Appendix D

Water Quality Monitoring Plan

ADMIRALTY INLET PILOT TIDAL PROJECT
FERC PROJECT NO. 12690

WATER QUALITY MONITORING PLAN

(submitted with the Final Application for a New Pilot Project License)

Submitted by:

Public Utility District No. 1 of Snohomish County

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1.0 INTRODUCTION

Public Utility District No. 1 of Snohomish County (the District) proposes to deploy two utility-scale turbines in Admiralty Inlet, Puget Sound, Washington. The project will involve the deployment, operation, monitoring, and evaluation of two 6-meter diameter Open-Center turbines developed and manufactured by OpenHydro Group Ltd. The project is expected to generate 680 kilowatts (kW) of electrical energy during periods of peak tidal currents, with an average energy output of approximately 27.5 kW.[1] The project will generate a modest amount of energy; however the primary purpose of the project is to gather data to better inform the viability of commercial tidal energy generation from the technical, economic, social, and environmental standpoints. This data is critical to the responsible advancement of commercial scale tidal energy in the United States.

The turbines will be located in Admiralty Inlet, sited approximately 1 kilometer west of Whidbey Island in Puget Sound, Washington. The water depth at this location is approximately 58 meters deep. Two electrical transmission cables connecting the turbines to shore will be installed underground using horizontal directional drilling (HDD) from a point onshore to an exit point at approximately 19-meter water depth. The cables will be laid on the seabed from the HDD exit point approximately 1700 meters to the turbine connection point.

Terrestrial activity for the project, including HDD and electrical connections, will take place on private property to the east of the Coupeville-Port Townsend Ferry terminal. Some terrestrial activities are anticipated to take place near a designated shoreline area of Puget Sound. Additional information regarding installation of the turbines and cables is presented in section 3 below and in Exhibit E of the District's Final License Application to the Federal Energy Regulatory Commission.

The purpose of this Water Quality Monitoring Plan is to support the District's applications for aquatic resource permits and authorizations, including a 401 Water Quality Certification from the Washington Department of Ecology (Ecology). The table on the following page outlines all in-water activities associated with the project and proposed monitoring for each. Details are presented in the sections that follow.

[1] Expected generation figures are based on the most recent data available to the District and are the output of a model intended to predict turbine performance within Admiralty Inlet. However, electrical generation from tidal energy conversion devices is highly site-specific and may be influenced by even small changes in the final location of the turbines. Further, performance will be influenced by other factors as well, including actual efficiency of the devices, specific currents encountered, and the effect of turbulence. Therefore, the figures herein are estimates only and may change based on updated data, precise turbine location following deployment, actual performance, and other factors.

In-Water Activity	WQ Monitoring Proposed?	Turbidity /Sediment	CTDO	Oil/Sheen (visual monitoring)
Long-Term Anchors	No	No	No	Yes – for vessels and construction equipment
HDD and On-Shore	Yes	Yes	No	
Subsea Cable	Yes	No	No	
Turbine Deployment	Yes	No	No	
Turbine Operation	Yes	No	Yes	
Turbine Maintenance	No	No	No	
Turbine Removal	Yes	No	No	
Cable Removal	To be determined based on cable condition at completion of project			

2.0 Potential Project Effects on Water Quality

2.1 Increase in Turbidity During HDD Activities and Turbine Deployment

Section 3 below describes HDD and turbine deployment procedures. There is potential for increased turbidity during HDD activities due to a "frac-out," where drilling mud or fluid escapes into the environment as a result of a spill, tunnel collapse, or rupture to the surface. The Horizontal Directional Drilling Plan (described further in section 3.1) contains procedures and practices to minimize potential for a frac-out to occur. In addition, HDD activities will be carefully monitored and the response plan in the Horizontal Directional Drilling Plan will be implemented if a frac-out is detected.

During turbine deployment, no increase in turbidity is anticipated when the turbine foundation makes contact with the sea floor. Surveys of the project area by remotely operated vehicle (ROV) indicate a rocky cobbled sea bed nearly devoid of sediment. This is not unexpected, as the high current in the area limits or prevents the accumulation of sediment on the sea floor.

2.2 Spills During Installation, Operation, and Maintenance

During the construction and maintenance of the project, a number of vessels, including tugs, a deployment barge, and other workboats will be employed. These vessels contain fuel, hydraulic fluid, and other potentially hazardous materials. The OpenHydro deployment barge contains a 300-liter diesel tank and a 350-liter hydraulic oil tank. To prevent exposure of these fluids to the environment, the deployment barge includes a secondary containment unit with a 1033-liter capacity. All marine construction and maintenance contractors will be required to maintain a spill response plan.

2.3 Leaking Equipment

The turbines contain no oils or lubricants that could potentially contaminate the environment. Rather, the turbines rely on seawater where lubrication is needed. As a result, there is no risk of fluid leakage from the turbines. Electrical components associated with the turbine generators, including transformers and surge protectors, will either be "potted" units containing no fluid, or will be located on land to avoid risk of leaks to surface water. No oil-filled electrical equipment will be located underwater.

The only other ancillary component of the project installed in the water is equipment associated with the project's monitoring requirements. The monitoring equipment does not require oils or lubricants, thus there is also no risk of fluid leakage from ancillary components of the project.

2.4 Leaching From Anti-Foul Paint

Biofouling is not considered to be an operational issue for the OpenHydro unit based on previous deployment experience. A double layer of antifouling paint will be applied to the turbine blades and the rotor outer ring only, representing a total surface area of approximately 95 m^2 per turbine. Anti-fouling paint will be applied to the above components prior to deployment of the turbines, well in advance of the turbine entering the marine environment. No anti-fouling paint will be applied to turbine foundations. All coatings and paints will be fully approved for use in the marine environment.

3.0 IN-WATER AND NEAR-WATER ACTIVITIES

3.1 Long-Term Anchor Installation

Two long-term anchors with acoustic releases are proposed to aid in deployment and retrieval of monitoring equipment and conducting ROV surveys. The anchors will either be embedment type or concrete blocks depending on further analysis of the sea floor substrate. The anchors will be lowered to the sea floor prior to the turbine and cable installation. The anchors will be designed to stay in place for the duration of the pilot project. The District anticipates removing the anchors at the conclusion of the project. Vessels will be required to install the anchors, and thus visual monitoring for oil/sheen from the vessels will be conducted No effects to water quality are anticipated for this work, therefore no other water quality monitoring is proposed.

3.2 Horizontal Directional Drilling and On-Shore Activities

On-shore activities consist of the installation of a termination vault, a control building, an underground back-haul cable from the termination vault to the control building, and approximately 70 meters of overhead back-haul cable (primarily utilizing existing pole locations) from the control building to the interconnection point with the PSE grid.

Installation of the two electrical transmission cables from the turbines to the termination vault includes a subsea portion and a transition from subsea to terrestrial. The subsea portion is discussed in section 3.2. The transition from the subsea portion of the cables to the terrestrial termination vault will begin at approximately 19 meters of water depth, where the cables will enter an underground conduit that will exit at the termination vault. The conduit will be installed

using HDD procedures. Details regarding the HDD procedures are fully described in the Horizontal Directional Drilling Plan prepared by Sound & Sea Technology, dated January 31, 2011, and summarized in the following paragraphs. Best management practices (BMPs) in accordance with Washington Department of Ecology's Stormwater Management Manual will be implemented to minimize adverse environmental effects from HDD and on-shore activities.

A typical HDD entry site layout measures 37 m by 23 m (120 feet by 75 feet) and also includes an excavated sump pit approximately 1.8 m x 1.8 m x 1.2 m near the entry point. The sump pit allows recovery of the drilling mud coming from the borehole. The mud is picked up by a sump pump and transferred to the solids control unit where the drilled solids are mechanically settled out, allowing the mud to be re-circulated down the hole and used again. Once the trunk cable conduit is placed, the HDD equipment will be removed and only the cable pull and trenching equipment will remain to complete the HDD operations. Demobilization of the HDD operations consists not only of disassembling and removal from the site of all HDD equipment and materials but also site restoration including the following:

- Restoration of site to original grade;
- Replanting and/or new planting of vegetation as needed;
- Repair of any site structures as needed; and
- Removal of any project generated debris.

The total time to deploy, drill, decommission, and restore the grounds typically takes approximately 30 days. The District does not anticipate any significant geologic effects to the terrestrial environment. The Project will introduce only minor and temporary disturbances to soils from installation of the termination vault and power control building, trenching the two back haul segments of cable, and HDD process. The District will restore the site to pre-installation conditions, ensuring no long term effects.

The drilling fluid is composed of naturally occurring bentonite clay and water. The clay is insoluble and made up of small particles that function as a lubricant for the drill head and pipe, a transport for the cuttings being removed from the hole, and as a sealant that fills the annulus space surrounding the drill hole. The drilling mud pressure and volume are monitored during drilling operations to assure there are no leakages due to fractures in the structure of the material being drilled through. If a fracture is present it is possible for drilling mud to escape onto the surface or into the water, commonly known as a "frac-out." While no fractures are expected in this glacially deposited substructure the driller is always monitoring for a frac-out. By monitoring the pressure and volume, such fractures can be identified as they occur and steps can be taken to eliminate the problem. The driller can stop or slow down the operations to give the mud a chance to seal the frac-out. If that is impractical or doesn't work an alternative route can be taken.

As the drill stem approaches the exit point on the ocean floor, the drilling conditions will be carefully monitored. These conditions determine the time or distance from the exit when a shift from the bentonite drilling fluid to fresh water drilling is achieved. By flushing the drill string with fresh water, the drilling mud is circulated out of the system and a mud free exit is achieved. It must be reiterated that drilling conditions, not a pre-determined distance will be the factor as to what point the change to water will occur. As a rule of thumb, 100 feet is the average distance at

which a change to fresh water happens. The driller and surveyor will know when the bottom hole assembly exits the sea floor, not by a loss in pressure, but by watching the console inside the drill cab. When the bottom hole assembly is no longer supported by the soil, the angle of inclination will fall off dramatically thus signaling the bore exit. The marine support crew will be dispatched to dive on the exit and verify the exit point. Once the exit has been verified by the divers, the on-site inspector will be given the true offshore exit coordinate to approve.

Additional drilling details are presented in the Horizontal Directional Drilling Plan.

3.3 Subsea Cable

The two turbines will be connected from their deployment location on the seafloor to the termination vault by one subsea cable per turbine (two total cables). These subsea cables will be laid on the seafloor and will span the approximately 1700 meter distance between the conduit and the turbines. The subsea cables will not be trenched or attached to the seafloor, thus the process to install these cables will not require ground-disturbing activities. However, cable laying vessels will be required to install the cable, and thus visual monitoring for oil/sheen from the cable installation vessels will be conducted. If any fluids are observed leaking from vessels or their equipment, work will be stopped and appropriate cleanup measures will be implemented. Water quality effects from installation of the cables are not anticipated, therefore no other monitoring is proposed.

3.4 Turbine Deployment

The following vessels will be required to deploy the OpenHydro turbines:

- Installation barge;
- Tug with 50 metric tons or greater rated bollard pull; and
- Personnel transfer/safety boat.

Turbines will be deployed using a specialized barge designed specifically for the OpenHydro turbines. This can only be done during weaker currents. Each turbine will be lowered to the sea floor using cables attached to the barge. Turbine foundations will be held in place using gravity only; no pilings are required. Proposed monitoring during turbine deployment includes visual monitoring for leaking oil or other engine fluids from deployment vessels. The turbine uses no lubricating oils or fluids. Water quality effects from turbine deployment are not anticipated, therefore no other monitoring is proposed.

3.5 Turbine Operation

During turbine operation, water quality parameters, including conductivity, temperature, and dissolved oxygen, will be continually monitored using instrumentation mounted to the turbine as part of the environmental monitoring package. No other water quality monitoring is proposed during regular operation of the turbine.

3.6 Turbine Maintenance

Periodic maintenance may be performed based on recommendations by the turbine manufacturer, OpenHydro. During maintenance, the entire turbine and foundation would be removed and brought to the surface using the same process as during deployment. No water quality monitoring is proposed during maintenance aside from visual monitoring for oil/sheen from marine vessels. If any fluids are observed leaking from vessels or equipment, work will be stopped and appropriate cleanup measures will be implemented. The turbines are lubricated by water and contain no lubricating oils or grease.

3.7 Turbine Removal

The procedures and methods for turbine removal at the end of the license term are the same as deployment but in reverse order. Monitoring will include turbidity and visual monitoring for leaking fluids from vessels.

3.8 Cable Abandonment or Removal

Transmission cables will be assessed by ROV during operation and at the completion of the project. At or near the conclusion of the project the District will consult with Ecology and other agencies to determine whether cables should be left in place and abandoned to avoid further sea floor disturbance from removal or whether they should be removed. The District will consult with Ecology and other agencies to develop an appropriate abandonment or removal plan and the District will implement that plan.

4.0 Water Quality Monitoring Methods and Background

4.1 Monitoring Methods, Number of Samples, Equipment, and Frequency

A conductivity, temperature, and dissolved oxygen monitor will be included as part of the environmental monitoring instrumentation package mounted on the turbine foundation.

4.2 Turbidity/Sediment

If a frac-out or other release of grout material occurs, HDD work will stop and turbidity samples will be collected using a turbidity meter. HDD work will not resume unless and until turbidity is less than or equal to 5 NTU over background turbidity when background turbidity is 50 NTU or less, or when there is more than a 10 percent increase over background turbidity when background turbidity is more than 50 NTU. If the turbidity samples show that either of these benchmarks is exceeded the following steps shall be taken:

1. Ensure all BMPs specified in the SWPPP are installed and functioning as intended.
2. Assess whether additional BMPs should be implemented and make revisions to the SWPPP as necessary.
3. Sample the sampling location daily until the analysis results are less than 25 NTU (turbidity) or 32 cm (transparency).

If the turbidity samples show that turbidity is over 250 NTU at any time, the following steps shall be conducted:

1. Notify Ecology by phone within 24 hours of analysis.
2. Continue daily sampling until the turbidity is less than 25 NTU.
3. Initiate additional treatment BMPs such as off-site treatment, infiltration, filtration and chemical treatment within 24 hours of the first 250 NTU exceedance.
4. Implement additional treatment BMPs as soon as possible, but within 7 days of the first 250 NTU exceedance.
5. Describe inspection results and remedial actions that are taken in the site log book and in monitoring reports.

4.3 pH Monitoring

If a frac-out or other release of grout material occurs, pH monitoring will be conducted using a pH meter.

4.4 Oil and Sheen

Visual monitoring for oil and sheen will be employed. During vessel operations, including barge deployment and operation and maintenance activities, visual monitoring for a potential release of oil or other fluids will be conducted. If any oil or sheen is observed, work will stop and appropriate measures will be taken to contain and clean up the release in accordance with each vessel's spill response plan.

5.0 REPORTING

5.1 Frequency/Format

A monitoring report will be submitted to Department of Ecology in accordance with requirements set forth in the 401 Water Quality Certification.

5.2 Detection of Exceedances

Any results exceeding water quality standards will be promptly reported to Department of Ecology in accordance with permit requirements.