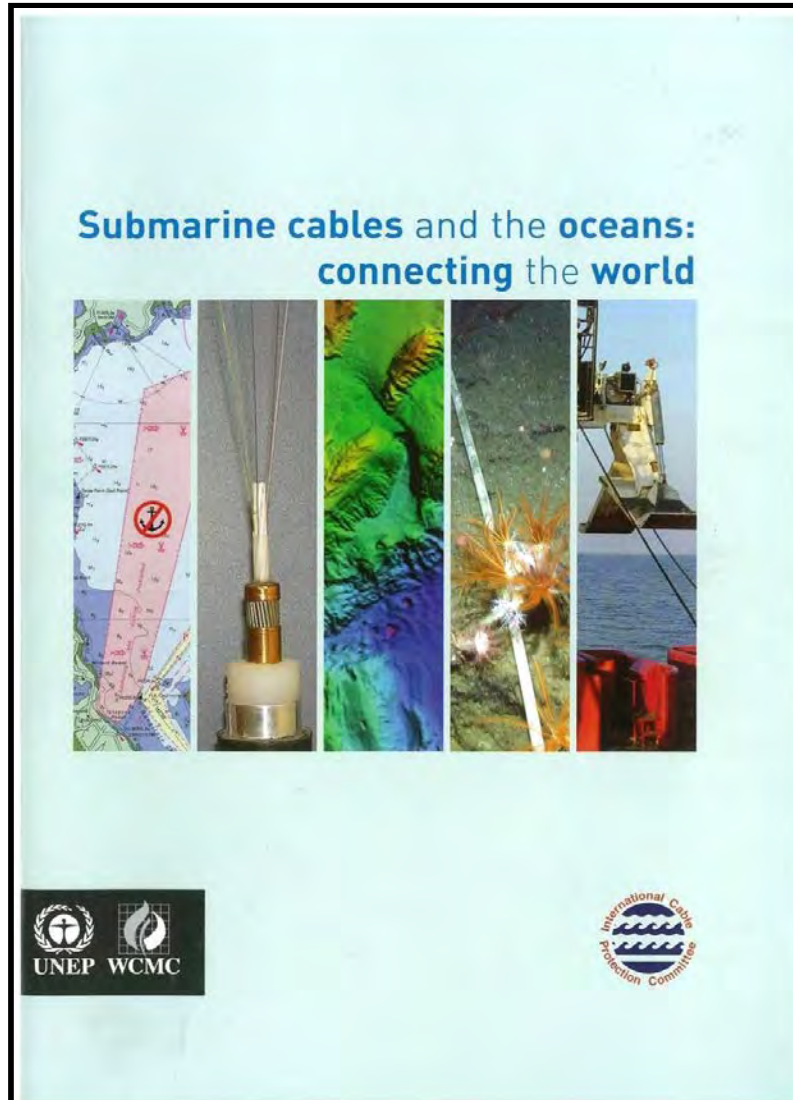
- **Coastal State encroachment on traditional freedoms under UNCLOS (United Nations Convention on the Law of the Sea) to lay, maintain and repair international cables**
- **Resolution of Continental Shelf boundaries under UNCLOS**
- **Lack of national legislation to implement UNCLOS obligations to protect international cable infrastructure beyond territorial waters**
- **Restrictions on international cables that are imposed without any scientific basis to appease local constituencies, some of which regard submarine cables as an alternative revenue source**

More Information

This booklet was prepared in collaboration with UNEP (United Nations Environmental Programme) and was published in 2009.

It provides an objective, factual description of the submarine cable industry and the interaction of submarine cables with the marine environment.

A copy can be downloaded by clicking here



Glossary

- **Armour:** steel wires placed around cable for strength and protection
- **Coaxial cable:** two concentric conductors separated by an insulator; enabled telephone calls over long distances using analogue technology
- **Fibre-optic cable:** Optical fibres encased in protective tube that is also a power conductor for repeaters. Enables telephone, video and data communications over long distances using light; has much greater capacity, reliability and signal quality
- **Repeater:** Submersible housing containing equipment that is needed to boost the signal at regular intervals on long submarine cable systems; powered from the cable terminal
- **ROV:** Remotely Operated Vehicle – a submersible tool that works on the seabed to inspect, bury or recover the cable
- **Telegraph cable:** Copper wires insulated with gutta-percha, wrapped in India rubber and steel wire

Contacts

Technical Content and General Enquiries:

Mr. Graham Marle
Email: graham.marle@iscpc.org

Historical and Environmental Content:

Professor Lionel Carter
Email: lionel.carter@iscpc.org

Legal Content:

Mr. Doug Burnett
Email: doug.burnett@iscpc.org

Presentation compiled by Lionel Carter, Graham Marle and Doug Burnett

Acknowledgements

Alcatel-Lucent Submarine Networks

British Telecom

Cable & Wireless

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Government of Canada

IFREMER

KDDI

LM Glasfiber

Lonnie Hagadorn

Monterey Bay Aquarium Research Institute

Neptune Canada

NASA

NIWA

NOAA

Porthcurno Telegraph Museum

Seaworks NZ

Southampton University

Submarine Cable Improvement Group

Telecom NZ

TE SubCom

Transpower NZ

UK Cable Protection Committee

UN Environmental Programme

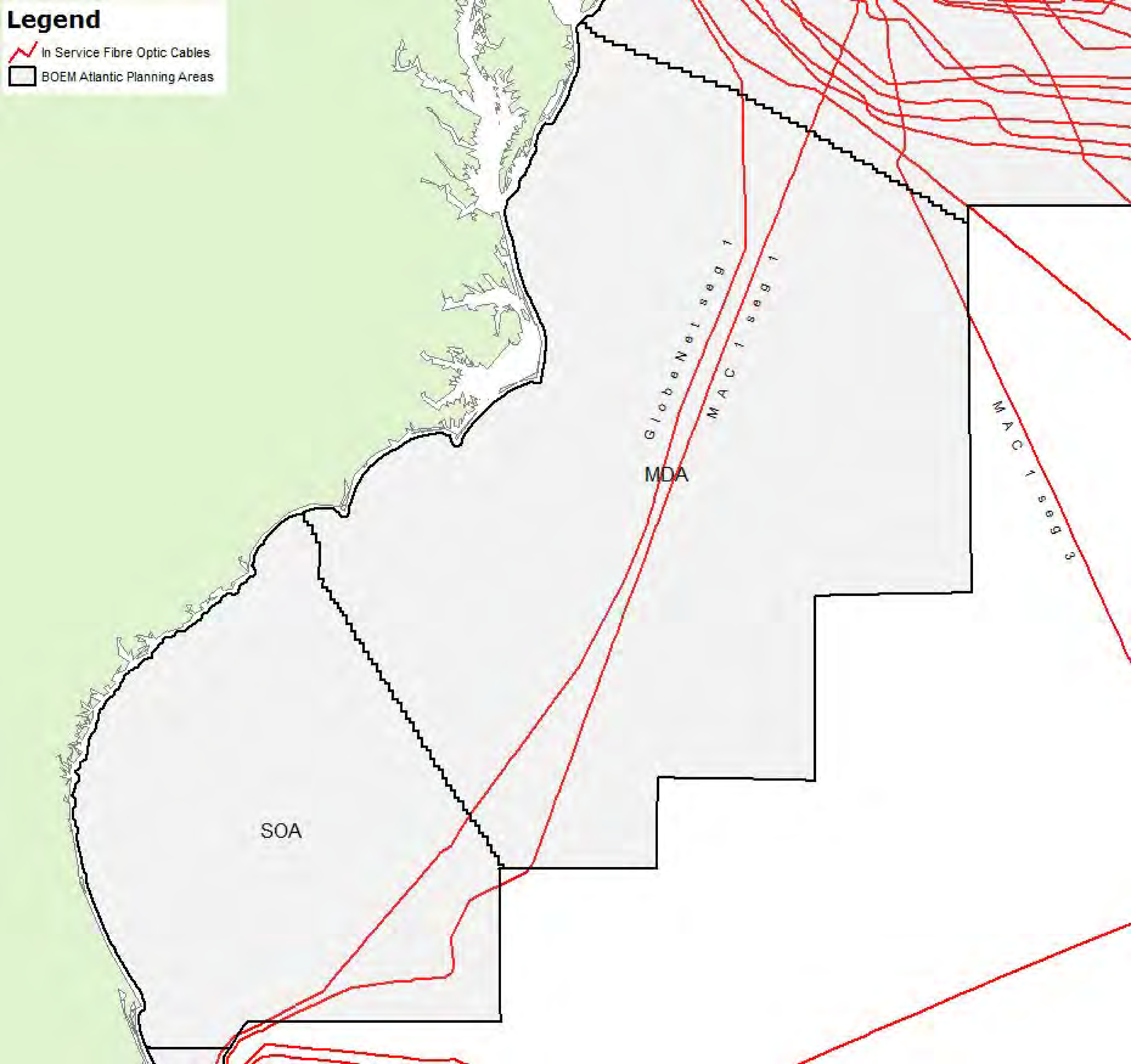
University of Auckland

University of Massachusetts

ICPC - Sharing the seabed in harmony

APPENDIX 3

MAP SHOWING EXISTING SUBMARINE TELECOMMUNICATIONS CABLES WITHIN THE MID AND SOUTH-ATLANTIC PLANNING AREAS OF THE OCS



Legend
In Service Fibre Optic Cables
BOEM Atlantic Planning Areas
GlobeNet seg 1
MAC 1 seg 1
MAC 1 seg 3
MDA
SOA

24 May 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
Office of Environment (MS 5410)
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394
GGEIS@boem.gov

olsen
associates, inc.
Coastal Engineering

Re: Comments on the Draft PEIS for Atlantic G&G Activities

Dear Mr. Goeke:

The following comments are presented in regard to the Draft Programmatic Environmental Impact Statement (DPEIS) for Mid- and South-Atlantic OCS Geological & Geophysical (G&G) Activities, dated April 2012. My comments principally concern the DPEIS impacts upon Marine Minerals (MM) sites. As the Permit Agent, consulting engineer and/or Engineer of Record for numerous beach restoration projects in Florida that utilize and rely upon MM sites as an offshore sand source, I am very familiar with the G&G activities required to develop, dredge, and monitor these MM resources.

The proposed Alternatives (A and B) would place impractical, scientifically unjustified, and burdensome requirements upon the public interests that utilize the MM sites for public shore protection (beach restoration) projects. The DPEIS is unclear and inconsistent in terms of recognizing the distinctions between (a) high-frequency, low-energy survey devices utilized for MM sites versus airguns and other lower-frequency/high-energy devices, and (b) restrictions for MM sites versus Oil & Gas (O&G) and Renewable Energy (RE) sites.

The DPEIS fails to demonstrate adverse impacts to marine life from the high-frequency, low-energy devices commonly used to develop and monitor MM sites. The claimed (potential) impacts to marine turtles are speculative, at best. The DPEIS analysis and conclusions are based upon computer models of sound without adequate calibration and verification. The array of sound sources did not even consider the commonly used low-energy, dual-frequency fathometer; yet the DPEIS proposes restrictions on its use in tandem with all other equipment.

The proposed calendar restrictions on activities in Alternatives A and B would limit the days available to perform surveys to impractically small windows of time – particularly given the vagaries of ocean weather and the need to identify periods of consistently calm seas to perform the surveys. Alternative B, for example, presents impossibly narrow windows to perform MM surveys offshore of Brevard County: two weeks in late April and two weeks in early November, of which the latter is typically unusable because of nor'easter storms.

Through its lease agreements, BOEM requires pre- and post-construction surveys of MM sites. For unjustified reasons, BOEM appears to be increasingly seeking (1) tighter restrictions on timing of those surveys relative to construction, and (2) time-intensive higher-resolution survey methods. BOEM cannot require and expect its lease partners to conduct increasingly complex surveys (presumably for the benefit of BOEM) amidst increasingly onerous and unrealistic restrictions. It is difficult and costly enough attempting to comply with existing restrictions and expectations for the development and monitoring of these MM sites, let alone dealing with new layers of restrictions and review.

The proposed requirements to put marine observers aboard the small vessels used for MM surveys, and to suspend surveys when animals are sighted, are unjustified and onerous. If these requirements are justified and reasonable, then should not all recreational vessels and merchant ships be equipped with marine observers and/or be required to turn off their fathometers when operating in federal waters? What defensible evidence or rational justification is there that a 25-ft survey vessel operating at trawling (survey) speeds and surveying with high-frequency, low-energy devices will impact marine animals on the Outer Continental Shelf?

Has BOEM considered the very significant increase in costs to the public to provide such observers and to shut down a survey for at least 30 minutes every time an animal is observed? The beach projects for which MM sand is used, at least in Florida, are constructed in the public interest and with 100% public (Federal, State, and Local) funds. Any increased restriction on OCS activities for these public projects must consider the fiscal costs of these restrictions to the public relative to the real benefit to environmental protection that will be received. At least in terms of MM sites, the proposed Alternatives A and B do *not* make such consideration of the public interest.

The draft PEIS is ambiguous in terms of what G&G activities are exempt from restriction for MM sites, and how exceptions will be made. Throughout the document (say, for one example, Section 2.1.2.3), it is suggested that exemptions apply to high-resolution (non airgun) surveys for RE and MM sites, but then it is stated that surveys will be "reviewed on a case-by-case basis, and authorization may include additional mitigation and monitoring requirements…." It is therefore not clear what is and is not to be allowed for G&G surveys of MM sites, nor what burdensome process might be involved in gaining approvals for surveys under either Alternatives A or B. It is clear, however, that having to submit requests – and awaiting BOEM staff time to review requests – for high-resolution (non airgun) surveys of MM sites is onerous, costly, and of no net benefit to the environment or the public interest.

I strongly urge BOEM to consider the following recommendations:

1. Adopt Alternative C and retain the status quo for MM surveys.

2. If Alternative C is untenable owing to the political pressure to address O&G sites, then adopt Alternative A – but very clearly identify those G&G methods and devices that are *automatically exempt* from additional restrictions, at least for MM sites. This includes exemptions from calendar restrictions and observers.

olsen associates, inc. | 2618 Herschel Street | Jacksonville, FL 32204 | 904.387.6114 | FAX 904.384.7368

www.olsen-associates.com | email: olsen@olsen-associates.com

3. Exemptions for high-resolution G&G activities for MM sites might specify types of allowable equipment and methods but should *additionally* specify the minimum frequency and maximum energy level, to avoid confusion or uncertainty regarding what is and is not exempt equipment.

4. Exemptions for listed equipment/methods should be automatic and *not* require case-by-case review and approval. Review and approval otherwise burdens both BOEM staff and the public.

5. Alternative B should not be adopted nor further considered.

I appreciate the opportunity to submit these comments for the record. Thank you for your consideration in this matter.

Sincerely,

Kevin Bodge, Ph.D., P.E.
Senior Vice President & Principal Engineer, II

cc: Ernest Brown (Brevard County Natural Resource Management Office)
Patrick Giniewski (U.S. Air Force, 45th Space Wing)
Tom Heal (City of Jacksonville, Public Works)
Donald Dankert (NASA/Kennedy Space Center Env. Mngt. Branch)
Jerry Scarborough (U.S. Army Corps of Engineers, Jacksonville District)
Jeff Littlejohn (Florida Dept. of Environmental Protection)
Danielle Fondren (Fla. Dept. of Env. Protection, Bureau of Beaches & Coastal Systems)

CONSUMERENERGYALLIANCE

Statement By

Kevin Doyle
Consumer Energy Alliance
April 16, 2012
Jacksonville, FL

Good afternoon. My name is Kevin Doyle. I am the Florida Executive Director for the Consumer Energy Alliance, a nonpartisan, nonprofit group dedicated to expanding dialogue between the energy and consuming sectors and ensuring balanced national energy policy. I am pleased to comment today on behalf of CEA.

Considering that more than 30 years have passed since the last estimates of Atlantic OCS energy resources were completed, we must allow for seismic studies to be conducted in an environmentally-friendly manner so that proper resource assessments can be made to support future lease sales.

With the availability of newer and better seismic exploration technologies, it is likely that current estimates of oil and natural gas resources in the Atlantic OCS will change because the latest technology will allow for the development of resources that were previously thought unrecoverable or because new locations of these resources might be found. In fact, further exploration has led to increased resource estimates in parts of offshore Alaska and the Gulf of Mexico, where oil estimates increased by 400 percent and natural gas estimates doubled between 1995 and 2003.

Quite simply, there is much for us to learn about the energy resources contained within Atlantic waters, and we must begin that process now. We must recognize the tremendous economic opportunity that safe and responsible offshore energy exploration presents to the citizens of Florida and the nation at large.

Jak 1pm

CONSUMERENERGYALLIANCE

According to a 2011 Woods Mackenzie study, oil and gas development in the Atlantic OCS could generate up to 140,000 jobs and $14 billion in government revenue annually.

The U.S. oil and gas industry supports over nine million American jobs – both directly and indirectly – and generates nearly $1 trillion in economic activity every year. If access to areas currently off-limits to production were granted, an additional $1.7 trillion in government revenues could be generated.

It is time to implement a balanced, commonsense national energy strategy that creates jobs, improves our national energy security and responsibly allows access to our abundant offshore resources.

In conclusion, CEA feels that with the appropriate mitigation measures, seismic surveys can be undertaken with little or no impact to marine life. As such, we hope that the process surrounding the development of the PEIS moves forward expeditiously so that this essential data can be available as soon as possible to support future lease sales and resource assessments.

CEA thanks the Bureau of Ocean Energy Management for their work on the PEIS.

Thank you.

CHARLESTON METRO
CHAMBER OF COMMERCE

P.O. Box 975
Charleston, SC 29402-0975
843.577.2510
843.723.4853 fax
www.charlestonchamber.net

May 22, 2012

Mr. Michael R. Bromwich
Bureau of Ocean Energy Management
1849 C Street, NW
Washington, D.C. 20240

Dear Mr. Bromwich:

The Charleston Metro Chamber of Commerce supports the Bureau of Ocean Energy Management's permitting of geological and geophysical activities for oil and gas exploration and development in the Mid and South Atlantic Planning Areas.

The Chamber strongly supports development of a comprehensive energy strategy for our nation and our state to help lesson our dependence on foreign oil. Exploration of energy sources within the United States is a logical part of that strategy. By developing our own resources, we are helping to create jobs and strengthen our nation's national defense at the same time.

By approving the seismic study of offshore drilling on the Atlantic Outer Continental Shelf, the U.S. government would be taking a solid first step in this process. In a recovering economy such as ours, it is important that we assess all opportunities that would spur economic development. Hundreds of thousands of jobs would be created by opening the Atlantic Outer Continental Shelf. This would also give our regional business community a competitive advantage over our international counterparts.

The Charleston Metro Chamber of Commerce supports the efforts by the Bureau of Ocean Management in beginning the process of studying the Atlantic Outer Continental Shelf for oil and gas resources.

Sincerely,

Mary Graham

Mary Graham, CCR, IOM, CCE
Senior Vice President
Business Advocacy

Atlantic PEIS for G&G Activities
Public Meetings
IAGC / Geophysical Industry Public Comments
(Short Version)

- My name is ___Matthew Padon_ and I am with SeaBird Exploration and here today representing the International Association of Geophysical Contractors – the IAGC.

- IAGC is the international trade association representing the industry that provides geophysical services to the energy industry, including both the conventional and renewable energy sectors.

- IAGC members have expressed interest in conducting geophysical activities on the Atlantic OCS.

- IAGC member companies play an integral role in the successful exploration and development of offshore energy resources through the acquisition and processing of geophysical data.

There is a Need and Value of New Geophysical Data

- Geophysical surveys are key tools used in exploration of oil and natural gas and siting of renewable energy facilities.

- Geophysical data is critical to the successful discovery and efficient development and production of oil and natural gas. When applied early in the exploration process, geophysical data aides E&P companies in focusing their analysis and illuminates the most prospective areas for future oil and natural gas exploration *(allowing for the elimination of those areas that are unlikely to be prospective).*

- Geophysical data is critical for the development of renewable energy providing important key data required to site renewable energy facilities and design the foundation of structures that will be required for the development of renewable energy.

- Geophysical data is also very valuable to the federal government, and even to state governments. Geophysical data is critical in understanding the oil and natural gas resource base of the US OCS.

- Advancements over the last ten years in data acquisition and processing technology has resulted in fewer dry holes and a smaller exploration, development and production footprint.

Specific Comments Regarding the Draft PEIS

- Of the three alternatives listed, IAGC supports Alternative A – The Proposed Action, which allows the greatest coverage using deep penetration seismic and includes seasonal closure areas for the Right Whale.

Atlantic PEIS for G&G Activities
Public Meetings
IAGC / Geophysical Industry Public Comments
(Short Version)

- We do not support a 40 km separation distance between simultaneous seismic operations which is included in the mitigation measures proposed as part of Alternative B.
  - Notwithstanding that geological and geophysical permits recently approved in the GOM Western and Central Planning Areas include this mitigation measure as a condition of permit approval, it was not developed using any scientific or anecdotal evidence.

- We believe the PEIS should be expanded to include the North Atlantic Planning Area.
  - E&P companies need geophysical data that they can use to tie past and current production data from offshore Nova Scotia to the US Atlantic basins. Without this new data there will be a very significant gap in the regional work that E&P companies will want to perform.

  - The incremental cost and time to extend the PEIS to the North Atlantic Planning area would be minimal and would allow for geophysical data acquisition to occur for renewable energy siting requirements as well as when this area is finally considered for natural gas and oil exploration and production.

  - If the North Atlantic Planning Area is not included, we encourage BOEM to conduct individual, project-specific environmental assessments as needed that will allow geological and geophysical operations to take place.

- Lastly, each of the G&G permit applications currently on file with BOEM are for the purpose of acquiring non-exclusive seismic data which would be licensed to E&P companies as they develop a better understanding of the hydrocarbon resource potential in preparation of pending lease sales.
  - Although the Atlantic PEIS will pave the way for future seismic activity in an area of great interest with the Exploration companies, without any planned leasing in the next 5 years the likelihood of seismic contractors investing in non-exclusive seismic data acquisition is very uncertain.

Our sector of the Energy Industry that is Geophysical Operators Meet the Environmental Challenges

- Our industry conducts operations globally in a variety of environments. In particular, the geophysical industry has 50 years of experience in the US GOM OCS and 40 years of experience in the US Arctic OCS. During that time, there has been no scientifically-supported evidence that routine seismic surveys result in population-level impacts for any marine mammal species.

- Our industry routinely employs operational practices which protect whales, dolphins and other marine life. With these appropriate, risk-based mitigation measures, **we feel that seismic surveys have, and will continue to be undertaken with little or no biologically significant impact to marine mammal populations and to marine life in general.** In addition, it is important to remember that seismic surveys are temporary and transitory and use a low-frequency, short duration source signal.

- **The IAGC values the stakeholder process and are committed to participating in a dialogue with all stakeholders to explain what we do, why we do it and the measures that we take to protect the environment.**

- I have with me today several educational items that explain modern marine geophysical data acquisition, underwater sound, and the measures the geophysical industry implements to ensure minimal impacts of our operations on the environment. This information is available for BOEM and those in attendance in the back of the room.

Conclusion

- IAGC wishes to again express our appreciation for this opportunity to voice our support and commitment to work with BOEM and all stakeholders in the development of the Atlantic PEIS.

API

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Michael D. Ward
Executive Director

Virginia Petroleum Council
701 East Franklin Street, Suite 1112
Richmond, Virginia 23219
Ph: 804-225-8248 Fax: 804-225-7104
Email: wardm@api.org

April 24, 2012

PUBLIC STATEMENT
Draft Programmatic Environmental Impact Statement (PEIS) for Geological and Geophysical (Seismic) studies in the Mid-and South Atlantic OCS areas

Good afternoon. My name is Michael Ward, Executive Director of the Virginia Petroleum Council. Thank you for the opportunity to speak today about this PEIS, which will support the issuance of permits to conduct geological and geophysical study activities on the Atlantic Outer Continental Shelf (OCS).

The oil and natural gas industry has a long history of working with the Department of the Interior to develop this country's natural resources to the benefit of the U.S. economy and all Americans. Our industry stands ready to invest in exploration off the Atlantic OCS, and this PEIS is a needed first step to begin the process of generating the data that will allow for more robust estimates of the potential for oil and natural gas development in this area. Generating new data is very important for the Atlantic OCS, given that current estimates are based on decades-old data and have not benefited from the technological advances in seismic surveying and computer modeling in use by the industry today.

Although it is difficult to accurately estimate the amount of resources without the benefit of drilling, current estimates are likely to be conservative, given that history has shown that active exploration and development often leads to increased resource estimates.

However, the belief that moving forward with this decision can quickly lead to filling the information gaps on potential oil and gas resources is misguided. This gesture falls short in initiating forward-thinking, comprehensive energy policy. In fact, the data-collection

activities envisioned by the administration will not likely happen unless companies are convinced the prospects for leasing in the Atlantic OCS in the near future are real. As we all know, current OCS policy does not allow for a lease sale for Virginia or the Atlantic until 2017 at the earliest.

It is important to remember that the government does not generate this data; seismic companies do. And they generally do this on a speculative basis, hoping to sell the data to operators who are looking to purchase leases in an area. With no lease sale scheduled in the Atlantic, and thus no potential customers, seismic companies have little incentive to gather new data.

Not including the North Atlantic Planning Area in this PEIS is yet another short-sighted policy decision. Wherever seismic work will occur, marine exploration is carefully regulated by the federal government and managed by the operator to avoid impacting marine mammals. Current regulations require that trained marine mammal observers are onboard to watch for mammals. When starting a seismic survey, operators use a ramp-up procedure to gradually increase the sound level being produced, which allows animals to leave the area if the sound is uncomfortable. Also, operations stop if a marine mammal enters an "exclusion zone" around the operation and are not restarted until the zone is all-clear for at least 30 minutes.

Considering economic benefits, we can create more jobs and generate more revenue if allowed to responsibly develop and produce – here in the United States – more of the oil and natural gas we need. But more development – especially on public lands and federally controlled waters – requires that industry and government share a vision of the potential benefits and act as partners to fully realize them.

While Atlantic OCS leasing and development would help the nation and its economy, it would also have a significant positive effect on Virginia's economy. It would bring much needed jobs in a variety of industries. According to a recent Wood Mackenzie study, opening up Atlantic offshore areas that are currently unavailable could bring over 13,000 jobs to Virginia.

These are not limited to jobs directly associated with oil and natural gas development, but jobs created indirectly by those companies that supply equipment and other support services – both offshore and onshore – as well as construct the infrastructure required to drill offshore.

In addition, offshore development can generate much-needed revenue to fund critical services, including roads, environmental conservation and education. According to a Wood Mackenzie study, $1.9 billion dollars in revenue could be generated for the Commonwealth of Virginia from 2012 to 2030 if offshore development were allowed to take place in areas that are currently off-limits from development.

We appreciate the opportunity to comment on this PEIS for geological and geophysical studies in the Atlantic OCS. The oil and natural gas industry stands ready to invest in safe exploration and development of the OCS should administration policies change to take full advantage of the opportunities that are present.

SOUTH CAROLINA CHAMBER Of COMMERCE

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

Dear Mr. Goeke:

The South Carolina Chamber of Commerce, the state's unified voice of business, supports the Bureau of Ocean Energy Management's permitting of geological and geophysical activities for oil and gas exploration and development in the Mid and South Atlantic Planning Areas. This process is a vital first step in ensuring a lower cost, domestic energy supply for American businesses.

Obtaining updated seismic information is the foundation for the Bureau to begin the leasing and drilling processes for offshore oil and gas resources in the Atlantic. The current Administration's delay of lease sales by at least seven years has been detrimental to the process of opening this area to offshore drilling and has hurt the American economy. However, the Administration's recent announcement to begin the process of obtaining updated seismic data begins the process of reversing the detrimental effects of the delay of lease sales to businesses and consumers in this country.

A domestic energy supply will strengthen U.S. energy security, which will help reduce energy risks to America's businesses. With gas prices close to $4.00 a gallon, businesses are suffering, and the U.S. government should assess every opportunity to safely produce domestic energy. Increasing costs of doing business is affecting the country's economic growth, but offshore drilling will help keep ever-increasing gas prices under control.

Opening the Atlantic Outer Continental Shelf (OCS) to offshore drilling could provide hundreds of thousands of new jobs and generate significant revenue for both state and federal governments.

The South Carolina Chamber of Commerce supports the efforts by the Bureau of Ocean Management in beginning the process of opening the Atlantic OCS to drilling for oil and gas resources, increasing America's energy security and reducing the price of oil and gas for America's businesses. Thank you for consideration of our comments on this important issue for a robust American economy.

Sincerely,

Otis Rawl
President and CEO

1301 Gervais Street
Suite 1100
Columbia, SC 29201

(803) 799-4601

Fax
(803) 779-6043

www.scchamber.net

Environmental Stewardship Concepts, LLC
1006 Pump Rd. Henrico, VA 23238
Phone-804-741-2922
Fax- 804-741-2922
pdefur@estewards.com

June 28, 2012

Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (GM 623E)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Dear Mr. Goeke,

My name is Dr. Peter deFur, and I am owner and president of the consulting firm Environmental Stewardship Concepts, LLC and a member of the Mid Atlantic Fishery Management Council. I have 40 years of experience in the environmental field and worked on the OTA analysis of oil and gas development off the Mid Atlantic coast in the 1970s.

I have reviewed the Programmatic Environmental Impact Statement for the Mid- and South Atlantic planning areas. It is my strong belief that the most favorable option is C, with strict conditions and controls for the few cases in which oil and gas exploration permits are granted. This recommendation is based on the evidence of impacts on the coastal resources and the substantial efforts by many organizations to maintain sustainable resources and protect others.

These conditions and controls are what will make option C viable. First, there should be no exploration during whale migration season, or during turtle spawning and egg-laying times. Any activity on an Essential Fish Habitat (EFH) must bring an observer to document the exploratory activities and their interactions with fisheries. Any ship strikes of protected species must result in immediate return to port, with no questions asked, and an immediate report to NMFS and USFWS.

Scallop and surf clam grounds are two of the most important fishery resources; as such, no exploration work should be conducted on such sites, and the oil and gas industry must fund research on the impact of any and all exploration activities prior to the initiation of any exploration work. If any work is carried out near trawling areas, a vessel or commercial expert fisherman must be hired to guide them clear of schools of fish that must be avoided with a wide area of clearance.

The scientific literature provides evidence that air guns and other loud acoustic disturbances have adverse impacts on various living coastal resources, including, but not limited to squid, mammals, bivalves and shrimp. Little research has been published on the two commercial bivalves, scallop and surf calms, that are among the most valuable fisheries, measured by the value of landings.

A study done by J.L. Fewtrell and R.D. McCauley found a consistent response of alarm from various species of captive marine fish and one species of squid, when exposed to the noise of an airgun exceeding 147–151 dB re 1 μPa SEL. The louder the noise became, the more significantly the alarm response was observable, causing increased energy expenditure and behavioral alteration, whose effects could long ranging with over-time exposure to the noise (Fewtrell and McCauley 2012).

Another study done on sperm whales in the Gulf of Mexico yielded similarly alarming results, showing behavioral changes in the feeding processes of these whales. In addition, the whales did not attempt to avoid the “ramp-up” noise of warning produced by the air gun, calling into question the, “efficacy of ramp-up as a mitigation protocol” (Miller, Johnson, Madsen, Biassoni, Quero, and Tyack 2009). In short, there has simply not been enough study done to examine the long-term effects of the noise produced by air guns on the animals found in the Mid- and South Atlantic region, but the results we do have are distressing.

I hope that you will consider this matter carefully before deciding on a course of action. Our actions today dictate the effects that our wildlife will face tomorrow. We must consider migratory mammals, finfish, turtles, squid, bluefin tuna, and a whole host of other animals that will feel the effects of whatever course is taken. I encourage you to consider Option C as the most viable option available.

Sincerely,

Peter L. deFur, Ph.D
Environmental Stewardship Concepts, LLC

References

Fewtrell, J. L., and R. D. McCauley. "Impact of Air Gun Noise on the Behaviour of Marine Fish and Squid." *Marine Pollution Bulletin* 64.5 (2012): 984-93. *SciVerse*. Elsevier BV, 3 Mar. 2012. Web. 28 June 2012.

Miller, P. J.O., M. P. Johnson, P. T. Madsen, N. Biassoni, M. Quero, and P. L. Tyack. "Using At-Sea Experiments to Study the Effects of Airguns on the Foraging Behavior of Sperm Whales in the Gulf of Mexico." *Deep Sea Research Part I: Oceanographic Research Papers* 56.7 (2009): 1168-181. *SciVerse*. Elsevier BV, 17 Mar. 2009. Web. 28 June 2012.

energy API

Georgia
Petroleum Council
A Division of API

Richard B. Cobb
Executive Director

50 Hurt Plaza
Suite 720
Atlanta, Georgia 30303
Telephone 404-522-2574
Fax 404-577-1375
Email cobbr@api.org
www.api.org

April 18, 2012

PUBLIC STATEMENT

Draft Programmatic Environmental Impact Statement (PEIS) for Geological and Geophysical (Seismic) studies in the Mid- and South Atlantic OCS areas

Good afternoon. My name is Richard Cobb and I'm the Executive Director of the Georgia Petroleum Council which is a Division of the American Petroleum Institute. Thank you for the opportunity to speak today about this PEIS, which will support the issuance of permits to conduct geological and geophysical study activities on the Atlantic Outer Continental Shelf (OCS).

The oil and natural gas industry has a long history of working with the Department of the Interior to develop this country's natural resources to the benefit of the U.S. economy and all Americans. Our industry stands ready to invest in exploration off the Atlantic OCS, and this PEIS is a needed first step to begin the process of generating the data that will allow for more accurate estimates of the potential for oil and natural gas development in this area. Generating new data is very important for the Atlantic OCS, given that current estimates are based on decades-old data and have not benefited from the technological advances in seismic surveying and computer modeling in use by the industry today. Although it is difficult to accurately estimate the amount of resources without the benefit of drilling; our past experience has shown that active exploration and development often leads to increased resource estimates.

However, the belief that moving forward with this decision can quickly lead to filling the information gaps on potential Atlantic OCS oil and gas resources is misguided. This effort falls short in initiating forward-thinking, comprehensive energy policy. In fact, the data-collection activities envisioned by the administration will not likely happen unless companies are convinced the prospects for leasing in the Atlantic OCS in the near future are real. As we all know, current OCS policy does not allow for a lease sale in the Atlantic until 2017 at the earliest.

It is important to remember that the government does not generate this data; seismic companies do. And they generally do this on a speculative basis, hoping to sell the data to operators who are looking to purchase leases in an area. With no lease sale scheduled in the Atlantic, and thus no potential customers, seismic companies have little incentive to gather new data.

Excluding the North Atlantic Planning Area in this PEIS is yet another short-sighted policy decision. There is a great deal of interest in surveying and eventually developing this area. Oil and natural gas companies need geological and geophysical data that they can use to compare with geologic features in other offshore areas where there is current oil and natural gas production. Without this new data, a significant data gap will remain.

We can create more jobs and generate more revenue if allowed to responsibly develop and produce – here in the United States – more of the oil and natural gas we need. But more development – especially on public lands and federally controlled waters – requires that industry and government share a vision of the potential benefits and act as partners to fully realize them. The oil and natural gas industry already supports 9.2 million U.S. jobs and 7.7 percent of the U.S. economy, delivers more than $86 million a day in revenue to our government, and, since 2000, has invested more than $2 trillion in U.S. capital projects to advance all forms of energy, including alternatives.

A Wood Mackenzie study shows that developing the offshore areas that had been subject to congressional moratoria until recently, as well as, the resources in Alaska's Arctic National Wildlife Refuge and a small portion of currently unavailable federal lands in the Rockies, would:

- Lift U.S. crude oil production by as much as 2.8 million barrels per day in 2025, equivalent to 30 percent of the nation's current imports;
- Increase natural gas production by 6.5 billion cubic feet per day in 2025;
- Create 530,000 new jobs; and
- Add $206 billion in cumulative government revenue by 2025. $196 billion from the OCS alone.

While Atlantic OCS leasing and development would help the nation and its economy, it would also have a significant positive effect on Georgia's economy. It would bring much needed jobs in a variety of industries. According to the recent Wood Mackenzie study, opening up Atlantic offshore areas that are currently unavailable could bring 2600 jobs to Georgia.

These are not limited to jobs directly associated with oil and natural gas development, but jobs created indirectly by those companies that supply equipment and other support services – both offshore and onshore – as well as construct the infrastructure required to drill offshore.

In addition, offshore development can generate much-needed revenue to fund critical services, including roads, environmental conservation and education. According to a Wood Mackenzie study, $285 million dollars in revenue could be generated for the State of Georgia from 2012 to 2030 if offshore development were allowed to take place in areas that are currently off-limits from development.

We appreciate the opportunity to comment on this PEIS for geological and geophysical studies in the Atlantic OCS and the oil and natural gas industry stands ready to invest in safe exploration and development of the OCS should administration policies change to take full advantage of the opportunities that are present.

FACT SHEET

Oil & Natural Gas Exploration and Geological and Geophysical (Seismic) Surveys

NEW SEISMIC DATA – IMPROVED RESOURCE ESTIMATES

Resource estimates of the Atlantic OCS are hindered by a lack of data, especially the newer seismic exploration technologies that industry has developed. Current undiscovered, technically recoverable resources estimate for Atlantic OCS:

- 3.3 billion barrels of oil
- 31.3 trillion cubic feet of natural gas

Estimates may be conservative as they have not benefited from the use of new seismic and computer modeling technology and some areas remain largely unexplored.

- Today, seismic surveys using modern technology produce sub-surface images which are much clearer than those from 25 years ago.
- Further exploration generally leads to increased resource estimates. For example, between 1995 and 2003, estimates of oil resources in the Central and Western Gulf of Mexico increased by over 400% while natural gas resource estimates in the area more than doubled.
- In another example, the 1970s resource estimates for Prudhoe Bay, Alaska were that it held 9 billion barrels in oil reserves. With the discovery of additional fields on the Alaska North Slope the industry has since produced nearly 16 billion barrels from the region.
- Estimates change because of technology changes that allow development of resources that were previously thought unrecoverable or because new geologic theories about where oil and natural gas might be located.

SEISMIC SURVEY OPERATIONS – REGULATED AND SAFE

Modern offshore oil and natural gas exploration requires the use of seismic surveys, which use compressed air to create sound waves that when reflected back to the surface can be analyzed by computers and used to assist in defining geologic structures beneath the ocean floor.

- The seismic sources create impulsive sounds of ultra-short duration and very low frequency, using compressed air released into the water at very high pressure.
- Seismic information is used by geologists and geophysicists to assess the location and size of potential oil and natural gas deposits, which often lay several miles beneath the ocean floor.

Marine seismic exploration is carefully regulated by the federal government and managed by the operator to avoid impacting marine mammals. Current regulations require that:

- Trained marine mammal observers are onboard to watch for mammals.
- When starting a seismic survey, operators use a ramp-up procedure to gradually increase the sound level being produced, which allows animals to leave the area if the sound is uncomfortable.
- Operations stop if a marine mammal enters an "exclusion zone" around the operation and are not restarted until the zone is all-clear for at least 30 minutes.

ConocoPhillips

ConocoPhillips Company
P. O. Box 2197
Houston, Texas 77252-2197

VIA E-MAIL: ***GGEIS@boem.gov***

July 2, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section,
Office of the Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Blvd.
New Orleans, Louisiana 70123-2394

Subject: Comments on the Draft PEIS for Atlantic G&G Activities

Dear Mr. Goeke:

ConocoPhillips Company (ConocoPhillips) is pleased to provide comments on the Draft Programmatic Environmental Impact Statement (EIS) for geological and geophysical (G&G) survey activities in the Federal waters of the Mid-Atlantic and South Atlantic Outer Continental Shelf (OCS) published March 2012 by the U.S. Department of Interior, Bureau of Ocean Energy Management, Gulf of Mexico OCS Region (BOEM).

ConocoPhillips is one of North America's leading energy producers, and one of our primary strategic objectives is to produce more oil and natural gas in the United States. We are a leading producer of natural gas in the United States, the largest producer of oil in Alaska, and among Canada's largest producers of natural gas (much of which flows to the U.S.). We have major positions in most of the nation's leading producing basins with active exploration and development drilling programs. ConocoPhillips is known worldwide for its technological expertise in deepwater exploration and production, reservoir management and exploitation and 3-D seismic technology. Since the Moratorium was lifted, ConocoPhillips has participated and plans to participate in multiple wells in the deepwater Gulf of Mexico. In addition, ConocoPhillips has bid over $215 Million on 124 blocks at the OCS Western Planning Area Lease Sale 218 held on December 14, 2011 and the OCS Central Planning Area Lease Sale 216/222 held on June 20, 2012. These and other OCS activities by ConocoPhillips reflect ConocoPhillips' commitment and interest in the BOEM's offshore program.

Of the alternatives presented, ConocoPhillips supports Alternative A; however, ConocoPhillips believes BOEM should expand the EIS to include the North Atlantic Planning Area, thus removing any potential delays in the potential future exploration of this area. ConocoPhillips does not support Alternatives B and C set forth in the EIS.

The need for the proposed action (Alternative A) is to further the orderly development of OCS resources. Oil serves as the feedstock for liquid hydrocarbon products; among them gasoline, aviation and diesel fuel, and various petrochemicals. To exclude deepwater areas in the OCS from potential oil and gas exploration and development would not achieve the desired goal of reducing risk in the search for offshore oil and gas resources. The purpose and need for the oil and gas leasing program is to help meet the Nation's energy needs.

Clearly, the OCS contains potentially significant resources and conducting the proposed action set forth in the EIS is vitally important to America's energy security. In addition, these potentially significant, untapped resources of oil and natural gas are critically important to sustaining our national economic growth and maintaining much-needed jobs in virtually every sector of the economy. ConocoPhillips' continued commitment to the OCS will largely depend on the extent to which the BOEM continues to makes high potential areas available for leasing.

ConocoPhillips supports Alternative A set forth in the EIS; however, ConocoPhillips believes the EIS should be expanded as stated above. In addition, ConocoPhillips has provided input and supports the comments set forth in the EIS comment letter sent by the American Petroleum Institute and the International Association of Geophysical Contractors. ConocoPhillips appreciates the opportunity to comment on the EIS. Should you have any questions, please contact me at (281) 293-3139.

Sincerely,

Richard Lunam
Vice President, North America Exploration

DIRECTED SUSTAINABLE FISHERIES, INC.

A CONSULTING COMPANY

Mr. Gary D. Goeke, Chief, Regional Assessment Section   ggeis@boem.gov
Office of Environment (MS5410)
Bureau of Ocean Energy Management (BOEM)
Gulf of Mexico OCR Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Monday July 2, 2012

Re: Comment on the Draft PEIS for Atlantic G&G Activities

To: Mr. Gary D. Goeke,

Thank you for this opportunity to allow Directed Sustainable Fisheries, Inc. (DSF) to comment to you on behalf of many of our fishing industry clients about the BOEM considerations for using seismic testing to locate renewable energy sources beneath the ocean sea floor along the Mid-Atlantic Fishery Management Council (MAFMC) and South Atlantic Fishery Management Council (SAFMC) regions of the United States (US) Exclusive Economic Zone (EEZ). On May 25, 2012 the DSF sent a comment about seismic testing to Michelle Morin at BOEM. Please review that DSF comment again in addition to this newest DSF comment.

After considerable thought and review of various written material, some dating back over a decade or more, it is the opinion of the DSF that seismic testing in the MAFMC and SAFMC EEZ should not be conducted ever again. The cost to the marine environment's living resources is unacceptable due to death and injury to endangered and threatened stocks, as well as rebuilding and healthy stocks of various marine life.

Captain James Lovgren from the MAFMC region has submitted significant comments to BOEM and the public that demonstrates the harm that will come from such activities. A post on www.SavingSeafood.org speaks volumes about the marine destruction caused by seismic testing. The URL is located at http://www.savingseafood.org/opinion/james-lovgren-two-weeks-left-for-fishing-industry-to-submit-comments-on-seismic-te-2.html and BOEM should address those concerns before going forward with these terrible ideas.

From written research it seems not only marine mammals will be harmed, but many healthy stocks of saltwater fish in the broad vicinity of these air gun blasts may be destroyed at various life stages. Use of seismic testing around marine protected areas (MPAs), coral habitat areas of concern (CHAPC) and around any known fishing reef areas should never be conducted. Evidence seems to indicate that a loss of catch per unit of effort (CPUE) upwards of 70% may be normal and damage could take months if not years to decades for the marine environment to repair itself.

I will end this comment here and hope that the US government and BOEM chooses to stand down from seismic testing in the MAFMC and SAFMC EEZ, as well as state waters and not sacrifice the ocean's marine bounty to energy corporations that seek profit from destruction.

Rusty Hudson

PO BOX 9351
DAYTONA BEACH, FLORIDA 32120-9351
386-239-0948 TELEPHONE
386-253-2843 FAX
DSF2009@AOL.COM

Russell Howard Hudson, President
Directed Sustainable Fisheries, Inc. (DSF, Inc.)
PO Box 9351
Daytona Beach, Florida 32120-9351

(386) 239-0948 Telephone
(386) 253-2843 Facsimile

DSF2009@aol.com

Saltwater Fisheries Consultant
Shark Specialist
Deep-Sea Fisherman and Shrimp Boat Captain
Recreational, For-Hire & Commercial Fishing Life Experience, 1959-2012
Retired 100-ton United States Coast Guard (USCG) Licensed Sea Captain
Seafood Coalition (SFC) member
National Marine Fisheries Service (NMFS) Highly Migratory Species (HMS) Advisory Panel (AP) commercial member
Atlantic States Marine Fisheries Commission (ASMFC) Coastal Shark (CS) AP Florida (FL) commercial & for-hire recreational member
Former South Atlantic Fishery Management Council (SAFMC) Marine Protected Area (MPA) AP FL commercial member
Former NMFS Atlantic Large Whale Take Reduction Team FL member (ALWTRT)
Former NMFS Bottlenose Dolphin Take Reduction Team FL member (BDTRT)
Current American Elasmobranch Society (AES) member
Participant, observer and/or contributor to US coastal shark stock assessments during 1992, 1996, 1998, 2001, 2002, 2005, 2006, 2007, 2011 and 2012
Participant, observer and/or contributor SouthEast Data, Assessment and Review (SEDAR) 11 (Large Coastal Sharks), 13 (Small Coastal Sharks), 16 (King Mackerel), 19 (Red Grouper/Black Grouper), 21 (Large Coastal Sharks/Small Coastal Shark), 24 (Red Snapper), 25 (Black Sea Bass/Golden Tilefish), SEDAR 28 (Spanish Mackerel/Cobia) and SEDAR 29 (Gulf Blacktip Shark)

Mr. Gary D. Goeke, Chief,
Regional Assessment Section, Office of Environment (MS 5410)
Bureau of Ocean Energy Management, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, New Orleans, Louisiana 70123-2394
Re: Comments on Mid Atlantic G&G Draft EA

June 30th, 2012

To Whom it may Concern:
Thank you for the opportunity to comment on the Draft Mid-Atlantic G&G EA. I will restrict my comments to marine mammals. A tremendous amount of work has gone into estimating the potential effects of oil and gas exploration activities on the marine mammal fauna in the mid-Atlantic. I appreciate the efforts of all involved. There are however, four areas where there are serious scientific shortfalls: 1) animal density and estimation; 2) right whales; and 3) estimate of acoustic disturbance, and 4) cumulative impacts.

Marine Mammal Density and Estimation Methods
The entire draft EA and estimation analyses are dependent upon an extremely sparse dataset. By restricting the marine mammal assessments to the Navy's Nodes database, which is based on data from a very limited number of NMFS shipboard surveys in the area (which are mostly limited to the summer months), there arise several problems.

First, there is no scientific basis for extrapolating the modeled marine mammal densities to areas where there are no surveys. The notion that marine mammals can be categorized by habitat preference and oceanographic characteristics is attractive, but multiple efforts have failed to make definitive links except in a few isolated circumstances (e.g. breeding lagoons for grey whales). Extrapolating pelagic distributions of "pelagic" animals to unsurveyed areas, for example, is unsupported by existing data. The notion that these efforts are using "best available data" is not an excuse for making stuff up. In our analyses of critical features associated with whale distribution, the strongest explanatory variable (among things like temperature, depth, rugosity, chlorophyl) is latitude and longitude, by an overwhelming amount. As an explanatory variable, location is strongly influenced by effort, and survey effort in the mid Atlantic is lacking (see Appendix 1, effort maps by month for the mid and south Atlantic areas, using all sources)

Second, the use of the AIM model to extrapolate animal movements within the mid-Atlantic region is inappropriate. For example, right whale animats are parameterized with data from a feeding ground in the Bay of Fundy (a seasonal feeding aggregation area), whereas the mid Atlantic area is clearly and definitively a migratory corridor. Many of the other species are parameterized with either outdated literature, or information from a completely different ocean basin. Further, many of the animals have not been studied in the mid-Atlantic, so parameters used in this model are guesses from other areas, and may or may not apply. If the AIM model were to be used for this, it needs substantial updating, and it needs to identify the uncertainty associated with its model runs. When there are less data, there is more uncertainty. And in the mid-Atlantic, data on marine mammal behavior and habitat preferences are extremely sparse in the offshore environment, leading to high levels of uncertainty.

Third, the extrapolation of primarily warm weather surveys to the winter months is inappropriate. Most marine mammals engage in some sort of seasonal movements – either inshore-offshore, north-south, or a combination of these. But lack of data in this area prevents anyone from knowing which species do what. Even in the Gulf of Maine, where the marine mammal guild is arguably the most studied in the North Atlantic, the apparent right whale (*Eubalaena glacialis*) breeding ground was just discovered over the last few years (Cole et al, in review). Stranding data from the mid Atlantic suggests that the region is an important wintering ground for harbor porpoise (*Phocoena phocoena*) and finback whales (*Balaenoptera physalus*), but the survey data from offshore is so limited that in the winter months that no information is available. Before any estimates of winter marine mammal distribution and abundance can be made in the mid-Atlantic, systematic surveys are needed.

Fourth, the selection of the data for the density model runs eliminates a large collection of datasets for many areas within the mid-Atlantic area. The statement that this represents the "best available" data is wrong. Using the limited NMFS survey data alone eliminates huge aerial survey efforts in the Georgia Bight, recent aerial survey efforts off the Carolinas and Cape Hatteras, and offshore surveys for the proposed Navy Ops Area off of Jacksonville. (These data are readily available by request to the North Atlantic Right Whale Consortium: www.narwc.org). The modeled densities shown reflect a tiny subset of the available data, and in addition, fail to take advantage of newer GIS techniques for modeling densities from a variety of sources, including strip transect, line transect, satellite tags, and opportunistic data.

The following maxim holds true here – all models are wrong, but some are useful. In this case, the sparse data (especially outside of the summer months) combined with the liberties taken in extrapolating the data to non-surveyed areas and seasons, makes none of the take estimates believable, and the results of these models are more wrong than useful. It is possible that this activity will have 35,000 Level A takes of marine mammals, but it could be only 3500, or just as likely, it could be 350,000 or more. These models need to be updated with the best available data and there is a lot missing. There should be some more advanced thinking and analysis devoted to integrating the multiple datasets available. Also, model results should be presented with confidence intervals around the final numbers. Knowing what we know about marine mammal survey limitations and the density estimates, the take estimates presented in the DEIS should probably have 95% confidence intervals somewhere between twice and ten times the size of the estimates, but they could be much larger.

The take-home message from this review of the models and the data is that the approach needs considerable refinement, but mostly it needs some data. BOEM should support the NMFS proposed AMAPPS program to the fullest extent originally proposed, which includes surveys over the entire area in all four seasons. Those surveys are the only way to overcome the limitations of these models, and to obtain reliable density estimates, and subsequently reliable estimates of takes from oil and gas seismic exploration. In addition, because of the broadscale nature of AMAPPS, there should be supplementary surveys of areas shown to be biological hotspots to provide detailed information on a finer scale. The AIM model is an interesting approach, but it needs to be parameterized with data from the appropriate ocean basin and time of year. Survey data may provide some of this, but first a careful review of the Atlantic literature on the relevant species (including NMFS tech reports) is needed. At the end of an appropriate series of surveys, data analyses, and modeling exercises, there are likely to be areas where marine mammals occur year-round in high abundances. BOEM should consider placing these biologically important areas off-limits for G & G exploration, since the EIS makes clear that no other mitigating strategies are mature enough to minimize harm.

Right Whale Mitigation

All of the proposed G&G activity in the mid-Atlantic has the potential to alter the path of right whales migrating southward to the calving grounds (while pregnant), and returning northward in the late winter with their newborn calves. Although the exact path of migration is not known, the limited tagging and sightings data places most right whale records between 5 and 30 miles offshore along the entire mid-Atlantic. The other balaenid that has been studied (the bowhead whale, *Balaena mysticetus*) showed displacement in the vicinity of seismic surveys on a feeding ground (Richardson et al., 1999). If right whales behave as their arctic cousins, they are likely to avoid airgun sounds. If this avoidance behavior is the response of right whales to activity taking place during the migratory periods, there is the possibility that such activity will create an acoustic barrier to migration of either pregnant females or mothers with newborn calves, both of which could have significant population effects for this highly endangered species. In a migratory corridor the consequences of displacement are unknown, but could force mothers with newborn calves offshore into rougher and more predator occupied waters, potentially reducing calf survival. Therefore, the expanded time-area closure described in the EA's alternative B is the only reasonable alternative to provide some protection for the most vulnerable component of this population, pregnant females, and mothers with newborn calves (see also Firestone et al, 2008).

Our analyses of the right whale migratory path indicate the mean distance from shore in the mid-Atlantic during the winter is about 20 km, and slightly more in the spring. Because the mean is heavily influenced by the few animals that occur far offshore, the median is likely to be a better measure of the average distance of migrating animals from shore, and generally we would concur with the 20km coastal buffer (Table 1). However, the data underlying these analyses are extremely sparse, are not supported by systematic survey data, and may be heavily biased by the lack of offshore effort.

Table 1. Analysis of the distance to shore for all right whales sightings in the mid and south-Atlantic OCS G&G Area of Interest. (Includes all data from the North Atlantic Right Whale Consortium database)

Distance from shore	Mean	Median	Standard Deviation
Winter (Nov/Dec/Jan)	20,157.11	5,650.5	39,489.71
Spring (Feb/Mar/Apr)	22,849.23	11,765.41	30,631.69
Combined (Nov-Apr)	22,150.93	9,597.59	33,178.41

Acoustic Disturbance

The EIS estimates the acoustic level B disturbance levels of boomers, placing the R_{max} at slightly over 15km. Recent analyses of pile driving for wind farm construction off the Scottish coast showed that potential for sound levels high enough to cause behavioral disturbance extended up to 50 km from the construction site (Bailey et al. 2010). Humpback whales song recorded on the Stellwagen Bank National Marine Sanctuary were significantly reduced when animals were exposed to the transmissions of an Ocean Acoustic Waveguide Experiment (peak @400Hz at ~225dB source level) about 200 km away from the animals (Risch et al., 2012). Both finback whales (*Balaenoptera physalus*) and blue whales (*Balaenoptera musculus*) have respectively been shown to have both behavioral and acoustic changes in response to low frequency sonar (Croll et al., 2001) and seismic surveys (Di Iorio and Clark, 2010). Castellote et al (2012) showed both displacement and acoustic behavioral changes by finback whales in response to seismic noise levels, and suggested that these behavioral changes could adversely affect reproduction and survival. Thus the EIS appears to widely underestimate the long distance capability of G & G seismic work to alter the behavior of large whales.

In addition, there is limited reference to the responses of right whales to low frequency noise (Parks et al. 2007, 2008) and novel sounds (Nowacek, et al. 2004), as well as the potential large scale impacts on right and other whales from increased industrial noise in the oceans (Clark et al.2007; Tyack, 2008, Nowacek, et al., 2007, and Rolland et al., 2012). These omissions mean that the EIS does not consider the emerging body of literature that suggests significant impacts from anthropogenic noise on marine mammals, and in particular, the effects of louder low frequency noises from seismic exploration on large whales.

Cumulative impact
The EIS is silent on the cumulative impacts of this and two other major activity expansions in the Atlantic OCS areas. These three activities include 1) alternative energy leasing and construction, 2) Navy activities, including the proposed expansion of operations areas along the east coast of the U.S., and 3) the G & G seismic assessments in the mid and south Atlantic areas. The EIS for each of these projects should include a cumulative (and additive) assessment of all of these activities combined, since it is clear that they will occur simultaneously. The National Environmental Policy Act requires exactly this kind of analysis.

In addition, the EIS indicates that several seismic surveys could be underway simultaneously in the region. If this were the case, the actual potential for displacement and disturbance of marine mammals may be much larger than the EIS suggests. The cumulative impact of multiple seismic surveys are likely to have significant effects on regional populations of marine mammals, and may have serious consequences for right whales (See Stone and Tasker, 2006; Clark et al, 2007;2009; Parks et al, 2007; 2008; Tyack, 2008).

Mitigation (Appendix C)
The EA's proposed mitigation plan does not begin to approach minimal standards for scientific observation data collection. Professional survey teams in both aerial and shipboard surveys are usually considered capable of covering approximately one square mile of ocean within a quadrant. For the G & G surveys, two observers on a vessel for mitigation observation is not adequate, since observation hours (especially during the summer months) may be 12 hours or more, and observers need a break at least every two hours. At a minimum, if seismic surveys are to be contingent upon the presence or absence of marine mammals, appropriate scientific survey and observation methods should be employed, calculating the area to be mitigated as a starting point, and then taking into account the sightability of different species, as well as sighting conditions such as height of eye, sea state, and visibility, as well as the limitations of observers. From such calculations, one can determine an appropriate observation strategy for the activity, and then determine the number of observers needed to adequately mitigate the acoustic disturbance. A revision of the mitigation strategy along these lines is critical for G&G surveys, permitting, construction planning, and BOEM's long term planning for offshore development.

Conclusions
This EA has used inadequate data to estimate the effects of oil and gas seismic operations off the mid-Atlantic on marine mammals. Consequently, it provides completely unreliable estimates of "takes" with no confidence intervals, and makes unwarranted assumptions about animal "takes" and responses to noise, and the consequences of displacement. These unknowns and assumptions could lead to serious problems for several endangered whale species, as well as delays in permitting and construction.

In conclusion, I recommend the following: 1) BOEM should support the NMFS AMAPPS and other surveys as needed across the entire oil and gas call region in all seasons, 2) use the newly acquired sightings data to support updated modeling efforts to bring the estimates of density and "takes" up to contemporary scientific standards, 3) conduct a review of the right whale migratory patterns, and consider additional distance restrictions on the use of seismic activities within 50km the coast during the migratory season, 4) conduct a true cumulative effects assessment, that includes oil and gas seismic operations, wind farm construction and operations, cable laying operations, and newly proposed navy operation areas, all of which will be occurring in the mid-Atlantic, and where the combined effects will be biologically cumulative and potentially damaging, 5) develop a scientifically based mitigation plan that has adequate observers, survey coverage, contingencies that account for species differences and sighting conditions, and 6) use updated data to identify biologically sensitive areas where no G & G activities should occur. Thank you again for the opportunity to comment on this EA.

Sincerely,

Scott D. Kraus, PhD
Vice President for Research
New England Aquarium
Central Wharf
Boston, MA 02110
617-973-5457

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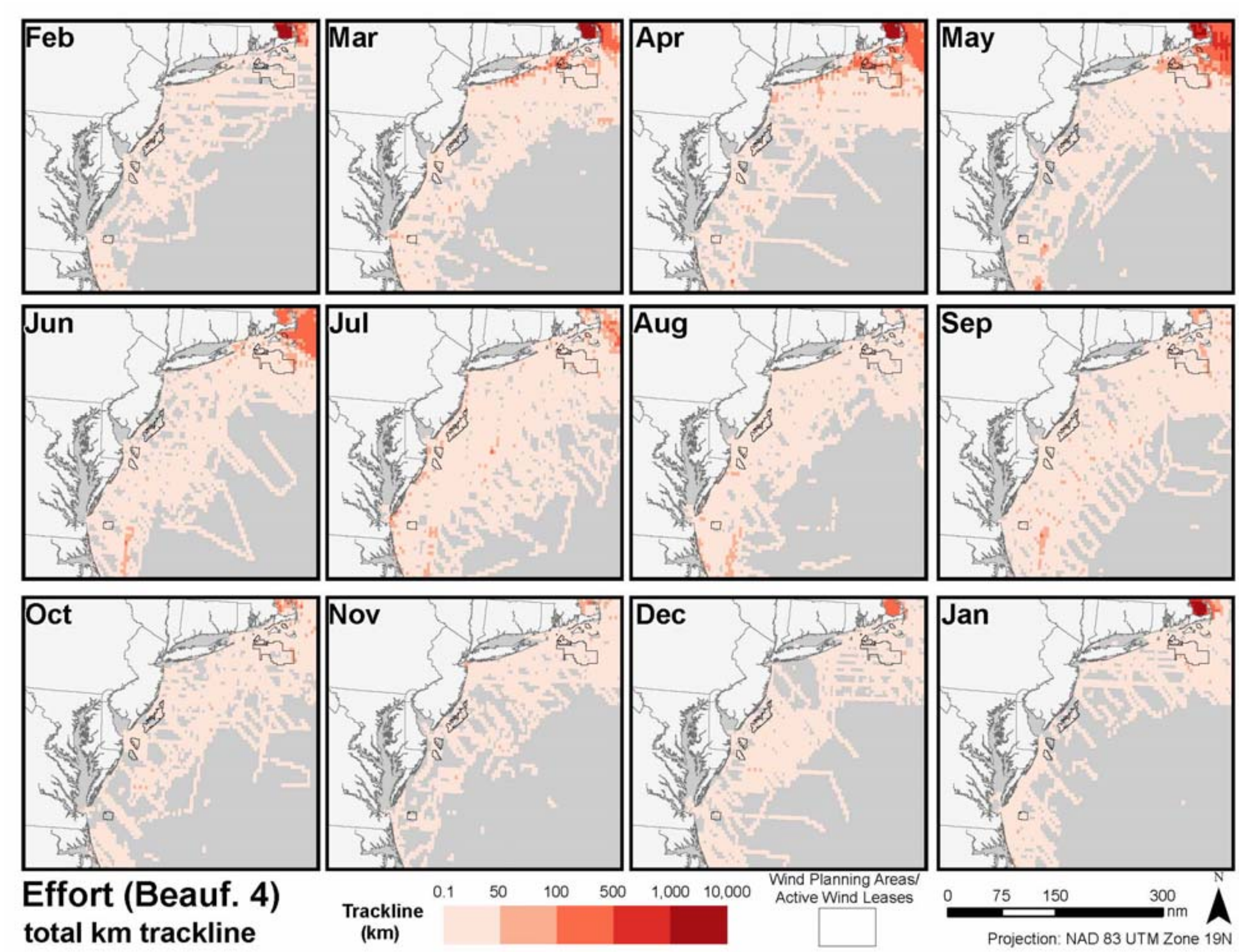
Appendix 1. Survey effort maps for the mid and south Atlantic OCS sites (all sources).



NEW JERSEY PETROLEUM COUNCIL
A DIVISION OF THE AMERICAN PETROLEUM INSTITUTE
150 WEST STATE STREET TRENTON, NEW JERSEY 08608
TELEPHONE (609) 392-0800 FAX (609) 392-0775

J.E. BENTON, Executive Director
S.J. ROSS, Associate Director

April 27, 2012

Mr. Gary D. Goeke, Chief
Regional Assessment Section, Office of Environment (MS 5410)
Bureau of Ocean Energy Management, Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123–2394.

PUBLIC STATEMENT

Draft Programmatic Environmental Impact Statement (PEIS) for Geological and Geophysical (Seismic) studies in the Mid- and South Atlantic OCS areas

Good afternoon. My name is Scott Ross and I'm the Associate Director of the New Jersey Petroleum Council. Thank you for the opportunity to speak today about this PEIS, which will support the issuance of permits to conduct geological and geophysical study activities on the Atlantic Outer Continental Shelf (OCS).

The oil and natural gas industry has a long history of working with the Department of the Interior to develop this country's natural resources to the benefit of the U.S. economy and all Americans. Our industry stands ready to invest in exploration off the Atlantic OCS, and this PEIS is a needed first step to begin the process of generating the data that will allow for more robust estimates of the potential for oil and natural gas development in this area. Generating new data is very important for the Atlantic OCS, given that current estimates are based on decades-old data and have not benefited from the technological advances in seismic surveying and computer modeling in use by the industry today. Although it is difficult to accurately estimate the amount of resources without the benefit of drilling, current estimates are likely to be conservative, given that history has shown that active exploration and development often leads to increased resource estimates.

However, the belief that moving forward with this decision can quickly lead to filling the information gaps on potential Atlantic OCS oil and gas resources is misguided. This gesture falls short in initiating forward-thinking, comprehensive energy policy. In fact, the data-collection activities envisioned by the administration will not likely happen unless companies are convinced the prospects for leasing in the Atlantic OCS in the near future are real. As we all know, current OCS policy does not allow for a lease sale in the Atlantic until 2017 at the earliest.

It is important to remember that the government does not generate this data; seismic companies do. And they generally do this on a speculative basis, hoping to sell the data to operators who are looking to purchase leases in an area. With no lease sale scheduled in the Atlantic, and thus no potential customers, seismic companies have little incentive to gather new data.

Not including the North Atlantic Planning Area in this PEIS is yet another short-sighted policy decision. There is a great deal of interest in surveying and eventually developing this area. Oil and natural gas companies need geological and geophysical data that they can use to compare with geologic features in other offshore areas where there is current oil and natural gas production. Without this new data, a significant data gap will remain.

We can create more jobs and generate more revenue if allowed to responsibly develop and produce – here in the United States – more of the oil and natural gas we need. But more development – especially on public lands and federally controlled waters – requires that industry and government share a vision of the potential benefits and act as partners to fully realize them. The oil and natural gas industry already supports 9.2 million U.S. jobs and 7.7 percent of the U.S. economy, delivers more than $86 million a day in revenue to our government, and, since 2000, has invested more than $2 trillion in U.S. capital projects to advance all forms of energy, including alternatives.

A Wood Mackenzie study shows that developing the offshore areas that had been subject to congressional moratoria until recently, as well as the resources in Alaska's Arctic National Wildlife Refuge and a small portion of currently unavailable federal lands in the Rockies, would:

- Lift U.S. crude oil production by as much as 2.8 million barrels per day in 2025, equivalent to 30 percent of the nation's current imports;
- Increase natural gas production by 6.5 billion cubic feet per day in 2025;
- Create 530,000 new jobs; and
- Add $206 billion in cumulative government revenue by 2025. $196 billion from the OCS alone.

These are not limited to jobs directly associated with oil and natural gas development, but jobs created indirectly by those companies that supply equipment and other support services – both offshore and onshore – as well as construct the infrastructure required to drill offshore.

In addition, offshore development can generate much-needed revenue to fund critical services, including roads, environmental conservation and education

We appreciate the opportunity to comment on this PEIS for geological and geophysical studies in the Atlantic OCS and the oil and natural gas industry stands ready to invest in safe exploration and development of the OCS should administration policies change to take full advantage of the opportunities that are present.

Atlantic PEIS for G&G Activities
Public Meetings
IAGC / Geophysical Industry Public Comments
(Short Version)

- Good Afternoon, my name is Tom Neugebauer and I am with TGS-NOPEC Geophysical Company and here today representing the International Association of Geophysical Contractors – the IAGC.

- IAGC is the international trade association representing the industry that provides geophysical services to the energy industry, including both the conventional and renewable energy sectors.

- IAGC member companies play an integral role in the successful exploration and development of offshore energy resources through the acquisition and processing of geophysical data.

- IAGC members have expressed interest in conducting geophysical activities on the Atlantic OCS.

Why the Need and what is the Value of New Geophysical Data

- Geophysical surveys are key tools used in oil and natural gas exploration and with siting of renewable energy facilities.

- Geophysical data is critical to the successful discovery and efficient development and production of oil and natural gas. When applied early in the exploration process, geophysical data aides Exploration and Production companies in focusing their analysis and illuminates the most prospective areas for future oil and natural gas exploration *(allowing for the elimination of those areas that are unlikely to be prospective).*

- Geophysical data is critical for the development of renewable energy providing important key data required to site renewable energy facilities and design the foundation of structures that will be required for the development of renewable energy.

- Geophysical data is also very valuable to the federal government, and even to state governments. Geophysical data is critical in understanding the oil and natural gas resource base of the U.S. OCS.

- Advancements over the last ten years in data acquisition and processing technology have resulted in fewer dry holes and a smaller exploration, development and production footprint. I have with me today, seismic data examples that illustrate the advances in seismic acquisition since 2000. The majority of the Atlantic OCS seismic database was acquired during the mid sixties to late seventies.

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Atlantic PEIS for G&G Activities
Public Meetings
IAGC / Geophysical Industry Public Comments
(Short Version)

Regarding the position of IAGC and the Draft PEIS

- Of the three alternatives listed, IAGC supports Alternative A – The Proposed Action, which allows the greatest coverage using deep penetration seismic and includes seasonal closure areas for the Right Whale.

- We do not support a 40 km separation distance between simultaneous seismic operations which is included in the mitigation measures proposed as part of Alternative B.
    - Notwithstanding that geological and geophysical permits recently approved in the Western and Central Planning Areas of the Gulf of Mexico, include this mitigation measure as a condition of permit approval, it was not developed using any scientific or anecdotal evidence.

- We believe the PEIS should be expanded to include the North Atlantic Planning Area.
    - Exploration and Production companies need geophysical data that would be used to tie past and current production data from offshore Nova Scotia to the US Atlantic basins. Without this new data there will be a very significant gap in the regional work that Exploration and Production companies will want to perform.

    - The incremental cost and time to extend the PEIS to the North Atlantic Planning area would be minimal and would allow for geophysical data acquisition to occur for renewable energy siting requirements as well as when this area is finally considered for natural gas and oil exploration and production.

    - If the North Atlantic Planning Area is not included, we encourage BOEM to conduct individual, project-specific environmental assessments as needed that will allow geological and geophysical operations to take place.

- Lastly, each of the G&G permit applications currently on file with BOEM are for the purpose of acquiring non-exclusive seismic data which would be licensed to Exploration and Production companies as they develop a better understanding of the hydrocarbon resource potential in preparation of pending lease sales.
    - Although the Atlantic PEIS will pave the way for future seismic activity, in an area of great interest with the Exploration and Production companies, without any planned leasing in the next 5 years the likelihood of seismic contractors investing in non-exclusive seismic data acquisition is very uncertain.

Atlantic PEIS for G&G Activities
Public Meetings
IAGC / Geophysical Industry Public Comments
(Short Version)

In Meeting the Environmental Challenges

- Our industry conducts operations globally in a variety of environments. In particular, the geophysical industry has 50 years of experience in the U.S. Gulf of Mexico OCS and 40 years of experience in the U.S. Arctic OCS. During that time, there has been no scientifically-supported evidence that routine seismic surveys result in population-level impacts for any marine mammal species.

- Our industry routinely employs operational practices which protect whales, dolphins and other marine life. With these appropriate, risk-based mitigation measures, **we feel that seismic surveys have, and will continue to be undertaken with little or no biologically significant impact to marine mammal populations and to marine life in general.** In addition, it is important to remember that seismic surveys are temporary and transitory and use a low-frequency, short duration source signal.

In Conclusion

- The IAGC values the stakeholder process and are committed to participating in a dialogue with all stakeholders to explain what we do, why we do it and the measures that we take to protect the environment.

- I have with me today DVD's that explain modern marine geophysical data acquisition, underwater sound, and the measures the geophysical industry implements to ensure minimal impacts of our operations on the environment. This information is available for BOEM and those in attendance today.

- IAGC wishes to again express our appreciation for this opportunity to voice our support and commitment to work with BOEM and all stakeholders in the development of the Atlantic PEIS.

- As mentioned previously, IAGC will be submitting written comments as well.

Piedmont Natural Gas

May 16, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Subject: COMMENTS OF PIEDMONT NATURAL GAS COMPANY ON THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED GEOLOGICAL AND GEOPHYSICAL ACTIVITIES IN THE MID- AND SOUTH-ATLANTIC PLANNING AREAS.

Piedmont Natural Gas Company (Piedmont) is the trusted natural gas provider for more than 1 million residential and business customers in North Carolina, South Carolina and Tennessee. Piedmont is headquartered in Charlotte, North Carolina and has been in operation for more than 50 years.

On behalf of Piedmont, I am pleased to respond to the Bureau of Ocean Energy Management (BOEM's) request for comments with respect to the above referenced matter.

Piedmont is a proponent of opening the offshore areas of the Atlantic Coast, especially off North and South Carolina, to natural gas production in order to help increase future domestic energy supplies and maintain reasonable prices for consumers. We believe that careful and appropriate planning for offshore development is necessary now in order to ensure future generations a stable supply at stable prices of this abundant, clean, efficient, affordable and domestic energy source.

To that end, Piedmont encouraged the MMS, and here encourages BOEM, to focus on means by which multiple geological and geophysical activities can occur in a timely manner in the two planning areas. As the MMS and BOEM have noted, the oil and gas industry needs accurate data on potential hydrocarbon resources, as well as information on shallow geologic hazards and seafloor geotechnical properties, in order to explore, develop, produce, and transport hydrocarbons safely and economically, with minimal impact to the surrounding environment.

As Piedmont understands it, seismic geophysical exploration has been employed since the mid to late 1800s. Therefore, it is not new technology, and it is used safely by our most venerable oceanic institutions. Based on the applications pending before the BOEM, no explosives are used; rather 2D and 3D seismic studies occur through use of towed source arrays that emit a sound source in timed intervals. The PEIS therefore is appropriately focused on the occurrence of multiple 2D and 3D seismic activities occurring at or near the same time and means by which to mitigate any negative impact that might arise from multiple ongoing activities. For example, if there is a concern about staging of multiple vessels at one port, it seems quite possible to stage vessels out of several different ports.

Piedmont encourages swift action on approval of a Final PEIS, consistent with the applicable procedural requirements. Piedmont is pleased to note that BOEM has conducted multiple public input meetings on the Draft PEIS throughout the region over the past several weeks. Geological and geophysical activity is an important and necessary first step to determine whether future exploration and possible development is warranted. Given the interest that has been expressed by multiple parties in conducting those studies, and the long lead time necessary to bring any offshore resources to the market for the benefit of natural gas consumers, Piedmont urges that this first step proceed apace.

Sincerely,

Jane R. Lewis-Raymond
Senior Vice President, General Counsel, Corporate Secretary
and Chief Compliance and Community Affairs Officer

From:	Lindsay Potvin
To:	G&GEIS
Cc:	Carrie Thompson
Subject:	Jacksonville public comment
Date:	Tuesday, April 24, 2012 2:28:09 PM
Attachments:	RB Hoover public comment.pdf

Mr. Geis,
Attached please find public comment from Mr. R. B. Hoover, Vice President-Petroleum Supply for Gate Petroleum Company of Jacksonville. We would like to submit this comment in reference to the public hearing held in Jacksonville, FL on Monday, April 16, 2012.

Please feel free to contact me with questions and thank you for your time.

Lindsay Potvin
CoreMessage, Inc.
lindsay@coremessage.com
850.222.3767 - office
850.510.7409 - cell
@LindsayMegan02

Testimony to Bureau of Ocean Energy Management re offshore resources
April 16, 2012

My name is R B Hoover of Jacksonville, Florida. I am Vice President-Petroleum Supply for Gate Petroleum Company of Jacksonville and am President of Gate Biofuels. I also serve as the Vice Chair of the Florida Bioenergy Association.

Recent enhancements of drilling techniques and production stimulants have increased our domestic oil production for the first time in decades. Today, for the first time in over 50 years, it is realistic to speak of the United States regaining its energy independence.

One pathway toward that independence is the development of advanced biofuels that could supplement and, perhaps, eventually replace gasoline and diesel. Exciting work is being done here in Florida at our universities and at a number of pilot plants across the state. However, none of these projects is near commercial viability on a scale that would impact our demand for gasoline and diesel fuel.

In recent months we have witnessed a significant increase in the price of gasoline...not because of supply interruptions or strong demand. The increase has been triggered by concerns that hostilities in Iran could interrupt the flow of crude oil out of the Persian Gulf. This price increase amounts to a huge tax on the American public.

If we had devised a sensible plan decades ago for responsible development of our offshore petroleum reserves, we would not be paying this tax today.

It is not too late. The Department of Energy projects that in 2030 virtually all of our need for liquid transportation fuels will still be satisfied by petroleum. We should make certain that as much of that petroleum as possible comes from domestic sources.

Development of our offshore reserves is a key component in achieving that objective. Gathering current seismic data utilizing the latest technology is essential to that development.

From: John Saydlowski
To: G&GEIS
Subject: Geological and Geophysical Exploration on the Atlantic Outer Continental Shelf (OCS)
Date: Tuesday, May 29, 2012 3:58:46 PM

****THE FOLLOWING COMMENT IS HEREBY SUBMITTED VIA E-MAIL ON BEHALF OF NUCOR CORPORATION PURSUANT TO FR DOC. 2012–7693****

May 29, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

RE: Comments on the Draft PEIS for Atlantic G&G Activities

Dear Mr. Goeke:

I am writing on behalf of Nucor Corporation to urge the Bureau of Ocean Energy Management to move forward with offshore energy production in the Atlantic Outer Continental Shelf (OCS). Accessing energy resources in this area will help get the U.S. closer to its goal of energy independence, while creating high-paying jobs and reducing our trade deficit.

We support the Bureau allowing companies to proceed with seismic studies in the Atlantic OCS. These studies will provide important information for both the oil and gas and offshore wind industries by updating resource assessments to determine available oil and natural gas resources and wind energy potential. It is an important first step to finally allowing offshore energy production in the Atlantic.

We are already seeing the economic and energy security benefits from increased U.S. energy production. The dramatic increase in oil and natural gas from shale areas is putting hundreds of thousands of Americans to work and radically changing America's energy future. It is also driving down natural gas prices which is encouraging an expansion of our country's manufacturing base. Increased natural gas supplies and lower prices are a primary reason Nucor is building a $750 million Direct Reduced Iron (DRI) facility in Louisiana that will create 150 permanent jobs and 500 construction jobs.

Energy production in the Atlantic OCS can add to these economic and energy security gains. A study last year by Woods Mackenzie estimates that oil and gas development in the Atlantic OCS could generate up to 140,000 jobs and $14 billion in government revenue annually. The National Renewable Energy Laboratory estimates offshore wind development in the Atlantic will create

43,000 jobs and $200 million in economic activity.

Our government should be doing all it can to facilitate additional domestic energy production and not put regulatory barriers in place that impede progress. We have prohibited energy production off the Atlantic coast for far too long. It is time to move forward.

Sincerely,

Giff Daughtridge
Vice President & General Manager
Nucor Steel Berkeley

Contact Information:
P.O. Box 2259, Mt. Pleasant, SC 29465
Email: giff.daughtridge@nucor.com
Tel: (843) 336-6444

From: Thurston, Jean
Sent: Monday, April 16, 2012 10:48 AM
To: Bjerstedt, Thomas
Subject: FW: Submarine Telecommunications Cables and the PEIS

Hi Tom,

I saw Maurice Hill the other day and it reminded me of our year-long series of meetings together on the COP guidelines! I hope you are doing well down in the Gulf and things are slowing down somewhat (although probably not likely considering all the activities going on there).
We received this comment (below) from a representative of the submarine cable industry. Mr. Salley has concerns regarding impacts from the Atlantic G&G activities on the submarine cable industry. As some background, he also submitted comments to us on the Rhode Island Area of Mutual Interest (AMI) RFI and OREP has met with the North American Submarine Cable Association of which Mr. Salley is a member. I think his primary concern is that none of the activities in the G&G PEIS will cause damage to any cables, so I thought I would send this comment your way. Let me know what you think!

Thanks,
Jean

From: Salley, Steven F [mailto:frank.salley@verizon.com]
Sent: Monday, April 16, 2012 10:22 AM
To: Reeves, Casey L
Cc: Thurston, Jean; getourgee@verizon.net
Subject: Submarine Telecommunications Cables and the PEIS

Casey,

While I have not had a chance to do an in depth review of the recent PEIS associated with G&G Activities in Mid and South Atlantic Planning Areas, upon initial review there appears to be no mention of submarine telecommunications cables.

After repeated request for inclusion in your planning efforts, the continuing disregard or oversight of this critical infrastructure in your public documentation is not acceptable. Can you provide direction on how the submarine cable industry can raise this issue to the appropriate level in the BOEM where we can be heard?

I apologize in advance if I have overlooked any reference to the submarine cable issue in the recent document.

Regards

Frank Salley

From:	Carrie Thompson
To:	G&GEIS
Subject:	Public comment submittal for Jacksonville FL hearing
Date:	Tuesday, April 24, 2012 12:31:53 PM

Below please find a statement to be submitted from the OEM hearing in Jacksonville Florida. Additionally, please confirm receipt of this email. Thank you!

STATEMENT BY:

Nicolás Gutiérrez, Jr., FLA Energy Forum Chairman

Regarding Federal Bureau of Ocean Energy Management Hearings Held Today in Jacksonville

"This afternoon, Floridians and Jacksonville-area residents stepped forward to let the federal government know that we must reduce our reliance on foreign oil and increase domestic production. A critical first step toward energy independence is the approval of permitting for seismic surveying in the Atlantic Ocean. Without the data obtained through this research, we will never know what resources exist to help our country meet its growing energy demands. Knowledge is power, and these tests will yield the most up-to-date information using the latest technology possible to give us a clear picture of the resources available.

And, while new seismic surveys are a step in the right direction, that alone is not enough. Current policies prohibit companies from leasing land in this region and developing our natural resources until 2018. We simply cannot wait that long.

Further delays in developing Florida's energy assets not only take another energy source off the table for every U.S. citizen, it also means that our state is missing out on billions of dollars of much-needed state revenue and more than 160,000 desperately needed jobs.

On behalf of the FLA Energy Forum, and all Floridians concerned about our energy future, I ask the federal government to permit seismic surveying of the Atlantic so America can ultimately fulfill the goal of energy independence and security."

###

The FLA Energy Forum is non-partisan group of Floridians concerned about energy issues affecting the state. Members of the statewide forum support a balanced approach to increasing American supplies of energy, including expanded conservation efforts, development of renewable energy sources and increased domestic exploration of traditional energy sources.

cleanenergy.org
Southern Alliance for Clean Energy

1.866.522.SACE
www.cleanenergy.org

P.O. Box 1842
Knoxville, TN 37901
865.637.6055

34 Wall Street, Suite 607
Asheville, NC 28801
828.254.6776

250 Arizona Avenue, NE
Atlanta, GA 30307
404.373.5832

11 W. Park Avenue
Savannah, GA 31401
912.201.0354

P.O. Box 1833
Pittsboro, NC 27312
919.360.2492

P.O. Box 50451
Jacksonville, FL 32240
904.469.7126

P.O. Box 13673
Charleston, SC 29422
843.225.2371

April 20, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard,
New Orleans, Louisiana 70123–2394.

Dear Mr. Goeke:

The Southern Alliance for Clean Energy is a regional organization that promotes responsible energy choices that create climate change solutions and ensure clean, safe and healthy communities throughout the Southeast. We welcome this opportunity to engage in a thoughtful offshore energy discussion and we would like to thank you for your willingness to discuss offshore energy. SACE would like to voice our support for offshore wind energy while urging a moratorium on offshore oil or natural gas development in the Mid-Atlantic and South Atlantic planning areas.

Offshore Wind Energy is a Better Investment than Offshore Oil and Gas

While no offshore wind farms have been built in the U.S., several proposed wind farms are in the advanced stages of the permitting process. Most of the proposed projects are in the North Atlantic Planning area; however, the Mid-Atlantic and South Atlantic planning areas arguably have the best offshore wind resource in the country.[1]

Offshore wind energy isn't a new idea. Currently, nearly 4 gigawatts of offshore wind farms are operational in Europe.[2] A single gigawatt of offshore wind energy can generate as much electricity as is consumed by about 305,000 average-sized homes annually. Europe plans on installing 150 gigawatts of offshore wind energy by 2030, which would provide between 13% and 18% of that continent's electricity demand.[3] Based on these projections, some 293,000 manufacturing, installation, operations and maintenance jobs could be created in the offshore wind industry in Europe by 2030. Aside from Europe, China is the only other place in the world where offshore wind farms are currently operational.[4]

With offshore wind electricity generation, there is no air pollution, no risk of a catastrophic accident, no water consumption and no mining operations.[5] In addition to supplanting dirtier sources of energy, offshore wind farms may provide artificial reef sites. Some European studies suggest offshore wind farms act as habitat for fish and other wildlife, and may actually improve the ecosystem.[6] More research must be completed to determine the total ecosystem impact from offshore wind turbines.

Offshore Oil and Gas Prospecting is Unnecessary and Harmful

The current Draft Programmatic Environmental Impact Statement (DPEIS) issued by BOEM for geologic and geophysical (G&G) activities off the Mid-Atlantic and South Atlantic planning areas extends significantly beyond areas of interest for offshore wind energy deployment. Geological and geophysical surveys beyond the needs for offshore wind development amount to prospecting activities for offshore oil and gas development. The excessive and intrusive nature of G&G activities for oil and gas prospecting will cause undue harm to the marine environment. Additionally, previous oil and natural gas assessments of the Mid-Atlantic and South Atlantic show there are limited economically viable resources in these planning areas. Geophysical and geological activities beyond what is necessary for offshore wind energy deployment are unnecessary and harmful.

The proposed G&G activities in the DPEIS extend from 3 nautical miles to 350 nautical miles – far beyond the internationally recognized 200 nautical mile exclusive economic zone. In order to cover this substantial swath of ocean area, shipping and aerial traffic are likely to significantly increase. Excessive shipping traffic can cause displacement and mortality of marine species, including fish, sea turtles and marine mammals. The North Atlantic Right Whale is particularly at risk from ship strikes[7], and increasing shipping traffic for G&G activities may exacerbate hazards posed to this critically endangered species.

Seismic geological and geographic studies used for oil and natural gas resource assessments can emit extremely loud noises to penetrate deep into the seabed.[8] These sounds bounce back from the seafloor and below to a collection system onboard a ship. Far from being benign, these loud noises have been shown to cause marine mammals distress and even deafness if the wildlife is too close.[9] Many marine mammals and even fish rely on sound to navigate, hunt and mate. Conducting large-scale seismic testing off the Mid-Atlantic and South Atlantic coasts would do harm to the marine environment, and there is no guarantee of finding significant oil or natural gas resources.

Previous estimates on the offshore oil and natural gas resources for the Mid-Atlantic and South Atlantic show the areas do not contain substantial hydrocarbon resources. At $110 per barrel, the Bureau of Ocean Energy Management estimates that the economically extractable resource potential for the Mid-Atlantic and South Atlantic combined is approximately 1.5 billion barrels of oil and about 11 trillion cubic feet of natural gas from between 3 nautical miles to 200 nautical miles from shore.[10] To put the amount of oil potential into context, the U.S. consumes approximately 19 million barrels of oil a day[11], making the 1.5 billion barrels of oil worth about 79 days of U.S. oil demand. Natural gas consumption is expected to average about 70 billion cubic feet per day in 2012[12], which means the estimated natural gas resource offshore represents about 157 days worth of total U.S. demand. This minuscule amount of oil and natural gas cannot justify the large risk to the offshore environment from wide-scale G&G activities.

Furthermore, considering the end goal of G &G activities beyond areas of interest for offshore wind energy deployment is to drill for oil and gas, we would like to point out the intrinsic risk in investing time, energy, and money into the G&G process which may never even result in the production of energy. In the years between now and the potential installation phase of drilling rigs, clean energy technology and deployment are anticipated to advance greatly and supply greater amounts of clean energy for less expensively than they are currently capable. Given this scenario, the incentive for offshore drilling will be dampened, thus negating the value of near-term exploratory efforts. Furthermore as time passes and the public learns more about the long-term aftermath of the Deepwater Horizon disaster, we expect public opposition to offshore drilling to grow, particularly as offshore wind, as a clean, renewable, and popular ocean-based energy resource—and thus a counterpoint to offshore drilling—comes online.

Recommendations

In order to promote offshore wind energy, and minimize the financial and ecological risks associated with geological and geophysical (G&G) activities, the Southern Alliance for Clean Energy makes the following recommendations:

1) Contain G&G activities to the Wind Energy Areas (WEA) designated by the Bureau of Ocean Energy Management (BOEM). Thus far, BOEM has identified areas off Virginia, Maryland, Delaware and is actively working with taskforces in North Carolina and South Carolina to identify WEAs offshore.[13] These areas are likely to be the focal points for first-generation offshore wind farm installations within the planning areas. Focusing on these areas for G&G activities will minimize ship traffic and will be maximally beneficial for offshore wind energy development. BOEM should also work to develop WEA's for Georgia and Florida.

2) Limit G&G activities to collect relevant data for near-term offshore wind energy deployment. Average turbine installation depth and distance from shore for offshore wind farm projects under development in Europe are approximately 25 meters depth and 20 miles offshore; however, commercially available turbines have been installed in Europe in up to 50 meters depth and up to approximately 62 miles offshore. Most turbines installed utilize a pile-driven monopile foundation structure and submarine interconnection cables.[14] Shallow water, near-shore, shallow penetration G&G activities are best suited for offshore wind energy deployment technologies in the near term and BOEM should focus its efforts on these types of activities. Deep-penetration seismic surveys and electromagnetic surveys are likely unnecessary for offshore wind energy development and thus should be foregone.[15]

3) Minimize overlapping of similar G&G activities in the Mid-Atlantic and South Atlantic. Increased shipping traffic and intense acoustic surveying are likely to have impacts on the marine environment.[16] Disallowing duplicative G&G activities is likely to decrease these impacts by reducing ship traffic.

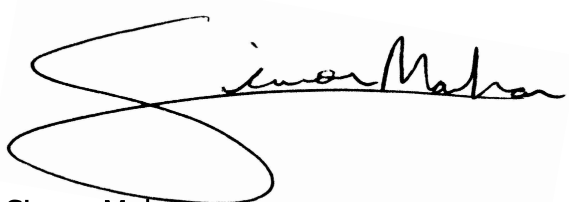
4) Prohibit G&G activities from November to April, which is when the North Atlantic Right Whale are most likely to be within the Mid-Atlantic or South Atlantic planning areas.[17]

5) Do not allow G&G activities specifically designed for offshore oil and natural gas resource assessments or have limited applicability to the offshore wind industry.

Conclusion

Based on the Mid-Atlantic and South Atlantic's offshore wind energy resource, as well as the benefits of developing offshore wind farms, the Southern Alliance for Clean Energy recommends that the Bureau of Ocean Energy Management work to urgently promote and develop offshore renewable energy. Offshore wind energy, without the risks that fossil fuel development poses to the health and vitality of the region, has more benefits than costs, and is preferred over developing the miniscule offshore oil or natural gas resource. With proper siting, studies and incentives, offshore wind energy can generate abundant clean energy and create numerous jobs while protecting the marine environment.

Sincerely,



Simon Mahan
Renewable Energy Manager
Southern Alliance for Clean Energy

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[1] National Wildlife Federation (2010). "Offshore Wind in the Atlantic: Growing Momentum for Jobs, Energy Independence, Clean Air, and Wildlife Protection."

[2] European Wind Energy Association (2012). "European Offshore Wind Industry – Key Trends and Statistics 2011." [http://ewea.org/fileadmin/ewea_documents/documents/publications/statistics/EWEA_stats_offshore_2011_02.pdf]

[3] European Wind Energy Association (2006). "No Fuel. Wind. Power without Fuel."

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[5] National Renewable Energy Laboratory (2010). "Large-scale Offshore Wind Power in the United States."

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[7] National Oceanic and Atmospheric Administration. "Reducing Ship Strikes to North Atlantic Right Whales." [http://www.nmfs.noaa.gov/pr/shipstrike/]

[8] National Academies Press (1997). Research Required to Support Comprehensive Nuclear Test Ban Treaty Monitoring, p. 123. [http://www.nap.edu/openbook.php?record_id=5875&page=123]

[9] National Academies Press (2003). Ocean Noise and Marine Mammals. [http://www.nap.edu/openbook.php?isbn=0309085365]

[10] United States Department of the Interior (2009, January). "Draft Proposed Outer Continental Shelf (OC) Oil and Gas Leasing Program: Considering Comments of Governors, Section 18 Factors and OCS Alternative Energy Opportunities." Minerals Management Service. [www.boemre.gov/5-year/PDFs/DPP_FINAL.pdf]

[11] Department of Energy (2012). "Petroleum and Other Liquids." [http://205.254.135.7/dnav/pet/pet_sum_snd_d_nus_mbblpd_a_cur.htm]

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[13] Bureau of Ocean Energy Management. "State Activities." [http://www.boem.gov/Renewable-Energy-Program/State-Activities/Index.aspx]
[14] European Wind Energy Association (2012). "European Offshore Wind Industry – Key Trends and Statistics 2011." [http://ewea.org/fileadmin/ewea_documents/documents/publications/statistics/EWEA_stats_offshore_2011_02.pdf]
[15] Minerals Management Service (2010). "Descriptions of Geological and Geophysical Activities." [http://www.gomr.boemre.gov/homepg/offshore/atlocs/uses_of_seismic_infosheet.pdf]
[16] National Geographic (2011). "Drifting in Static." [http://ngm.nationalgeographic.com/2011/01/big-idea/noisy-ocean]
[17] National Oceanic and Atmospheric Administration. "Learn More about the North Atlantic Right Whale." [http://sero.nmfs.noaa.gov/pr/mm/rightwhales/RightWhalesSouth.htm]

From:	Bob Hala
To:	G&GEIS
Subject:	Seismic Noise Monitoring
Date:	Tuesday, May 01, 2012 7:16:44 PM
Attachments:	Noise Sentinel Brochure.pdf

If the seismic blasting to explore oil reserves does move forward, monitoring should take place to ensure compliance is met.

Attached is a brochure for Noise Sentinel, which can be developed to incorporate hydrophones that are also offered by Brüel and Kjaer.

Please let me know if we can be of help in this matter.

Thanks,

Bob Hala
Account Manager
Brüel & Kjaer - Environment Management Solutions (EMS)
1050 Fulton Ave., Suite 213
Sacramento, Ca 95825
Tel: 866.240.8307
Dir: 916.604.8505
Cell: 916.969.8946
Fax: 916.265.7719
bob.hala@bksv.com
www.bksv.com/EMS

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Noise Sentinel

Noise Compliance Management

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- **Operation** to collect, verify and manage the noise data, sound recordings, weather and video;
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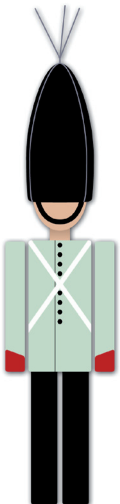

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Managing urban environmental noise involves many and varied tasks - from installing and maintaining monitoring equipment, solving noise complaints, noise mapping and policing noise limits to noise abatement and zoning. Reports must be made and then distributed, and all data, results, reports, and analyses must be archived for easy retrieval.

Noise Sentinel takes care of monitoring your compliance with noise limits; leaving you free to manage your core business rather than operate a noise monitoring system. Noise Sentinel has applications in construction, power generation, chemical plants, wind farms and any outdoor situation where long term noise compliance information and/or threshold alerting is needed.

Noise Sentinel takes a different approach to establishing a noise monitoring programme. We provide your regular noise level reports on a subscription basis, rather than only supplying equipment in which you must then invest resources to operate.

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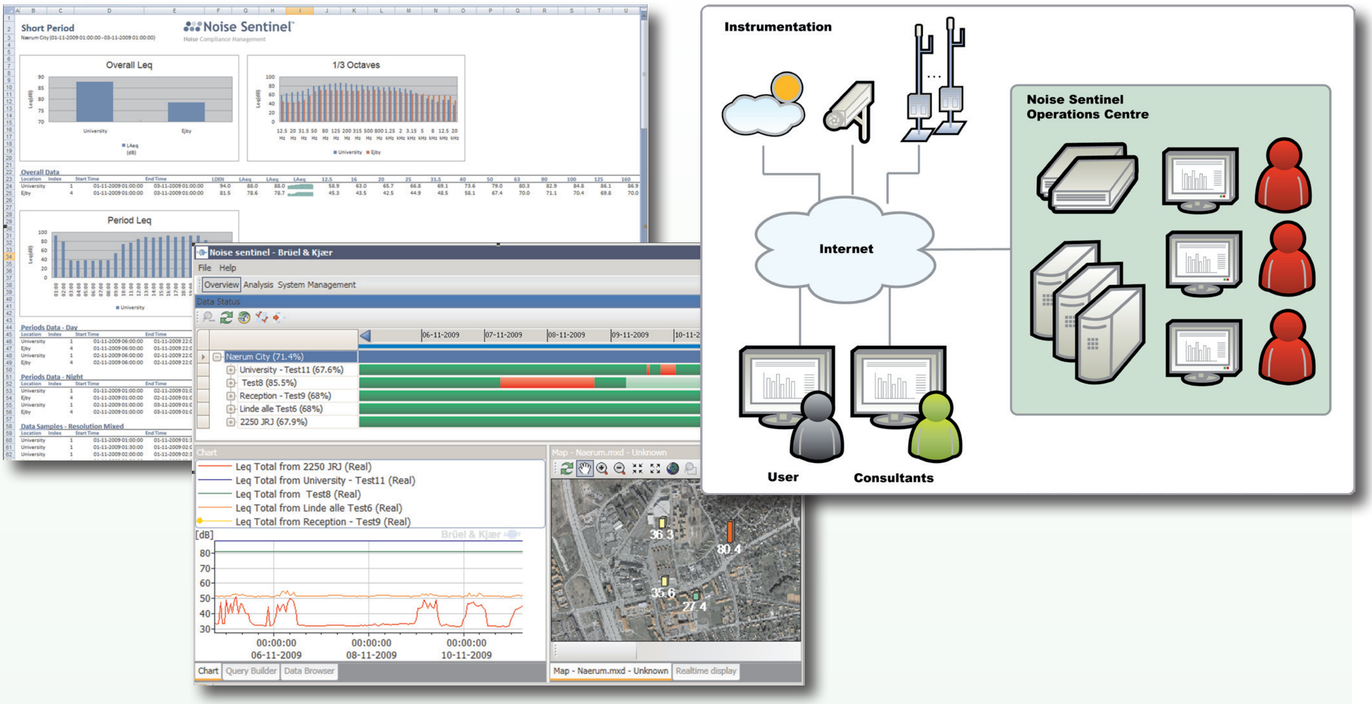

Noise Sentinel is web based and provides everything you need to meet your ongoing noise monitoring obligations. It has the following benefits over the established approach of purchasing and operating your own system.

- **The highest quality result - your operating licence may be under threat, it is important that you get this right**.
  - We manage the entire system for you 24 hours a day with automatic data recovery
  - We check and verify the data and make clear any data limitations or concerns so you have the full picture before you use the data
  - We are a professional services organisation; we do not stop at providing instrumentation, software and training - we deliver the results you need to manage your business
- **Simplified Operations**
  - We establish and operate the monitoring programme on your behalf
  - The service is flexible to adapt to changes in the monitoring programmes as it progresses, adding features and additional monitoring sites
  - We look after all your noise data, protect it, back it up and make it available for you whenever you need it 24/7
  - We look after all standards traceability so you can use the data to defend your position should you be challenged at any point in the future
  - All equipment is removed and sites made good at the completion of the programme
  - **We are responsible and accountable for all noise measurement**
- **Simplified Finances**
  - Reduces the amount of capital expenditure to commence monitoring
  - Provides certainty of cost throughout the life of the monitoring programme
  - A 10% to 20% lower total cost of operation

Noise Sentinel improves your focus and lets you place your attention on mitigation and management.

INTERESTED?

Visit www.bksv.com/NoiseSentinel for more details and to request a quotation. Alternatively contact your local Brüel and Kjær representative directly.

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Telephone: +45 4580 0500 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com

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