U.S. ARMY CORPS OF ENGINEERS
APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT
(33 CFR 325)

OMB APPROVAL NO. 0710-0003
EXPIRES: 31 AUGUST 2012

Public reporting for this collection of information is estimated to average 11 hours 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 the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED B APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Catherine Middle - Last - McLean	First - Timothy Middle - Leo Last - Feehan
Company - Consortium for Ocean Leadership - OOI	Company - Tetra Tech EC, Inc.
E-mail Address - cmclean@oceanleadership.org	E-mail Address - Timothy.Feehan@tetratech.com
6. APPLICANT'S ADDRESS:	**9. AGENT'S ADDRESS:**
Address- 1201 New York Ave NW, Suite 400	Address- 160 Federal St. 3rd Floor
City - Washington State - DC Zip - 20005 Country - USA	City - Boston State - MA Zip - 02110 Country - USA
7. APPLICANT'S PHONE NOs. w/AREA CODE	**10. AGENTS PHONE NOs. w/AREA CODE**
a. Residence b. Business c. Fax	a. Residence b. Business c. Fax
N/A 202-787-1631 202-332-8887	617-443-7521 617-737-3480

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Timothy Feehan to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)
Ocean Observatories Initiative (OOI) Pioneer Array

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
Atlantic Ocean - Mid-Atlantic Bight	Address N/A
15. LOCATION OF PROJECT Latitude: N See Attachment 1 Longitude: W	City - N/A State- N/A Zip- N/A

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)
State Tax Parcel ID N/A Municipality N/A
Section - N/A Township - N/A Range - N/A

17. DIRECTIONS TO THE SITE

The Pioneer Moored Array will extend approximately 47 kilometers (25 nautical miles) across the continental shelf in the Atlantic Ocean. The distance from shore (Martha's Vineyard) to the northern mooring line would be approximately 55 nautical miles (see attached Detail Sheet 1 of 12). The central mooring of the Pioneer Array will be located at 40° 08.2'N, 70°46.5'W at a water depth of 150 meters (see attached Detail Sheet 2 of 12). See Attachment 1 for detailed locations.

18. Nature of Activity (Description of project, include all features)

See Attachment 2, Nature of Activity

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

See Attachment 3, Project Purpose

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

NA

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
NA	NA	NA

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres NA

or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

NA

Attachment 1

LOCATION OF PROJECT

Pioneer Moored Array locations are described by site **name**, site **location**, approximate **water depth** at the site, and **mooring type(s)** to be deployed at the site. More than one mooring may be located at a particular site. Moorings will be deployed within a 0.5 nm radius "buffer zone" (suggested navigational avoidance zone) surrounding the site center. **Separation** is the distance between buffer zones. Deployments will occur in 2013 and 2014.

Mooring types are as follows:

- CSM – Coastal Surface Mooring
- CPM – Coastal Profiler Mooring
- CSPPM – Coastal Surface Piercing Profiler Mooring

Site	Location	Water Depth	Mooring(s)	Separation
Inshore	40°21.8'N 70°53.0'W	91.5 m (50 fm)	CSM with AUV dock, CSPPM *	13.2 km (7.2 nm) from Central- Inshore
Central-Inshore	40°13.6'N 70°53.0'W	125 m (68 fm)	CPM	11.6 km (6.3 nm) from Central
Central	40°08.2'N 70°46.5'W	133 m (73 fm)	CSM, CSPPM	---
Central-Offshore	40°05.9'N 70°53.0'W	150 m (82 fm)	CPM	8.2 km (4.5 nm) from Central
Offshore	39°56.4'N 70°53.0'W	450 m (246 fm)	CSM with AUV dock, CPM	15.6 km (8.5 nm) from Central- Offshore
Upstream-Inshore	40°21.9'N 70°46.5'W	91.5 m (50 fm)	CPM	7.2 km (4.0 nm) from Inshore
Upstream-Offshore	39°56.4'N 70°46.5'W	450 m (245 fm)	CPM	7.3 km (4.0 nm) from Offshore

* There may be a possible temporary deployment of a CPM at Inshore site in 2013, the CPM would then be relocated to Upstream-Inshore in 2014.

Attachment 2

Nature of Activity

1. Project Background

To provide the U.S. ocean sciences research community with the basic sensors and infrastructure required to make sustained, long-term, and adaptive measurements in the oceans, the National Science Foundation's (NSF's) Ocean Sciences Division developed the Ocean Observatories Initiative (OOI) from community-wide, national, and international scientific planning efforts. The Consortium for Ocean Leadership (COL) is the contract entity responsible for implementing the OOI for NSF, and is listed as the owner of the infrastructure in this application. Woods Hole Oceanographic Institution (WHOI) is COL's subcontractor (termed a marine Implementing Organization, or IO) for the Pioneer Array portion of the OOI, and provided most figures and drawings. WHOI will deploy and operate the Pioneer Array.

OOI builds upon recent technological advances, experience with existing ocean observatories, and lessons learned from several successful pilot and test-bed projects. The OOI will be an interactive, globally distributed and integrated network of cutting-edge technological capabilities for ocean observing. This network of sensors will enable the next generation of complex ocean studies at the coastal, regional, and global scale. OOI will complement the broader effort to establish the proposed operationally focused national system known as the Integrated Ocean Observing System (IOOS). As these efforts mature, the OOI integrated observatory will be the NSF's contribution to the National IOOS initiative and in turn will be a key and enabling U.S. contribution to the international Global Ocean Observing System and the Global Earth Observation System of Systems.

The OOI Coastal Observatories will enhance and expand upon existing coastal observing assets, providing unique research capabilities to address complex problems in the coastal environment. The Pioneer Array will include a network of moorings and autonomous robotic vehicles to monitor waters of the continental shelf and slope south of New England – the boundary where coastal waters meet the open ocean. The Pioneer Array is located at the shelfbreak front, where nutrients and other properties are exchanged between the coast and the deep ocean. Data from the Pioneer Array will provide new insights into coastal ocean processes such as shelf/slope nutrient exchange, air-sea property exchange, carbon cycling and ocean acidification that are important to the New England shelf, and to continental shelf ecosystems around the world.

2. General Description of Pioneer Array

The Pioneer Array will utilize three different mooring types supporting sea surface, water column, and seafloor instruments. Satellite telemetry and other wireless technologies will transmit data to shore. Two-way communication systems will enable the OOI to make oceanographic and meteorological data quickly available via the Internet. The Array is designed to be relocatable to other coastal areas, potentially relocating approximately every 5 years throughout the 25 to 30 year duration of the OOI program. The initial Pioneer Array deployment will be in the Middle Atlantic Bight, occupying a region 55

nautical miles (nm) south of Martha's Vineyard, MA. Deployment will start in 2013 and continue for a period of between 5 and 7 years.

The Pioneer Array will consist of two lines of recoverable moorings running approximately north-south across the continental shelf south of Martha's Vineyard. Ten moorings will be deployed at seven sites; three sites contain mooring pairs. The western (downstream) line includes six moorings at four sites, while the eastern (upstream) line includes four moorings at three sites. See Attachment 1 for the geographic locations (detail sheets 1 and 2) and depths of each mooring (also see detail sheets 3 through 12). The Plan View (detail sheet 2) displays the mooring sites on a map including distances between array components.

The quantities and types of moorings making up the Pioneer Array are as follows:

- **3 Coastal Surface Moorings (CSMs).** CSMs (detail sheets 3 through 5) include a surface buoy with onboard power generation, batteries, instrumentation, and multiple communications systems. The mooring line contains oceanographic instrumentation and is terminated with recoverable anchors. Two of the three CSMs will support an AUV docking station connected to the mooring base by up to 500 m of surface-laid submarine cable (detail sheets 11 and 12). The third CSM will be capable of supporting future "guest scientist" instrumentation. The surface-laid cables connecting the remote AUV docking stations to the mooring are the only cables that will be installed at the Pioneer Array. These cables will provide power and communications connections, and will be laid on the seafloor by a remotely operated vehicle (ROV);
- **5 Coastal Profiler Moorings (CPMs).** CPMs (detail sheets 6 through 8) include a surface buoy with multiple communication systems, oceanographic instrumentation along the mooring line, and recoverable anchors. All instrumentation on the CPMs will be powered by batteries.
- **2 Coastal Surface Piercing Profiler Moorings (CSPPMs).** CSPPMs (detail sheets 9 and 10) do not have a permanent surface buoy, but instead utilize sensors mounted on a buoyant profiling frame that periodically travels from a few meters above the bottom to the sea surface (e.g. 2 times per day at 12 hour intervals). While piercing the surface, satellite communication systems are used to transmit data to shore. The frame is winched back to the seafloor when data telemetry is complete, typically less than 10 min. Thus, the CSPPM has a surface expression for only tens of minutes a few times per day. CSPPMs have a fully recoverable anchor system. All instrumentation will be powered by batteries

Note that gliders and autonomous underwater vehicle (AUVs) will also run missions in the vicinity of the moored array (detail sheets 1 and 2), but are not regulated by the USACE and thus are not discussed further in this application except for the fixed AUV docking structures connected to the Inshore and Offshore surface moorings.

The Pioneer Array core instruments are a combination of standard meteorological and oceanographic sensors that will be distributed among the moorings. Instruments may contain alkaline, and in some cases lithium, batteries. All batteries will be recovered and properly disposed of on land – they will not be discarded at sea. The suite of measurements includes, but may not be limited to:

- Meteorological parameters (air temperature, rainfall, humidity, wind speed, etc.)
- Water temperature, salinity (conductivity), and pressure;
- Current speed;
- Dissolved nitrate, oxygen, and carbon dioxide;
- pH;
- light penetration;
- Chlorophyll-*a*, and other optical properties of seawater;

3. Structures or work in or affecting navigable waters of the United States (Section 10 of the Rivers and Harbors Act)

Coastal Surface Mooring (CSM)

The Pioneer CSM (detail sheets 3 through 5) utilizes a foam-hull surface buoy connected to a seafloor anchor frame with a combination of electro-mechanical (EM) cable and EM stretch hose. The three CSMs will house sensors on the surface buoy, below the buoy on an instrument frame, and on the anchor recovery frame.

The CSM surface buoy extends approximately 4.5 meters (m) above the water line and has a draft of approximately 1.3 m. The buoy has a foam flotation hull about 3.3 m in diameter. The portion of the buoy hull that protrudes above the water will be yellow, while the majority of tower elements will be white. The buoy air weight will not exceed 9100 pounds (4125 kilogram [kg]) when loaded with batteries, and will have a net buoyancy of 13,575 pounds (6150 kg) minimum.

CSM surface buoy towers will be outfitted with marine lanterns, passive radar reflectors and active radar transponders. The buoys will be equipped with photovoltaic panels and wind turbines to generate power. Due to the relatively high power requirements of CSM instrumentation, surface buoys may also be equipped with a methanol fuel cell to supplement solar and wind power generators. Energy is stored in Absorbed Glass Mat lead acid batteries in the buoy hull. All batteries will be recovered and properly disposed of on land – they will not be discarded at sea.

A universal joint on the bottom of the surface buoy provides the connection from the buoy to the EM cable, which, in turn, is connected to the EM stretch hose sections. The CSM is terminated at the seafloor by an anchor frame that contains an integrated anchor recovery system (detail sheet 5) and is approximately 1 m high with a footprint of 2.3 m x 3.3 m (7.59 m^2).

The Inshore and Offshore CSMs will be connected to AUV docks (detail sheets 11 and 12). The two AUV docks would be at depths of approximately 91 m (Inshore CSM) and 450 m (Offshore CSM). The dock includes power and communications connectors and a re-entry cone for the AUV to park for recharging. Each dock is approximately 3 m high with a footprint of 3.5 x 3.5 m (12.25 m^2). The dock has a wet

weight of 4,000 pounds (1,814 kg) and an air weight of 7,000 pounds (3,175 kg). Connection between the anchor frame and AUV dock is provided by a power and communications cable 0.7" – 1.2" in diameter by up to 500 m in length. The cable would lay on the surface of the seafloor. The expected cable laying method is for an ROV to connect the cable to the mooring anchor frame using a wet-mateable connector, lay the cable while transiting to the AUV dock, and then connect it to the dock using a wet-mateable connector. The cable and AUV dock will not extend beyond the 0.5 nm 'buffer zone' (voluntary, non-regulatory vessel avoidance area) of each CSM mooring site.

Coastal Profiler Mooring (CPM)

The five Pioneer CPMs (see detail sheets 6 through 8) will utilize a foam-hull surface buoy connected to a seafloor anchor with a combination of EM stretch hose and jacketed wire rope. An instrumented profiling body travels along the wire rope, and on some CPMs an Acoustic Doppler Current Profiler (ADCP) measures water currents.

The CPM surface buoy extends approximately 2.5 m above the water line and has a draft of approximately 1.6 m. The buoy has a foam flotation hull about 1.5 m in diameter. The portion of the buoy hull that protrudes above the water will be yellow. Scientific instruments and communication equipment on the tower will be white. CPM surface buoy towers will be outfitted with marine lanterns, passive radar reflectors and active radar transponders.

The EM stretch hose connects the surface buoy to subsurface flotation which maintains vertical tension in the wire-rope portion of the mooring. The subsurface flotation will be an approximately 1.6 m (64") diameter steel sphere located about 17 m below the surface and painted orange. An instrumented profiling body "crawls" along the jacketed wire rope from below the flotation sphere to about 20 m above the seafloor. The base of the CPM will be a recoverable mace anchor with approximate dimensions of 1 m in height and 1 m in diameter (0.79 m^2). The in-air weight of the mace anchor is approximately 7,017 pounds (3,183 kg).

Alkaline batteries in the buoy hull, profiling body and ADCP will provide power. All batteries will be recovered from moorings and properly disposed of on land – they will not be discarded at sea.

Coastal Surface Piercing Profiler Mooring (CSPPM)

The two Pioneer CSPPM (detail sheets 9 and 10) consists of a profiling body and a recoverable bottom frame with integral anchor. Oceanographic sensors are mounted in the profiler and on the bottom frame. The profiling body is approximately 2 m tall by 1 m wide and contains buoyancy sufficient to raise it to the surface. The profiling body will be painted by the manufacturer in a high visibility color (e.g. yellow or orange). The bottom frame is circular approximately 2.5 m in height above the seafloor with a 3.2 m diameter footprint (8.0 m^2). In air, the CSPPM bottom frame weighs approximately 2,500 pounds (1,133 kg). The bottom frame includes batteries and a power controller to re-charge batteries within the profiler. All batteries will be recovered and properly disposed of on land – they will not be discarded at sea.

The profiling body is tethered to the bottom frame. Under the control of a winch mounted on the frame, cable is unspooled, allowing the profiler to float upward in the water column. Typically, the profiler will

continue to the surface where a portion of the body will be above the water line. The profiler surfaces only periodically (e.g. 2 times per day at 12 hour intervals) to transmit data via satellite for a period typically less than 10 minutes.

4. Discharge of dredged or fill material into waters of the United States (Section 404 of the Clean Water Act)

Bottom Characterization

The United States Geological Survey Continental Margin Mapping (CONMAP) data catalog provides a source for bottom type data in the vicinity of the Pioneer Array. These data are in the form of shapefiles specifying closed contours surrounding areas with a homogenous bottom type. The data from the relevant region are displayed in Figure 1. Gravel is defined to have a grain size greater than 2 millimeters (mm), sand between 1/16 and 2 mm, silt between 1/256 and 1/16 mm, and clay smaller than 1/256 mm. If one of these classes is dominant, but others are present in significant percentages, the dominant class is listed last, after a slash; "clay-silt/sand," for example, refers to regions where sand dominates, but is mixed with smaller fractions of clay and silt. Considering the dominant class only, we find that the northern portion of the moored array is in a region dominated by silt, while the central and southern portions are in a region dominated by sand.

Based on WHOI's coordination with regional fishing groups and other marine users, buoy locations now differ between the current configuration and what was initially evaluated in the 2011 Final Site-Specific Environmental Assessment (SSEA; NSF 2011a). A Supplemental Environmental Report (SER; NSF 2013) has been prepared by the NSF to assess the potential impacts on the human and natural environment associated with proposed modifications in the design, installation, and operation and maintenance (O&M) of the OOI that were previously assessed in the SSEA. For the current configuration, the two parallel linear mooring lines originally evaluated have been shifted approximately 3.5 nm to the west, extend further north, and incorporate greater spacing between mooring sites than proposed in the SSEA (see detail sheets 1 and 2 for current configuration). The increased spacing between all mooring sites would allow greater flexibility in movement by fishing vessels and their gear within the Pioneer Array study area to minimize the potential for gear entanglement. In addition, efforts were made to site moorings near known 'hangs' that fisherman avoid. Our investigations have shown these 'hangs' are not known cultural resources, including shipwrecks and sunken military craft, which would be avoided if found. OOI's deployment plan is to avoid placing infrastructure directly on any known cultural resources.

The worst-case total area of impact from the Pioneer Array anchors and other project components is expected to be no greater than 79 m^2 (0.03 acres) of sand-clay/silt or clay-silt/sand bottom type (see Figure 1). Impact to the bottom is expected to be minimal, will not affect live hard-bottom, natural reefs or other living resources and not materially different than any other mooring currently deployed in the Atlantic Ocean. These minimal impacts resulting from the deployment of mooring anchors and project scientific equipment are summarized in Section 6. All project components, including anchors, will be fully recovered as each mooring is periodically recovered for maintenance and at the terminus of the Pioneer deployment off Massachusetts. In addition the impacts can be characterized as temporary

because each buoy footprint would be occupied for ~7 months and it is unlikely that the same exact bottom area would be reimpacted as moorings will shift slightly from deployment to deployment. These location shifts will be captured in updated Notice to Mariners (NM) notifications.

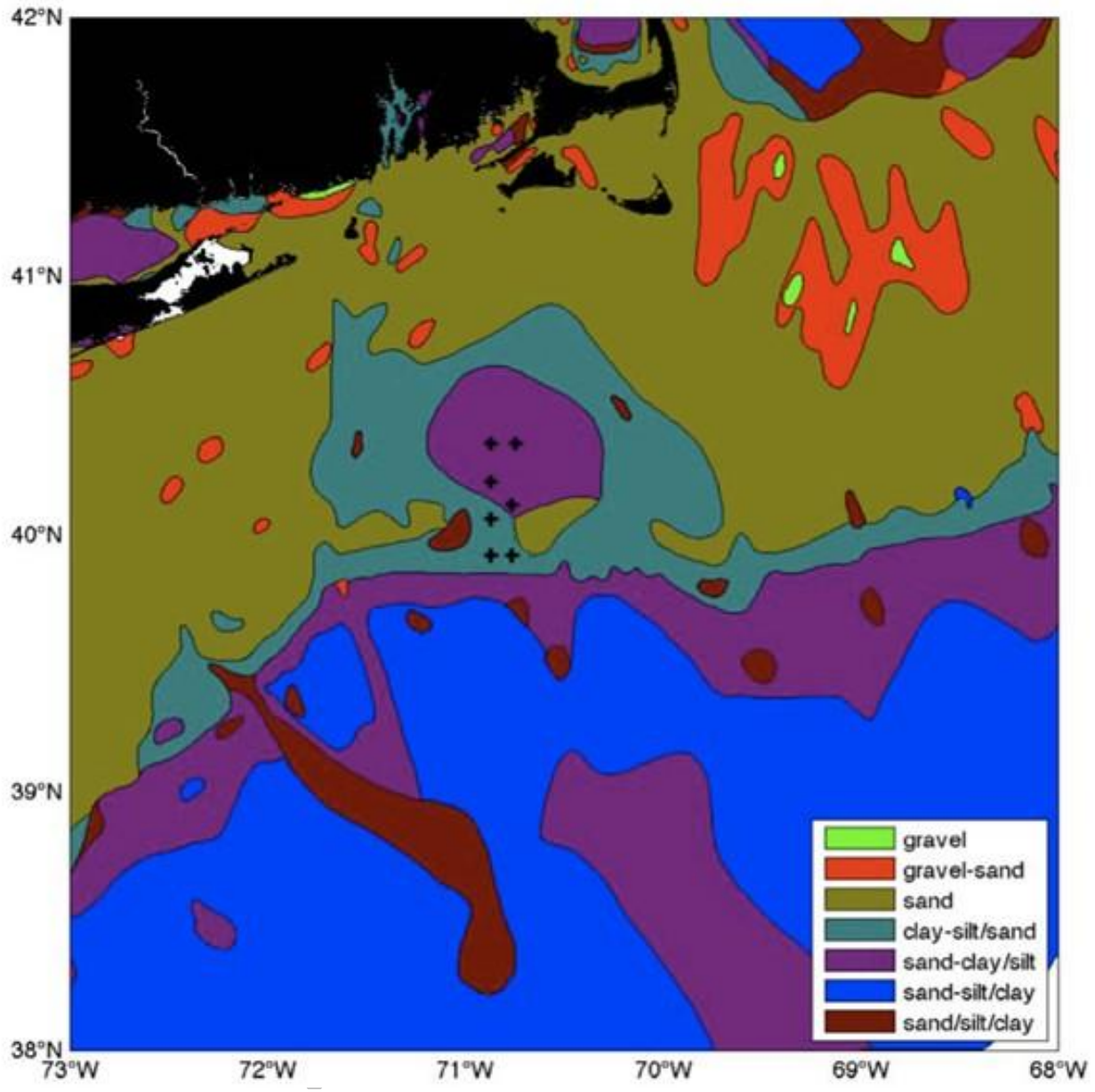


Figure 1. Distribution of sediment types in the region surrounding the Pioneer Array.
Areas in which data are unavailable are left white. Proposed mooring sites from the SSEA are marked with crosses. Current mooring locations have shifted slightly, but sediment types are not appreciably altered.

CSM

The CSMs (detail sheets 3 through 5) are terminated at the seafloor by an anchor frame approximately 1 m high, 2.3 m deep, and 3.3 m across. The anchor frame footprint is approximately 8 m^2. The total area occupied by the three CSM anchor frames is approximately 24 m^2. Two CSMs are connected to AUV docks with a base approximately 3.5 m by 3.5 m. In air, the complete AUV dock assembly weighs approximately 3200 kg. The AUV Dock footprint is approximately 12.25 m^2 (see detail sheets 11 and 12). For both AUV Docks, the total area occupied is approximately 24.5 m^2. Connection between the CSM and AUV dock is provided by a ground line approximately 0.7" – 1.2" (1.8 to 3.0 cm) in diameter. The ground line would lay on the surface of the seafloor and would not require burial or armoring. In a worst-case scenario, each AUV dock would require 500 m of ground cable. Thus, the total area covered by 2 AUV docks and associated cables could be as much as 55 m^2.

CPM

The CPM anchor will be a "mace" style, with approximate dimensions of 1 m in height and 1 m in diameter (see detail sheet 8). The in air weight of the anchor is approximately 3,183 kg. Total area of the CPM anchor footprint is approximately 0.79 m^2. The total area for the combined five CPM anchors is approximately 3.95 m^2.

CSPPM

The Pioneer CSPPM mooring bottom frame anchor is approximately 2.5 m in height with a 3.2 m diameter (see detail sheets 9 and 12). In air, the CSPPM bottom frame weighs approximately 1,100 kg. The CSPPM bottom frame footprint is approximately 8.0 m^2. The total area for the two CSPPM bottom frames is approximately 16.0 m^2.

5. Installation and Operation & Maintenance (O&M)

The first phase of Pioneer Array installation is planned to begin in 2013 with partial deployment of some moorings in the array; the remaining assets are planned for installation in 2014. One CPM will initially be deployed at the Inshore site in 2013 and will be permanently relocated to the Upstream-Inshore site in 2014, with no change in impact as a result. All Pioneer moorings and associated infrastructure will be installed and maintained from a University-National Oceanographic Laboratory System (UNOLS) vessel or vessel of opportunity using deployment and retrieval techniques common in oceanographic research. Moorings of these types are typically deployed over the side of the ship and anchors are lowered into place by winch. Estimated time to deploy a mooring with one vessel is
12 to 24 hours. Besides temporarily re-suspending sediment, the additional impact to benthic resources expected to occur during the deployment or recovery of a mooring is minimal. Any turbidity increase above background levels due to recovering and redeploying anchors and anchor frames, or dragging an anchor or anchor frame short distances, or will be temporary. There will be no jetting of anchors into the bottom – anchors will be lowered to the seafloor and picked back up via shipboard winch. Any minor ruts or indentations to the seafloor that persist following anchor recovery will fill back in as a result of natural processes that redistribute the sediment. Near-bottom turbidity may temporarily increase at the Inshore and Offshore sites as AUVs dock and undock during the anticipated weekly AUV mission cycle. The AUV docking cone will be located 1.5 m to 2 m above the seafloor. During

docking/undocking, the AUV will be travelling at speeds of less than 2 knots resulting in minimal wake that is not expected reach the seafloor. Any turbidity increase from docking/undocking will be temporary, returning to background levels as sediments settle, and localized to the AUV dock. As in the case of anchor deployment and recovery operations, any seafloor disturbance caused by AUV docking/undocking will be localized and will tend to recover between AUV missions as a result of natural processes that redistribute the sediments.

All Pioneer Array moorings will be permitted as Private Aids to Navigation (PATON) through the United States Coast Guard (USCG). Surface buoys will be marked per USCG requirements, with all required lights and markings. Locations for all moorings and associated components of the proposed Pioneer Array will be published on electronic National Oceanic and Atmospheric Administration (NOAA) charts once moorings are listed in the USCG Notice to Mariners and Local Notice to Mariners.

The Pioneer Array will be deployed for 5 to 7 years. The individual buoys, moorings, anchor frames, AUV docks, and scientific instruments will only be deployed for approximately 7 months then recovered and immediately replaced with equivalent equipment; this is referred to as a 'turn'. The recovered equipment will be returned to shore facilities at WHOI for refurbishment. Global-class vessels and coastal vessels will be used for deployment and recovery. The Global-class vessels will be for mooring service, glider recovery and redeployment, and AUV recovery and redeployment. The coastal vessel cruises will be for recovery and redeployment of AUVs, AUV docks and gliders.

Durable mechanical elements such as surface buoys, instrument frames, and acoustic releases will be refurbished ashore and are expected to last in excess of 10 years. Chain, cable and stretchable mooring hose will initially be replaced annually. However, as performance becomes fully characterized, the life cycle of these components may be extended. Wire rope and mooring hardware such as shackles and links will be replaced upon each recovery. Scientific equipment and power sources will be replaced as needed to be fully operable, or based on their expected operational lifetimes (multiple years).

Project Impacts from Installation and O&M

As stated previously, the 2011 Final SSEA has been updated with a SER (NSF 2013). The SER has been prepared by the NSF to assess the potential impacts on the human and natural environment associated with proposed modifications in the design, installation, and O&M of the OOI that were previously assessed in the 2011 Final SSEA (NSF 2011a). The SSEA was prepared by NSF to assess the potential impacts on the human and natural environment associated with proposed site-specific requirements in the design, installation, and operation of the OOI that were previously assessed in a Programmatic Environmental Assessment (PEA) (NSF 2008) and a 2009 SER (NSF 2009). The SSEA analysis concluded that installation and O&M of the proposed OOI as presented in the 2011 Final SSEA would not have a significant impact on the environment and a Finding of No Significant Impact (FONSI) was signed on January 31, 2011 (NSF 2011b). This finding remains unchanged after the 2013 SER was issued. The minimal potential impacts resulting from the installation and O&M of the Pioneer Array are summarized below.

Geological Resources

The entire Pioneer Array seafloor footprint is expected to be no greater than 109 m^2 (0.03 acres). Potential impacts to geological resources from the proposed Pioneer Array will only be from with the

placement of ten mooring recoverable anchor frames, up to 1000 m total of submarine cable, and two AUV docks, all installed on the seafloor. The placement of benthic infrastructure will result in short-term, insignificant impacts to surface sediments in the immediate vicinity of the proposed Pioneer Array assets, and there will be no significant impacts to marine geological resources.

Water Quality

Proposed installation and O&M activities of the proposed Pioneer Array will not introduce any materials or substances into the marine environment that would adversely affect marine water quality. Additionally, the project would not alter currents or circulation regimes. Turbidity due to re-suspension of sediments within a minor and localized area where the anchors, anchor frames, and cables would be placed on the bottom would likely occur, but would be temporary in nature and restricted to the hours of deployment and recovery. As discussed previously, any potential turbidity associated with AUV docking/undocking is expected to be minimal and less than turbidity caused by deployment and recovery of anchors and cables. The surface-laying procedure for the installation of the cable would result in some minor resuspension of bottom sediments. The impact of the cable settling on the seafloor is expected to displace a relatively small volume of water, which would create a local turbulence sufficient to resuspend nearby sediments. Due to the small size of the cable, it is expected that the turbulence would be minimal and temporary in nature.

Installation and removal of infrastructure and cable would not result in oil or grease or other physico-chemical changes that would impact water quality or sediment characteristics. The only hazardous substances that would be used in the proposed project are lubricants and fuel contained in marine vessels and equipment. Vessels would adhere to federal, state, and IO requirements (i.e., UNOLS Research Vessel Safety Standards 2009: http://www.unols.org/publications/manuals saf_stand/contents.htm; WHOI Health and Safety: http://ehs.whoi.edu/ehs/DesktopDefault.aspx) for the management of hazardous materials and hazardous waste. Vessels engaged in installation would adhere to all USCG (CWA §311) requirements regarding the containment, cleanup, and reporting of spills, which would assure that the effects are minimized. Therefore, no impacts to water quality with implementation of the Pioneer Array component of the proposed OOI are anticipated.

Cultural Resources

Potential impacts to cultural resources from the Pioneer Array will only be associated with the placement of ten mooring anchors, two AUV docks, and associated sensors on the seafloor. Prior to deployment of the proposed moorings and anchors, a site survey will be conducted within an approximate 1 km radius of each proposed anchor site to determine if any known or unknown cultural resources (e.g., shipwrecks) are within the vicinity. If cultural resources (including shipwrecks or sunken military craft) were found, they would be avoided when placing moorings. OOI's deployment plan is to avoid placing infrastructure directly on any known cultural resources. The best available data does not list any known cultural resources at the proposed revised Pioneer Array mooring locations (Wreck Hunter 2010; MassGIS 2012; NOAA 2012; TechnoOcean 2012). Project-specific multibeam bathymetric surveys conducted in April 2012 have not identified any significant objects or formations within the vicinity of the revised Pioneer mooring sites. Therefore, there would be no impacts to cultural resources,

including shipwrecks and sunken military craft, with implementation of the proposed Pioneer Array design modifications.

Marine Biological Resources Including Threatened and Endangered Species

The vessels and activity associated with deployment and recovery of ten surface and subsurface moorings, two AUV Docking stations, up to 1,000 m of surface-laid cable, and recoverable anchors and anchor frames on the sea floor may cause demersal and pelagic marine species to temporarily avoid the immediate vicinity of the Pioneer Array. However, such impact will not be significant due to the small scale and temporary nature of the proposed activities (estimated time to deploy a mooring with one vessel is 12 to 24 hours). Except when transiting to and from moorings, the vessel used for mooring deployment and recovery will move very slowly (1 to 2 knots) while gear is in the water and will not pose a collision threat to marine mammals. Entanglement of marine mammals is not likely because of the rigidity of the mooring cables, and marine mammals' ability to detect and avoid the mooring lines. Once deployed on the seabed, the proposed anchors, anchor frames, and AUV docks and cables will be equivalent to other hard structures on the seabed, posing very low risk of adverse effect to marine organisms.

Impacts from the placement of mooring anchors on the seafloor will include temporary mechanical disturbance of soft sediments, and temporary coverage (approximately 7 months) of relatively small areas of substrate by the anchor frames and AUV docks and cables. Based on the expected size and number of items deployed on the seafloor, an estimated 79 m^2 of essential fish habitat (EFH; see SSEA, and SER) will be affected. Over time, the natural movement of sediments by ocean currents and burrowing organisms will reestablish natural bottom topography around the items deployed on the bottom and following recovery. The minor temporary increases in turbidity and sedimentation will not affect the ability of EFH to support healthy fish populations. Therefore, the implementation of the Pioneer Array will not have an adverse effect on EFH in the area.

The active acoustic sources associated with instrumentation on the Pioneer Array will generally operate at frequencies much higher than those frequencies considered audible by fish and marine mammals (greater than 180 kilohertz (kHz), with most operating at frequencies greater than 200 kHz). For other instrumentation operating at frequencies between 2 and 1,200 kHz (e.g. ADCPs, bioacoustics profilers, altimeters, acoustic modems, and tracking pingers), fish and marine mammals will not be disturbed by any of these acoustic sources given their infrequent sampling, the brief period when an individual animal would potentially be within the very narrow beam of the source, and the relatively low source levels of pingers and acoustic modems. Therefore, deployment and operation of the Pioneer Array is not expected to result in significant acoustic impacts to fish and marine mammals, including species listed under the Endangered Species Act.

6. References

NSF. 2008. Final Programmatic Environmental Assessment for National Science Foundation-Funded Ocean Observatories Initiative (OOI). Prepared by TEC Inc., Annapolis, MD and Bainbridge Island,

WA under direction from the Consortium for Ocean Leadership, Washington, DC for NSF, Division of Ocean Sciences, Arlington, VA. June.

NSF. 2009. Supplemental Environmental Report for the Ocean Observatories Initiative. Prepared by TEC Inc., Bainbridge Island, WA under direction from the Consortium for Ocean Leadership, Washington, DC for the National Science Foundation, Division of Ocean Sciences, Arlington, VA. 30 April.

NSF. 2011a. Final Site-Specific Environmental Assessment for the Ocean Observatories Initiative. Division of Ocean Sciences, Arlington, VA. January. http://www.nsf.gov/geo/oce/envcomp/ooi/ooi-final-ssea-31jan11.pdf.

NSF. 2011b. Finding of No Significant Impact/Decision Document, Site-Specific Environmental Assessment, Ocean Observatories Initiative. 31 January. http://www.nsf.gov/geo/oce/envcomp/ooi/ooi-final-fonsi-31jan11.pdf.

NSF. 2013. Final Supplemental Environmental Report for Modifications in the Design, Infrastructure, and Installation of the Pioneer Array, Endurance Array, and Regional-Scale Nodes of the Ocean Observatories Initiative. Prepared by Cardno TEC on behalf of NSF.

Attachment 3

Project Purpose

Traditional approaches to ocean observing (e.g. ship-based expeditionary research, individual moorings and satellite imagery) continue to contribute enormously to our knowledge of the ocean system. However these approaches have spatial and temporal limitations, leaving many critical ocean phenomena unexplored. The OOI will address this gap by fielding sustained observing arrays to collect high resolution oceanographic data and deliver it freely and openly to the public in near-real time. Increased ocean coverage, the growth of technical capability, development of new and more precise predictive models, and increasing public understanding of the ocean will all be tangible measures of the OOI's contribution to transforming ocean science. In this manner, OOI will play a key role in keeping the U.S. science effort at the cutting edge of ocean knowledge.

The Pioneer Array portion of the OOI will provide the opportunity to make groundbreaking advances in our understanding of critically important coastal oceanographic processes by providing new ocean-observing capabilities capitalizing on cutting-edge technologies including:

- A multi-platform, multi-scale array of moorings and autonomous vehicles;
- Two-way communication with advanced platforms and sensors in the coastal ocean;
- Sustained measurements of physical, chemical, and biological properties for a duration of 5-7 years;
- Ability to observe episodic events that can only be captured through time-series observations;
- Power generation on surface buoys, and power delivery to instruments in the water column and near the seafloor;
- Advanced profiler moorings providing physical, chemical and biological measurements in the water column;
- Autonomous vehicles (gliders and AUVs) capable of adaptive sampling ;
- Remote AUV docks to supply power and communications via insulated surface-laid cable installed between docks and the MFNs.

The Pioneer Array portion of the OOI will provide the necessary infrastructure to advance ocean research in a variety of important areas. The broad scientific purpose of the Pioneer Array is set by four of the six overarching OOI Science Themes (OOI Science Plan, 2005; OOI Science Prospectus, 2007):

> *Ocean-Atmosphere Exchange.* Quantifying the air-sea exchange of energy and mass, especially during high winds, is critical to providing estimates of energy and gas exchange between the surface and ocean interior, and improving the predictive capability of storm forecasting and climate-change models. Conventional technology has been unable to support sustained observations under high wind conditions.

Climate Variability, Ocean Circulation, and Ecosystems. Being a reservoir and distributor of heat and carbon dioxide, the ocean modifies and is affected by climate. Understanding how climate variability affects ocean circulation, weather patterns, processes within the ocean's biochemical environment (including carbon cycling and ocean acidification), and marine ecosystems is an important driver for multidisciplinary observations.

Turbulent Mixing and Biophysical Interactions. Mixing occurs over a broad range of scales and plays a major role in transferring energy, materials, and organisms throughout the world's oceans. It has a profound influence on primary productivity, plankton community structure, biogeochemical processes in the surface and deep ocean, and the transport of material to the deep ocean. Quantifying mixing is essential to improving models of ocean circulation and ecosystem dynamics.

Coastal Ocean Dynamics and Ecosystems. Understanding the spatial and temporal complexity of the coastal ocean is a long-standing challenge. Quantifying the interactions between atmospheric and terrestrial forcing, and the coupling among physical, chemical, and biological processes, is critical to understanding the role of coastal margins in the global carbon cycle, developing strategies for coastal resource management and tracking coastal ecosystem health in a changing climate.

The specific science purpose for the Pioneer Array is improved understanding of cross-frontal exchange between the continental shelf and slope and its relation to synoptic, seasonal, and inter-annual forcing. The approach is to obtain a sustained, three-dimensional view of physical, biological and biogeochemical interactions within the shelf break frontal zone of the Middle Atlantic Bight. The overarching science question is: How do shelf/slope exchange processes structure the physics, chemistry, and biology of continental shelves? This question was further refined as part of a Shelf/Slope Processes Workshop (Pioneer Workshop, 2010) and resolved into the following focus areas:

1. Nutrient and carbon cycling over the outer continental shelf and upper continental slope;
2. Abundance, distribution, and biodiversity of phytoplankton near the shelfbreak;
3. Controls on the abundance and distribution of marine organisms at higher trophic levels;
4. Extreme events including winter storms and hurricanes.

Attachment 4

Federal, State and Local Approvals

1. Environmental Compliance Documentation - Summary of Environmental Consequences

The Final Site-specific Environmental Assessment (SSEA) for the Ocean Observatories Initiative (National Science Foundation [NSF] 2011a) was prepared to assess the potential impacts on the human and natural environment associated with proposed site-specific design, installation, and operation of the Ocean Observatories Initiative (OOI) previously assessed in a Programmatic Environmental Assessment (PEA) (NSF 2008) and a Supplemental Environmental Report (NSF 2009). The SSEA was prepared on behalf of NSF in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code [USC] 4321 et seq.), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] 1500-1508), and NSF procedures for implementing NEPA and CEQ regulations (45 CFR 640). The SSEA analysis concluded that installation and operation of the proposed Pioneer Array as presented in the Final SSEA would not have a significant impact on the environment and a Finding of No Significant Impact/Decision Document was signed on January 31, 2011 (NSF 2011b). NSF's compliance with the National Historic Preservation Act, Marine Mammal Protection Act, Endangered Species Act, and Coastal Zone Management Act has been completed.

The NSF initiated a process during the preparation of the Final SSEA and continued after issuance of the Final SSEA whereby marine stakeholders and the public, in particular the fishing community, could provide input to the site selection process, or micro-siting, for final mooring placement within the Pioneer Array study area analyzed in the SSEA. The micro-siting process was developed as a way for the marine user communities and general public to continue providing input on the specific placement of the uncabled moorings in their affected areas after the Final SSEA was completed. Stakeholder input to the micro-siting process for the Pioneer Array has occurred via public meetings, small workshops with fishing industry representatives, and/or e-mail.

The initial determination of candidate sites where the moorings could be placed was based on science and operational requirements. The extensive coordination and discussions with the marine user communities that utilize the Pioneer Array study area occurred until site-specific mooring placement was achieved that considered the regional fishing interests yet continued to meet the science and operational requirements. During public micro-siting meetings held in the New England region during 2010, it was suggested by members of the commercial fishing community that continuing the dialog regarding micro-siting and navigational safety concerns through smaller, informal meetings would better address issues and concerns associated with the installation and operation of the Pioneer Array. The Consortium for Ocean Leadership provided funding to the CFRF to facilitate a series of 4 meetings between representatives from the regional fishing community and regional OOI scientists during the fall of 2011. The meetings were summarized in a 2012 report *Pioneer Array Workshops – Exploration of Issues and Concerns Connected with the Planned OOI Pioneer Array Project* (CFRF 2012). The recommendations that resulted from these meetings informed the configuration of the Pioneer Array

that is assessed in this SER. The result is the current configuration and placement of the Pioneer Array moorings as described in Attachment 2 of this application. Discussions with the fishing community and other marine users will continue as necessary to address potential concerns during the installation and operation of the Pioneer Array.

The Supplemental Environmental Report (SER) for the Pioneer Array of the OOI (NSF 2013) has been prepared to assess the potential impacts associated with proposed modifications in the design, installation, and operation of the Pioneer Array component of the OOI that were previously assessed in the Final SSEA. Those modifications include the repositioning of mooring sites to accommodate fishing community concerns, the use of separate AUV docks with cable connection to the Inshore and Offshore surface mooring bases, and an increase in the glider mission area. All changes to mooring siting and glider mission area occurred within the area already assessed in the SSEA and PEA, and no new areas are included in the SER. The nature and extent of the proposed modifications to the Pioneer Array infrastructure, potential impacts to marine biological resources, cultural resources, air quality, water quality, geological resources, and socioeconomics (fishing) would not alter the conclusion of the 2011 SSEA. There would be no additional impacts on any resource area with implementation of the proposed Pioneer Array design modifications; the FONSI for the 2011 SSEA is still warranted (NSF 2011b).

2. Required Permits

The United States Army Corps of Engineers (USACE) dredge and fill and United States Coast Guard (USCG) permits are the only permissions required prior to the Pioneer Array deployment. The Consortium for Ocean Leadership (COL) will submit a USCG Private Aids to Navigation (PATON) application for the Pioneer moorings after receiving USACE Category 2 approval for infrastructure under the Massachusetts General Permit.

COL, on behalf of NSF, proposes a voluntary 0.5 nm buffer zone or navigational area of avoidance around each Pioneer Array mooring site. If avoided by fishermen and boaters, buffer zones may reduce the risk of commercial and recreational fishing gear entanglement and damage to the OOI moorings from boat collisions. COL will work with the USCG to develop guidance (to appear in Notice to Mariners [NM], Local Notice to Mariners [LNM], or National Oceanic and Atmospheric Administration [NOAA] chart annotations) regarding the suggested buffer zones (voluntary, non-regulatory avoidance areas) for the Pioneer array. The NM and LNM details will be provided to NOAA so that the Pioneer Array mooring locations can be updated on the NOAA electronic charts.

3. References

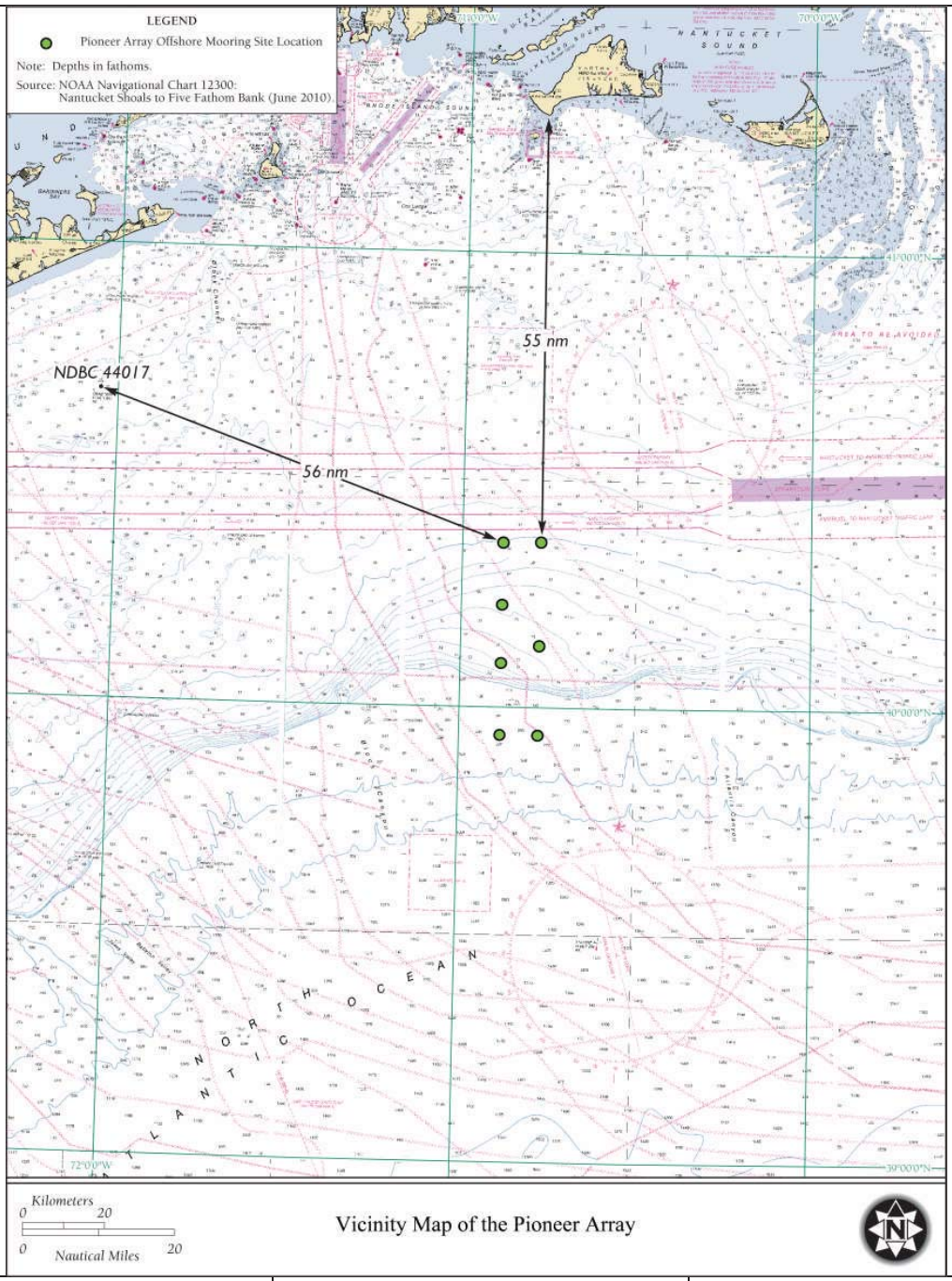
NSF. 2011a. Final Site-Specific Environmental Assessment for the Ocean Observatories Initiative. Division of Ocean Sciences, Arlington, VA. January. http://www.nsf.gov/geo/oce/envcomp/ooi/ooi-final-ssea-31jan11.pdf.

NSF. 2011b. Finding of No Significant Impact/Decision Document, Site-Specific Environmental Assessment, Ocean Observatories Initiative. 31 January. http://www.nsf.gov/geo/oce/envcomp/ooi/ooi-final-fonsi-31jan11.pdf.

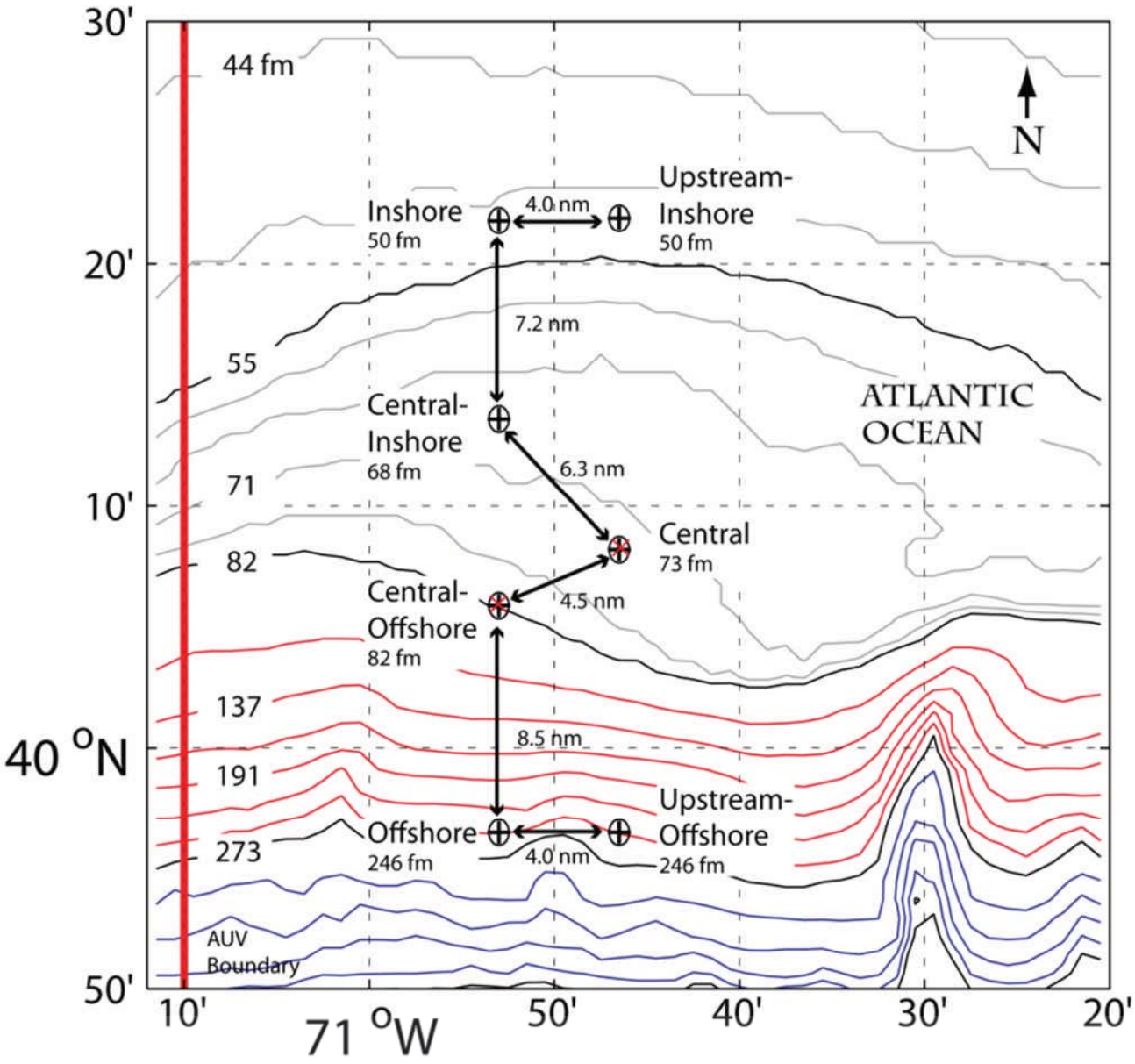
NSF. 2013. Final Supplemental Environmental Report for Modifications in the Design, Infrastructure, and Installation of the Pioneer Array, Endurance Array, and Regional-Scale Nodes of the Ocean Observatories Initiative. Prepared by Cardno TEC on behalf of NSF.

PIONEER ARRAY

Project Plan Detail Sheets



Purpose: Install Pioneer Array Moorings Inshore 40°21.8'N 70°53.0'W Central Inshore 40°13.6'N 70°53.0'W Central 40°08.2'N 70°46.5'W Central-Offshore 40°05.9'N 70°53.0'W Offshore 39°56.4'N 70°53.0'W Upstream Inshore 40°21.9'N 70°46.5'W Upstream Offshore 39°56.4'N 70°46.5'W Tetra Tech EC, Inc. 160 Federal Street, 3rd Floor Boston, MA 02110	**VICINITY MAP** APPLICATION BY: Consortium for Ocean Leadership – OOI 1201 New York Ave NW, Suite 400 Washington DC, 20005	Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard Date: OCT 2012 SHEET 1 of 12



Purpose: Install Pioneer Array Moorings

Inshore	40°21.8'N	70°53.0'W
Central Inshore	40°13.6'N	70°53.0'W
Central	40°08.2'N	70°46.5'W
Central-Offshore	40°05.9'N	70°53.0'W
Offshore	39°56.4'N	70°53.0'W
Upstream Inshore	40°21.9'N	70°46.5'W
Upstream Offshore	39°56.4'N	70°46.5'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

PLAN VIEW

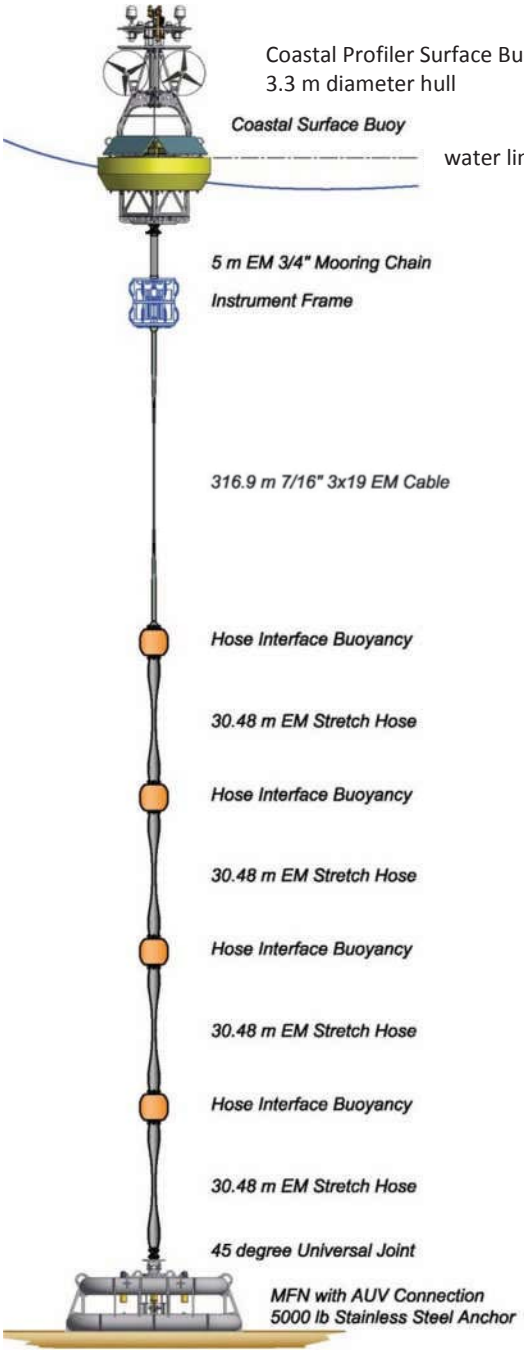
APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 2 of 12

Ocean Observatories Initiative
Pioneer CSM – Coastal Surface Mooring Detail
(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)



Purpose: Install Pioneer Array Moorings

Inshore	40°21.8'N	70°53.0'W
Central	40°08.2'N	70°46.5'W
Offshore	39°56.4'N	70°53.0'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CROSS SECTION OF COASTAL SURFACE MOORING

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

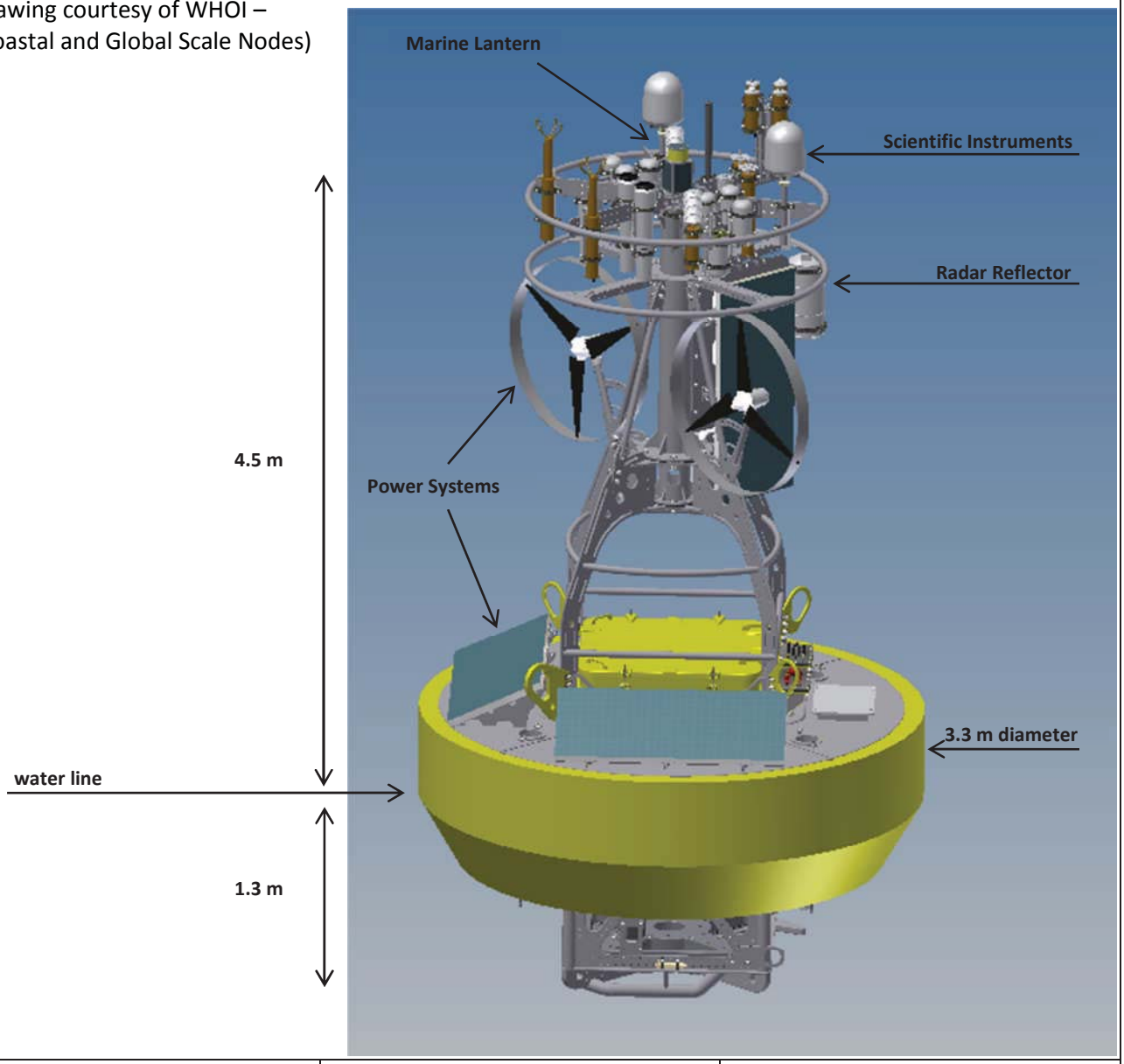
Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 3 of 12

Ocean Observatories Initiative
Pioneer CSM – Coastal Surface Mooring Buoy Detail

(All drawing courtesy of WHOI – OOI Coastal and Global Scale Nodes)



Purpose: Install Pioneer Array Moorings

Inshore	40°21.8'N	70°53.0'W
Central	40°08.2'N	70°46.5'W
Offshore	39°56.4'N	70°53.0'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CSM BUOY DETAIL

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

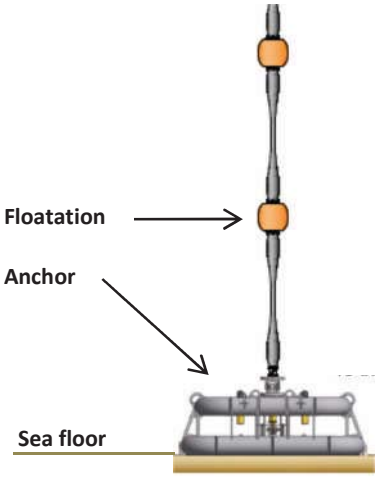
In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 4 of 12

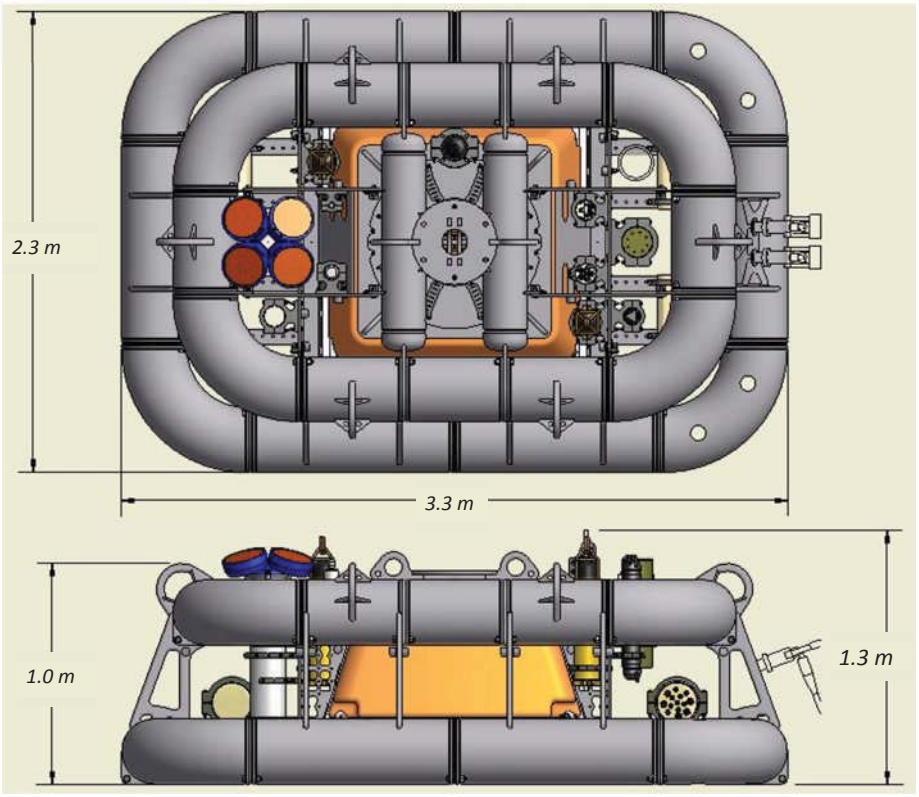
Ocean Observatories Initiative
Pioneer CSM – Coastal Surface Mooring Anchor Frame
Multi-function Node (MFN) Detail

(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)

Frame:1150 kg (2500 lbs)
Configured: 4200kg (9250lbs)

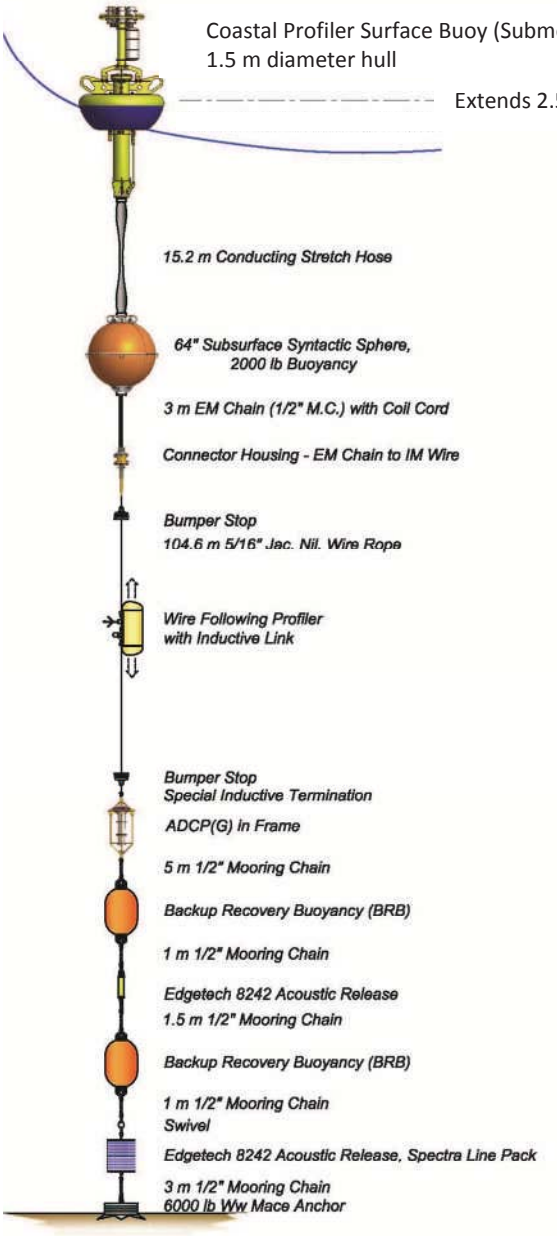


Top View – Side View



Purpose: Install Pioneer Array Moorings Inshore 40°21.8'N 70°53.0'W Central 40°08.2'N 70°46.5'W Offshore 39°56.4'N 70°53.0'W Tetra Tech EC, Inc. 160 Federal Street, 3rd Floor Boston, MA 02110	**CSM ANCHOR DETAIL** APPLICATION BY: Consortium for Ocean Leadership – OOI 1201 New York Ave NW, Suite 400 Washington DC, 20005	Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard Date: OCT 2012 SHEET 5 of 12

Ocean Observatories Initiative
Pioneer CPM – Coastal Profiler Mooring Detail
(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)



Purpose: Install Pioneer Array Moorings

Central Inshore	40°13.6'N	70°53.0'W
Central-Offshore	40°05.9'N	70°53.0'W
Offshore	39°56.4'N	70°53.0'W
Upstream Inshore	40°21.9'N	70°46.5'W
Upstream Offshore	39°56.4'N	70°46.5'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CROSS SECTION OF COASTAL PROFILER MOORING

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

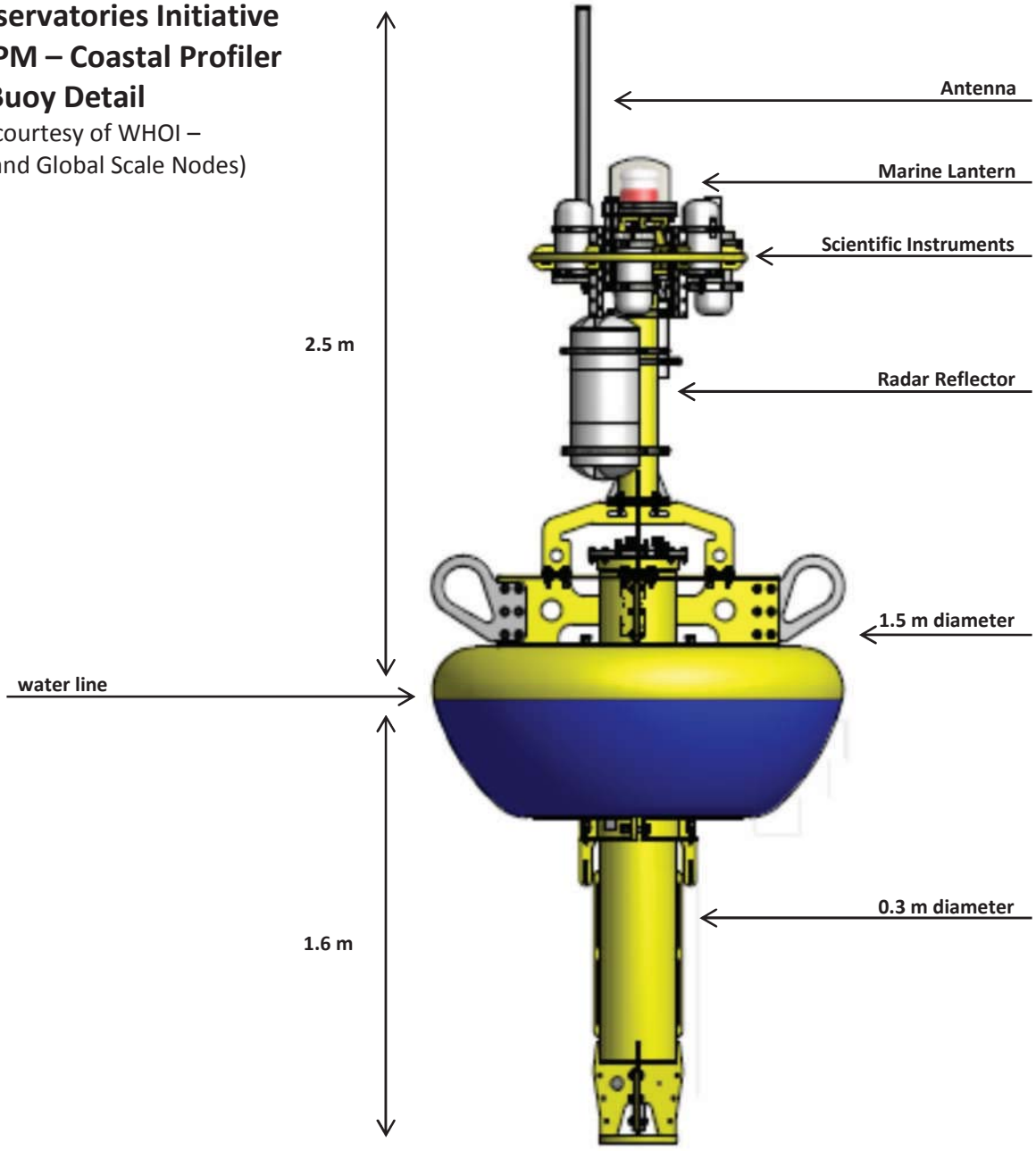
Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 6 of 12

Ocean Observatories Initiative Pioneer CPM – Coastal Profiler Mooring Buoy Detail

(All drawing courtesy of WHOI – OOI Coastal and Global Scale Nodes)



Purpose: Install Pioneer Array Moorings

Central Inshore	40°13.6'N	70°53.0'W
Central-Offshore	40°05.9'N	70°53.0'W
Offshore	39°56.4'N	70°53.0'W
Upstream Inshore	40°21.9'N	70°46.5'W
Upstream Offshore	39°56.4'N	70°46.5'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CPM BUOY DETAIL

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

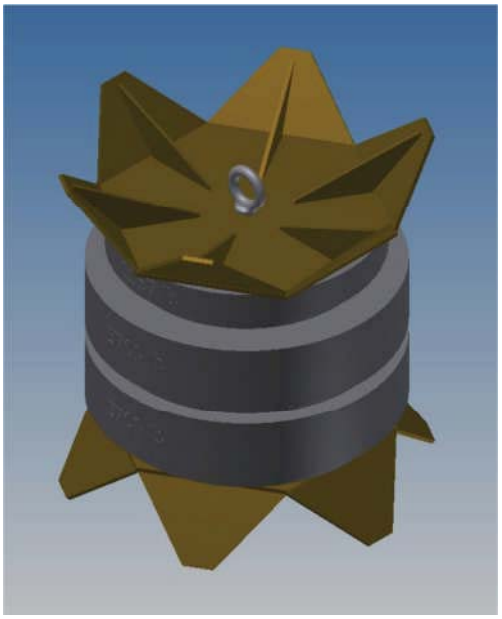
Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 7 of 12

Ocean Observatories Initiative
Pioneer CPM – Coastal Profiler
Mooring Anchor Detail

(All drawing courtesy of WHOI –
OOI Coastal and Global Scale No

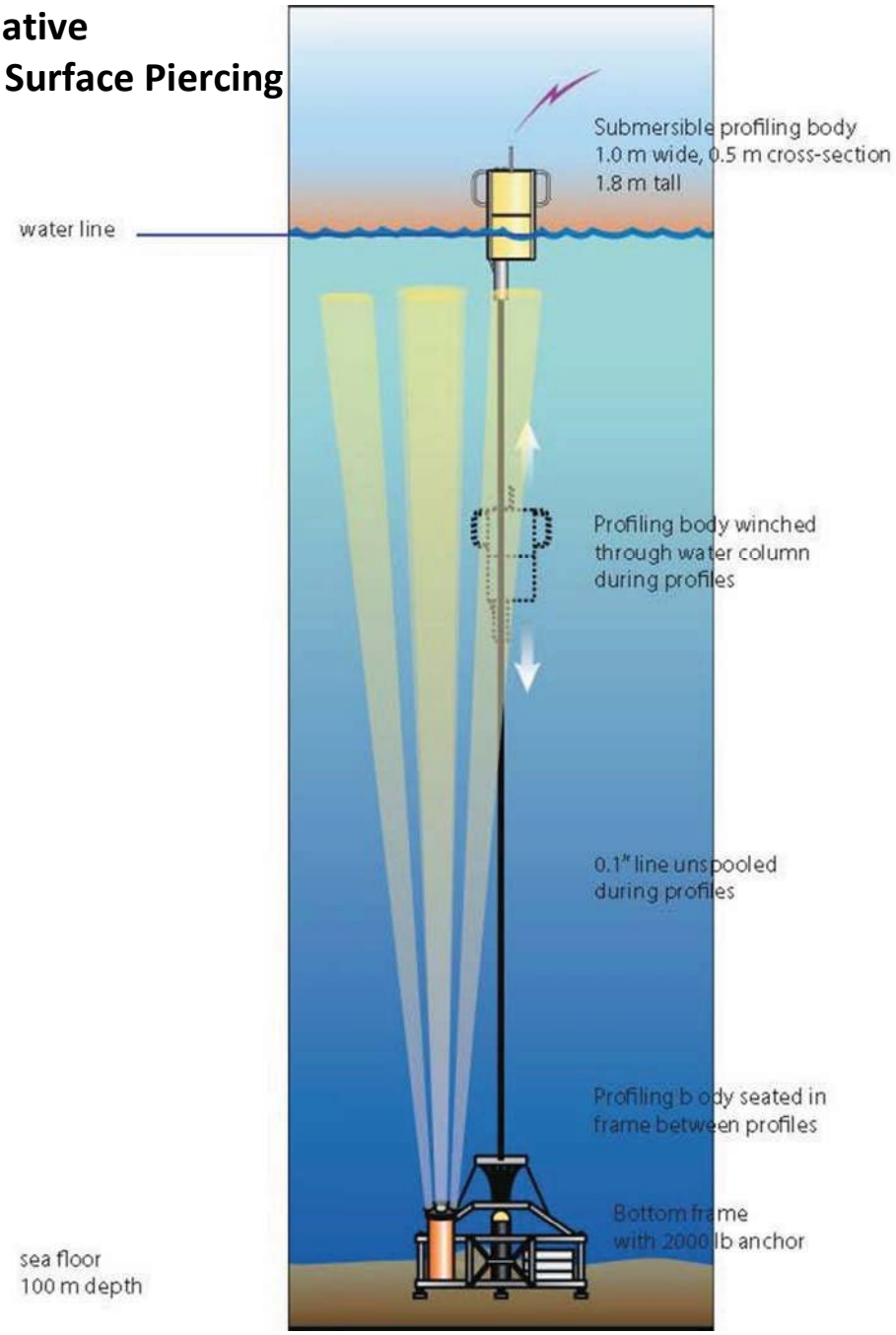


Purpose: Install Pioneer Array Moorings Central Inshore 40°13.6'N 70°53.0'W Central-Offshore 40°05.9'N 70°53.0'W Offshore 39°56.4'N 70°53.0'W Upstream Inshore 40°21.9'N 70°46.5'W Upstream Offshore 39°56.4'N 70°46.5'W Tetra Tech EC, Inc. 160 Federal Street, 3rd Floor Boston, MA 02110	**CPM Anchor DETAIL** APPLICATION BY: Consortium for Ocean Leadership – OOI 1201 New York Ave NW, Suite 400 Washington DC, 20005	Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard Date: OCT 2012 SHEET 8 of 12

Ocean Observatories Initiative
Pioneer CSPPM – Coastal Surface Piercing Profiler Mooring

(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)

Preliminary Design



Purpose: Install Pioneer Array Moorings

Inshore	40°21.8'N	70°53.0'W
Central	40°08.2'N	70°46.5'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CROSS SECTION OF COASTAL SURFACE PIERCING PROFILER

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

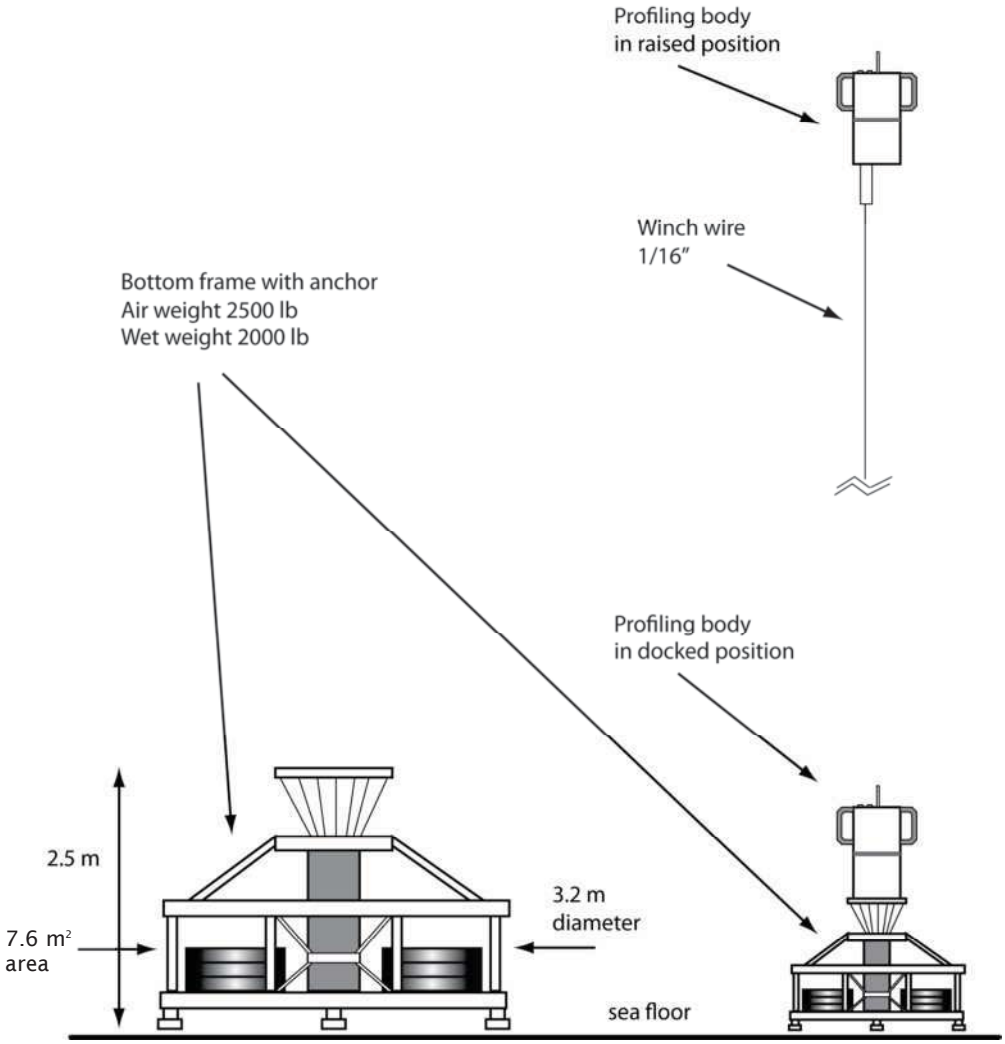
Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 9 of 12

Ocean Observatories Initiative
Pioneer CSPPM – Coastal Surface Piercing Profiler Mooring Detail
(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)

Preliminary Design

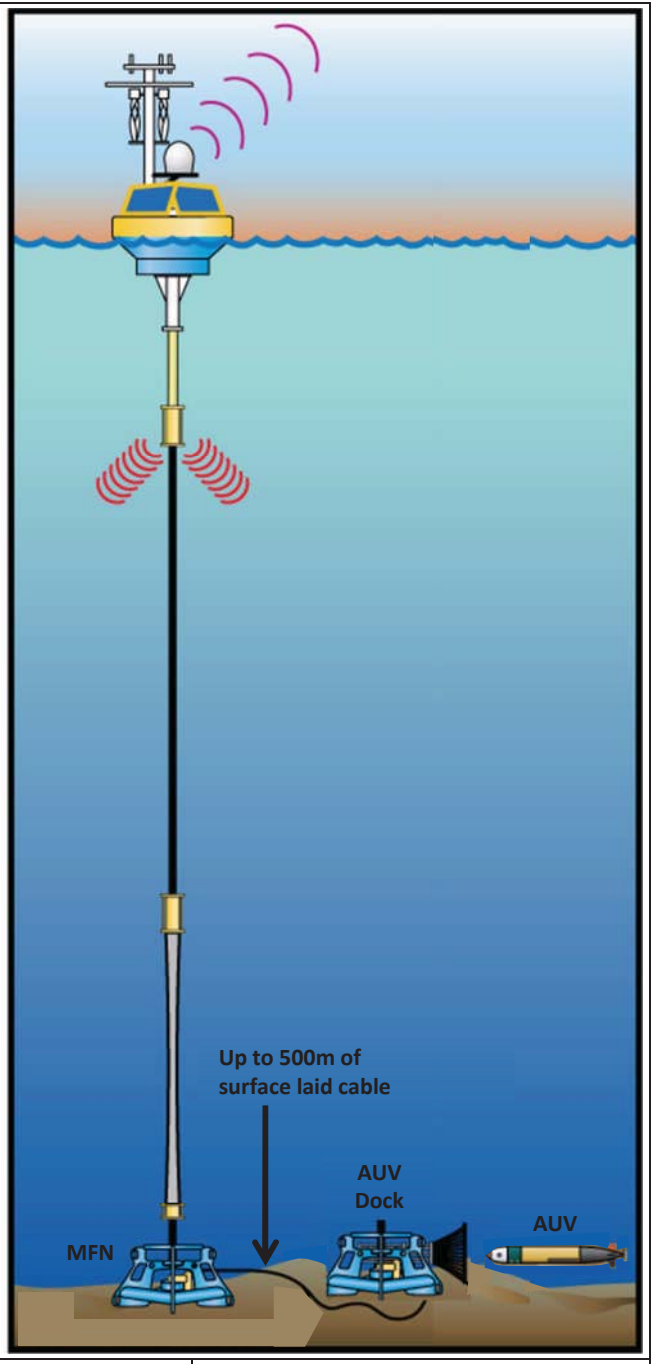


Purpose: Install Pioneer Array Moorings Inshore 40°21.8'N 70°53.0'W Central 40°08.2'N 70°46.5'W Tetra Tech EC, Inc. 160 Federal Street, 3rd Floor Boston, MA 02110	**CSPPM PROFILER DETAIL** APPLICATION BY: Consortium for Ocean Leadership – OOI 1201 New York Ave NW, Suite 400 Washington DC, 20005	Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard Date: OCT 2012 SHEET 10 of 12

Ocean Observatories Initiative
Autonomous Underwater Vehicle (AUV) Dock Detail

(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)

Schematic diagram of the Pioneer Array CSM mooring with cabled autonomous underwater vehicle (AUV) dock (not to scale). The AUV dock sits on the seafloor, separate from the Multi-function Node (MFN), and electrically connected to the MFN by a surface laid marine cable of 0.7-1.2 inch diameter and up to 500 meters (m) length.



Purpose: Install Pioneer Array Moorings

Inshore	40°21.8'N	70°53.0'W
Offshore	39°56.4'N	70°53.0'W

Tetra Tech EC, Inc.
160 Federal Street, 3rd Floor
Boston, MA 02110

CROSS SECTION OF AUV DOCK

APPLICATION BY:
Consortium for Ocean Leadership – OOI
1201 New York Ave NW, Suite 400
Washington DC, 20005

Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs

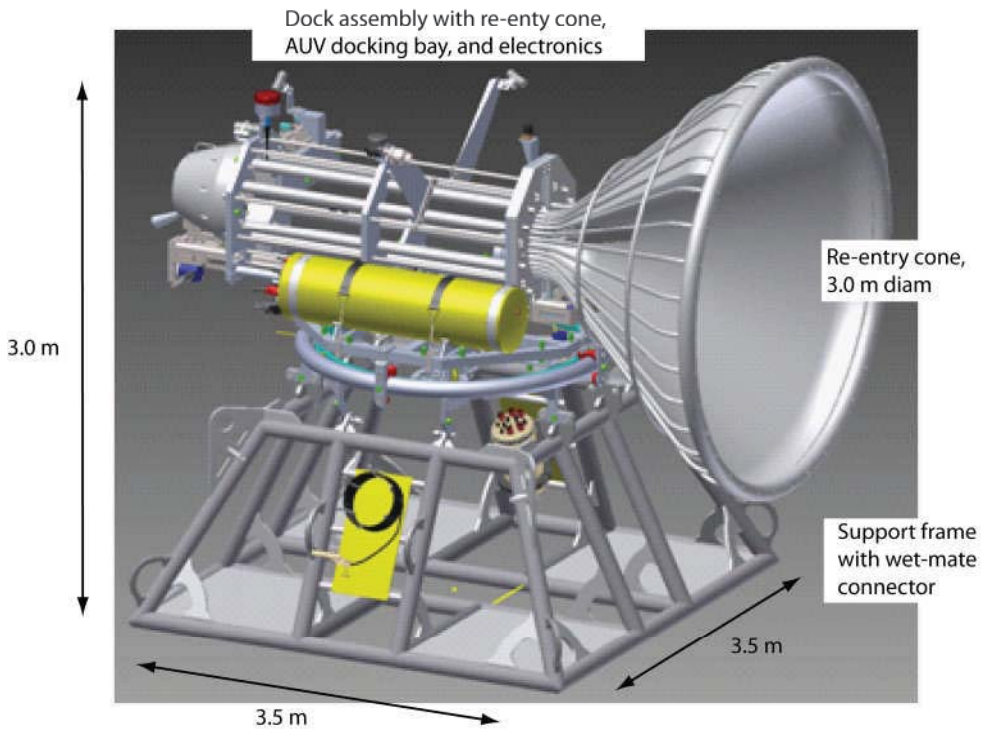
In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard

Date: OCT 2012 SHEET 11 of 12

Ocean Observatories Initiative
Autonomous Underwater Vehicle (AUV) Dock Detail

(All drawing courtesy of WHOI –
OOI Coastal and Global Scale Nodes)

Preliminary design



NOTES:

Wet weight (air weight) of AUV dock and frame assembly: 4000 lb (7000 lb)

Frame will rest on the sea floor adjacent to a CSM, water depths will range from 100 to 500 m

Not shown: Ground line, 0.7" - 1.2" diameter fluid -filled hose with multiple conductors, composite construction with inner elastomeric tube, braided synthetic radial reinforcement layers, and outer elastomeric cover, up to 500 m length, connecting dock to base of CSM

Purpose: Install Pioneer Array Moorings Inshore 40°21.8'N 70°53.0'W Offshore 39°56.4'N 70°53.0'W Tetra Tech EC, Inc. 160 Federal Street, 3rd Floor Boston, MA 02110	**AUV DOCK DETAIL** APPLICATION BY: Consortium for Ocean Leadership – OOI 1201 New York Ave NW, Suite 400 Washington DC, 20005	Proposed: 3 CSMs, 5 CPMs with wire-following profilers, and 2 CSPPMs In: Northwest Atlantic Ocean approximately 55 nm south of Martha's Vineyard Date: OCT 2012 SHEET 12 of 12