

Offshore Renewable Energy Installations

Impact on navigation and marine safety.

by MR. GEORGE H. DETWEILER, JR.
Marine Transportation Specialist

U.S. Coast Guard Marine Transportation Systems Management Directorate

To reduce our dependence on foreign energy supplies, alternative or renewable energy sources are being pursued. These sources exploit a wide range of technologies:

- solar photovoltaics or power plants;
- hydroelectricity (dams);
- ocean thermal energy conversion facilities;
- offshore renewable energy installations, which may include “wind farms,” marine current turbines, and wave generators (hydrokinetics).

All these technologies have the potential to affect marine navigation and safety, and although no offshore renewable energy installations presently exist in U.S. waters, several are contemplated following successful trials in other countries. Of the technologies being considered, wind farms and hydrokinetics pique the Coast Guard’s interest because their developers propose to locate them in U.S. navigable waters.

Navigation Impact

All offshore installations, regardless of type, will have impact on vessel navigation and safety in their vicinity.

Glossary of Terms

Wind Farm

A wind farm is a group of interconnected wind turbines used to produce electric power and is typically located off-shore to take advantage of strong winds blowing over the surface of an ocean or lake. A wind farm may consist of a few dozen to several hundred individual wind turbines, and can cover an extended area of 100 square nautical miles or more. In good meteorological conditions, they are readily identifiable visually and by radar.

Turbines

A wind farm’s turbines are comprised of three parts:

- a foundation below sea level,
- a transition section with a platform,
- a nacelle: a structure that houses the generator.

Turbine blades are located opposite the nacelle. Typical modern wind turbines are approximately 400 feet above the surface, have blade diameters 130 to 300 feet, and are rated between 500 kW and 7 MW.

Wave Energy Converter

A wave energy converter is a device that extracts energy directly from the surface motion of ocean waves or from pressure fluctuations below the surface.

Tidal Energy Converter

Tidal energy converters are submerged water turbines that can extract energy from ocean currents. These turbines have rotor blades, a generator for converting the rotational energy into electricity, and a means of transporting the electrical current to shore.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Offshore Renewable Energy Installations: Impact on navigation and marine safety.				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Coast Guard, Marine Transportation Systems Management Directorate, 2100 2nd Street SW, Washington, DC, 20593-7580				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Location. An offshore site could affect navigation based on the traffic volume, types of waterway users (deep draft or shallow draft vessels, high-speed craft, ferries), vessel sizes (length, width, height, draft, tonnage), and other vessel characteristics including speed capability, navigation equipment, and number of passengers.

In addition, an installation could affect non-transit uses of the area such as recreational fishing and day cruising, racing, marine regattas and parades, and aggregate dredging. Lastly, an offshore installation located near shipping lanes or in proximity to anchorage grounds or areas, safe havens, port approaches, and pilot boarding or landing areas could adversely impact vessels transiting in such locations.

Spacing. To make best use of the wind, turbine spacing is proportional to rotor size and the down-wind wake effect created. As such, wind farm turbines are generally spaced 500 meters or more apart.

Hydrokinetic projects such as wave generators or “buoy farms” are being contemplated as pilot projects, which will be limited in size and output. Footprint size will be small and may involve between four to 10 buoys, spaced much more closely than wind farm turbines.

Obviously both can limit or prevent vessel access within the installation, can create additional collision risk, and could limit the ability of vessels to maneuver and avoid collisions with the structures or with other vessels operating near them.

Visibility. These structures could also block or hinder the view of other vessels, the coastline, or other navigational features such as aids to navigation, landmarks, or promontories used by mariners to navigate.

Electronic impact. Larger structures could produce radio interference with respect to any frequencies used for aviation, marine positioning, navigation, or communications, including automatic identification systems. In addition, structures could produce radar reflections, blind spots, shadow areas, or other adverse effects on shipboard marine radar, and could produce sonar interference affecting fishing, industrial, or military systems in the area.

The site might also produce acoustic noise or noise absorption or reflections, which could mask or interfere with sound signals from other vessels or aids to navigation. Lastly, the generators and seabed cabling might produce electro-magnetic fields affecting compasses and other navigation systems.

Effects of tides, tidal streams, currents, seabed changes. Current maritime traffic flows and operations in the area of an offshore renewable energy installation are affected by the depth of water in which the installation is situated at various states of the tide. For example, the installation could pose problems at high water that do not exist at low water conditions, and vice versa. In addition, maritime traffic flow and operations are affected by currents in the area in which an installation may be situated, and current direction or velocity could increase collision risk.

Additionally, the structures themselves could cause changes in the set and rate of the tidal stream or direction and rate of the currents. Also, structures in the tidal stream could produce siltation, deposition of sediment or scouring, and other suction or discharge aspects, which could affect navigable water depth.

Mitigating the Impact

While these offshore renewable energy installations have many potential benefits, it’s important to recognize the equally potential negative effects mentioned and to devise plans to mitigate them. Typically this is determined during the environmental impact statement process.

Permitting Agencies

The “lead permitting agency” is that agency that will permit the offshore renewable energy installation and develop the environmental impact statement for the specific project. In general, agencies are determined by project type and location. Wind farms located on the outer continental shelf come under the permitting jurisdiction of the Bureau of Ocean Energy Management, Regulation, and Enforcement; otherwise the U.S. Army Corps of Engineers takes the lead.

For hydrokinetic projects, the lead permitting agency is the Federal Energy Regulatory Commission, and for ocean thermal energy conversion projects, it’s the National Oceanic and Atmospheric Administration.

Navigational safety risk assessment. For example, an offshore renewable energy installation developer should perform a systematic assessment of the risks to navigation safety associated with the proposed project and its location using the Coast Guard's risk-based decision making guidelines or other suitable industry standards.

It's important to identify any impact on navigational safety and assess the increase in risk associated as well as identify and evaluate potential measures that could be implemented to mitigate the increased risks.

The Coast Guard will review the assessment to develop a "safety of navigation" opinion and associated mitigation measures that it will forward to the appropriate lead permitting agency.

Navigational marking. The International Association of Marine Aids to Navigation and Lighthouse Authorities has promulgated recommendations on how to mark different types of offshore renewable energy installations, that they can be conspicuous under different meteorological conditions and during day and night. These recommendations include marking the installation perimeter with lights, marking an individual apparatus with alpha-numeric characters, and use of radar beacons, automatic identification system transceivers, and sound signals.

Charting and marine information. Proper charting (with proper chart nomenclature by a recognized hydrographic office) for offshore installations and their associated cabling is necessary to aid the mariner in transiting in or near these installations. Promulgation should also include notices to mariners, coast pilots, and notices in maritime publications.

Limited access areas and routing measures. It may be necessary to create limited access areas (safety zones, security zones, and regulated navigation areas) in and

around an offshore installation to protect the mariner and the developer's property. Other routing measures such as an "area to be avoided," precautionary areas, or traffic separation schemes also may be utilized.

Technology improvement. As the offshore renewable energy installation industry matures, technological advances in equipment design, fabrication, and materials may reduce the impact on shipboard electronic equipment. Other

mitigation measures may include modifications to reduce radar cross-section and telemetry from wind farms to radar, for example, as well as modifications to the shipboard radars themselves.

On the Horizon

Alternative or renewable energy is already here in the United States. Wind farms dot the landscape and are being proposed for offshore locations. Developers are working diligently to create hydrokinetic devices to harness water power from our rivers and along our coasts.

Although offshore installations may present new challenges to safe navigation in U.S. waters, proper preparation, a complete voyage plan taking into account all relevant information, and proper adherence to the applicable navigation rules should ensure safe passage for a vessel as well as its crew.

About the author:

Mr. George H. Detweiler, Jr., retired from the U.S. Coast Guard after more than 20 years of service. He is currently a marine transportation specialist in the Marine Transportation Systems Management Directorate at USCG headquarters. His major projects have included conducting port access route studies, creating ships' routing measures, reviewing offshore renewable energy installation proposals, and conducting tribal consultations.

Bibliography:

Maritime and Coast Guard Agency Marine Guidance "Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs" and "Offshore Renewable Energy Installations (OREIs): Guidance on UK Navigational Practice, Safety, and Emergency Response Issues."

For more INFORMATION:

The U.S. Coast Guard's Risk-Based
Decision-Making Guidelines

<http://www.uscg.mil/hq/cg5/cg5211/E-Guidelines.asp>

The International Association of Marine Aids
to Navigation and Lighthouse Authorities
marking guidelines

<http://www.orga.nl/index.php?page=231&l=en>

