INNOVATION™

Nova Innovation Ltd

Construction Method Statement

Shetland Tidal Array, Bluemull Sound

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1 Introduction

This Construction Method Statement has been drafted in accordance with the Shetland Island Council Works License (2013/001/WL) and Scottish Government Marine License (04859/15/0). The purpose of the Method Statement is to describe the methods and techniques that will be employed to install, operate and decommission the array of Nova M100 tidal turbines in the Bluemull Sound near Cullivoe in Shetland. The Vessel Management Plan is included in Section 3.

1.1 Project overview

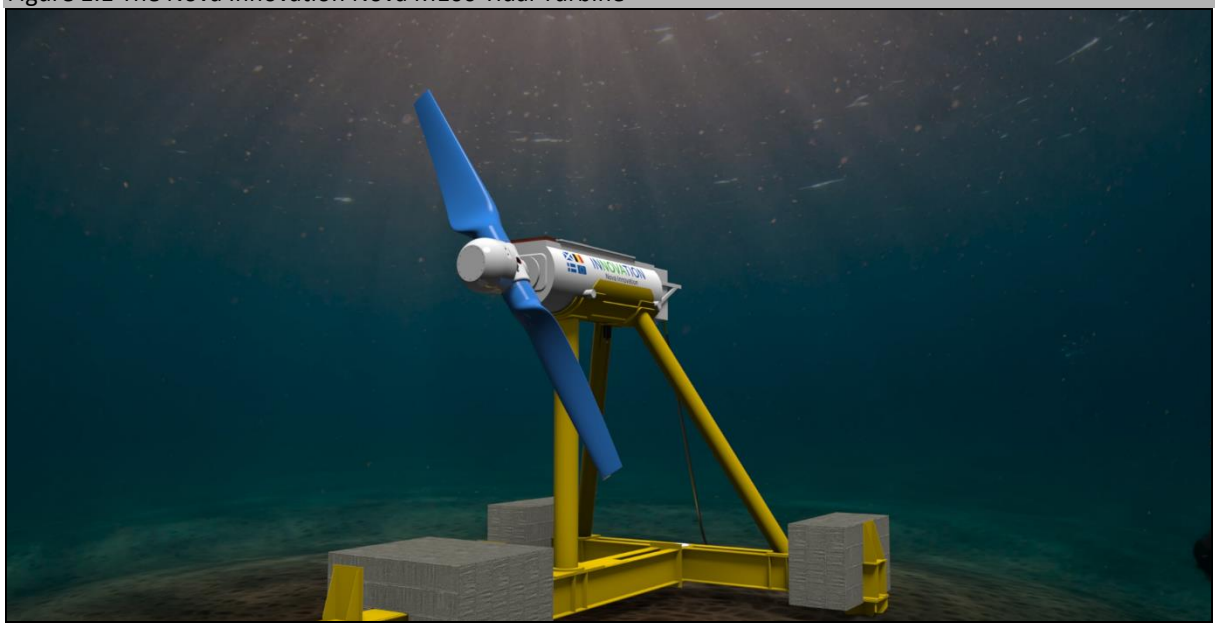
The tidal array will consist of five 100 kW tidal turbines, each of which will export electricity to the shore via a dedicated sub-sea cable. A representative image of the Nova Innovation 100 kW (Nova M100) device is shown in Figure 1.1

Each tidal turbine comprises a cylindrical nacelle unit, rotor and gravity base to secure it to the sea bed (no seabed drilling or additional site works are required). The negatively buoyant nacelle is securely connected to the base by means of a latching system.

The five Nova M100 devices are bottom mounted, gravity anchored, non-yawing, horizontal axis tidal turbines.

Each tidal turbine comprises a cylindrical nacelle unit, rotor and gravity base to secure it to the sea bed (no seabed drilling or additional site works are required). The negatively buoyant nacelle is securely connected to the base by means of a latching system.

Figure 1.1 The Nova Innovation Nova M100 Tidal Turbine



Source: Nova Innovation 2014

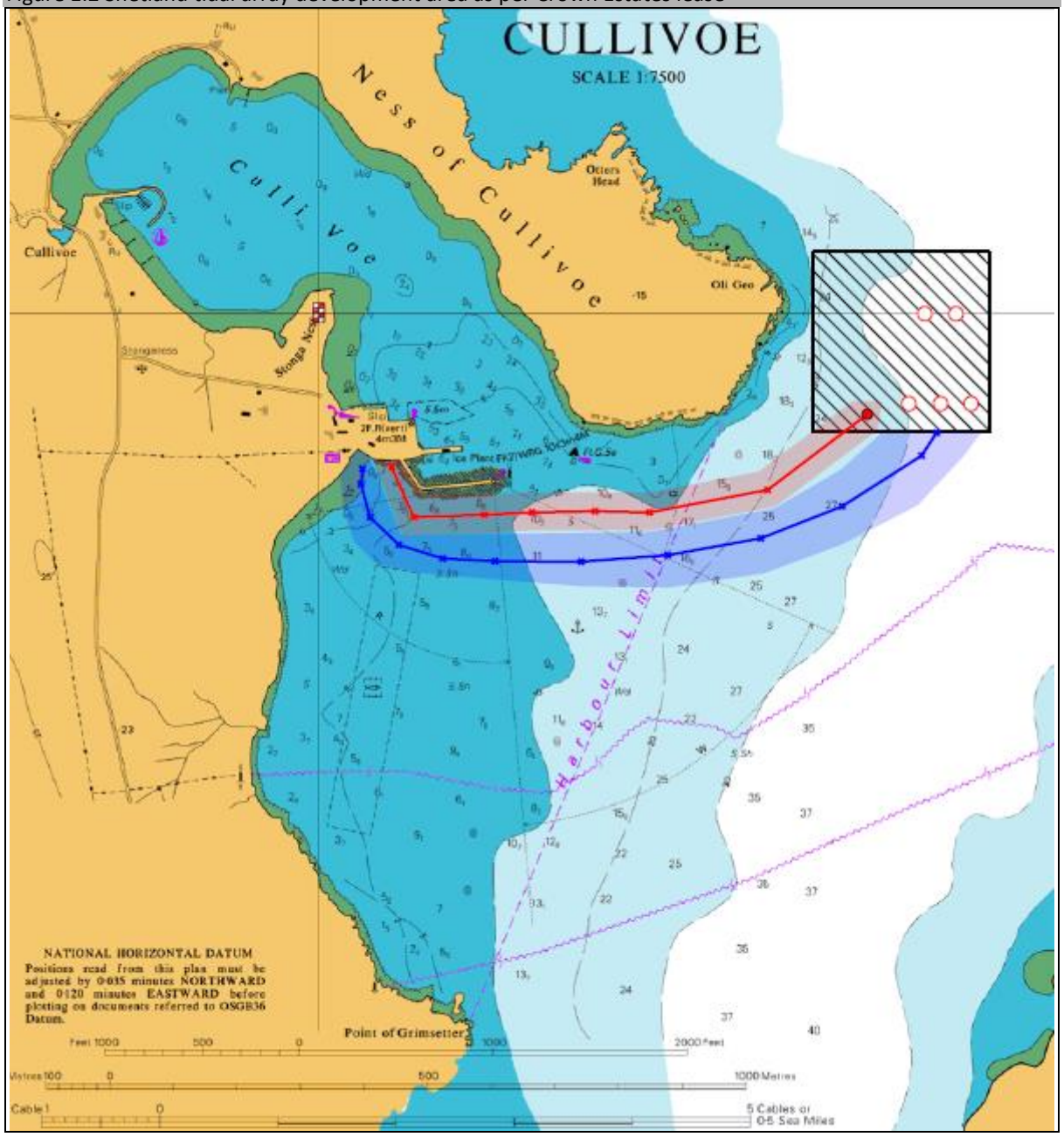
The turbine has a rotor diameter of 10 m, and a hub height of 9 m, making the total height 14 m from the bottom of feet to the tip of the blades. In the Bluemull Array the devices will be installed in water depths greater than 30 m, so clearance will be more than 15 m below mean tide. The footprint of the device is 13.5 x 12.2 m, and the weight in water is 80 tonnes.

The device will operate in a maximum sustained tidal speed of 2.6 m/s and is fixed to the seabed at a location that ensures that during operation all parts of the turbine are at least 15 m below lowest astronomical tide to allow ample draft clearance for shipping.

Site location

The Bluemull Sound is situated between the Shetland Islands of Yell and Unst. The site for the array is east of the Ness of Cullivoe. The turbines will be located in water of 30-40m depth and will each have a dedicated sub-sea cable back to land at the Cullivoe pier. Figure 1.2shows the proposed location of the tidal array.

Figure 1.2 Shetland tidal array development area as per Crown Estates lease



Source: Nova Innovation 2014

- The cross-hatched rectangle shows the requested lease area.
- The existing Nova 30 demonstrator turbine located on the site is marked with a red dot. The red line shows the path of the cable from this turbine to shore; the red shaded area is the Crown Estate lease area for this cable.
- The location of the five proposed array turbines are marked with open circles. The exact location of each turbine will be communicated to UKHO following deployment to be marked on hydrographic charts. The five array cables will follow the track of the blue line to shore, and will lie within the blue shaded area.

Site marking / buoys

Given the depth of the turbine and the advice of marine navigation stakeholders to keep the area clear of potential hazards, the site will not be marked with any buoys or markers during normal operation. Temporary marker buoys required during vessel operations will be deployed in compliance with COLREGS and removed on completion of deployment.

Operation

Each marine turbine comprises a cylindrical nacelle unit, rotor and a supporting frame attached via gravity to the seabed. The turbine blades are bidirectional and operate in both directions of tidal flow; the nacelle does not yaw. The turbine blades rotate in the tidal stream and power a generator that is housed within the nacelle. The electricity produced by the generator is exported to the grid by a subsea cable from the array to the shore. Each turbine will have its own cable, which will converge on-site and follow the same route to shore.

1.2 Project timescale

Site surveys were conducted in 2014. Device and cable deployment will be staggered: the first device was deployed in Q1 2016 and the final device is scheduled for installation in 2017. The planned construction schedule is shown in Figure 1.3 below.

Figure 1.3 Shetland tidal array fabrication and deployment schedule

Device	Operation	Sep 15		Feb 16		Feb 16		15 May 16		H2 16		TBC 2016	TBC 2016		TBC 2017	TBC 2017
T1	Deploy base															
T1	Deploy cable															
T1	Deploy nacelle															
T1	Remove nacelle															
T1	Redeploy nacelle															
T2	Deploy base, cable & nacelle															
T3	Deploy base, cable & nacelle															
T4	Deploy base, cable & nacelle															
T5	Deploy base, cable & nacelle															

Source: Nova Innovation 2016

Should the devices prove environmentally suitable and reliable it is envisaged that the array will operate beyond the three year period covered by the initial SIC Works License. The devices have been designed for an operational lifetime of 20 years, during which period they will undergo regular maintenance. The devices and cables are scheduled to be decommissioned in 2035.

1.3 Health, Safety and the Environment

The work will be conducted in compliance with Nova Innovation's HSE policy. All staff and personnel involved in the project will be fully briefed and trained and will exercise good health and safety and environmental work practices. This document should be read in conjunction with the project Environmental Monitoring and Mitigation Plan (EMMP).

Pollution prevention measures

There are no hazardous substances contained in the turbines. All exposed steel surfaces are painted with standard marine-grade paint. There will only be less than twenty litres of lubricant used in each device, which will be contained within a sealed unit (the gearbox) within the watertight nacelle.

Measures to avoid the introduction of marine non-native species (NNS)

None of the array equipment to be deployed in Bluemull Sound has been deployed subsea previously. Temporary moorings (e.g. chains) will either be sourced from Shetland or will be pressure washed or air dried prior to deployment in the Bluemull Sound. Attempts will be made to use locally based boats for offshore operations where it is practical to do so. Additional measures to avoid introduction of NNS during the project lifetime are outlined in the EMMP, following recommendations in *A Biosecurity Plan for the Shetland Islands* (NAFC 2015).

2 Construction method statement

This chapter covers the offshore operations associated with the Shetland Tidal Array – surveying, installation, maintenance and decommissioning – including the nature of the mooring and the type of vessels to be used. All operations will be managed locally by Nova Innovation personnel who will be resident in Shetland for the duration of the operations.

2.1 Vessels to be used

The scale of the tidal devices allows small, readily available multicat workboats to be utilised for all installation, maintenance and recovery operations. An example of a suitable vessel is shown in Figure 2.1: the Voe Earl will be used for deployment of the first three turbines in the array.

Figure 2.1 Representative turbine deployment and retrieval vessel (Voe Earl)

Source: Delta Marine

These vessels have previously proven more than capable of operating in the conditions commonly experienced in and around the Bluemull Sound, particularly during the successful deployment of our Nova 30 demonstrator tidal turbine. They have sufficient margin of additional operational safety capacity to be able to comfortably deal with the size and weight of equipment for this project. Any additional surveying operations will be conducted using a smaller, local vessel.

2.2 Post-deployment site surveys

A survey of the deployed turbine and cable route will be conducted using acoustic survey equipment deployed from a suitable vessel. Geolocation will be provided by the vessel GPS. The survey will confirm the position of the deployed device and cable, which will be communicated to UKHO to be marked on hydrographic charts.

2.3 Tidal device installation

Each tidal turbine will be individually deployed in the following stages:

1) A mobile land-based crane is used to transfer the steel base from its storage location on Belmont Pier to the Multicat deployment vessel. Forward concrete ballast is placed on the feet of the base.

2) The base is carried from Belmont Pier to Cullivoe Harbour, where the vessel crane is used to add concrete ballast to the aft feet of the base.

3) The base is carried by the Multicat from Cullivoe to the installation location, whence it is lowered to the correct position on the seabed. Guide chains connected to the base are attached to a temporary 'works' marker buoy.

4) The reeled cable is carried by the Multicat from Cullivoe Pier to the installation location. The cable is laid from the Multicat as a single length from the turbine location to the pier at Cullivoe. The cable end is connected to the temporary marker buoy. The cable is not fixed to the seabed, but lies on top of the sea bed with concrete mattresses and cast-iron clam shell protection utilised for stability and protection as required.

5) The Multicat returns to Cullivoe Pier and collects the turbine nacelle, which is brought to the installation location. The temporary marker buoy is recovered and guide chains and cable attached to the nacelle. Controlled by the guide chains, the nacelle is lowered from the vessel to the base to which it is mated by use of a secure latching system.

Timing and management of installation
All offshore operations will be conducted during slack tide at a time of optimum wave and weather conditions. The installation will be managed by Nova Innovation and Delta Marine staff who will be resident in Shetland for the project. Following successful commissioning, monitoring of the devices will be undertaken remotely via a fibre optic cable. This will allow the devices to be monitored either from the shore or remotely via a secure internet connection.

Environmental management and monitoring
Each device will be monitored manually and automatically for a period following deployment. If no harm is observed to the environment then the device will continue to be monitored automatically during its operating lifetime. Details of the monitoring plan are set out in the EMMP.

Post deployment site surveys
The location of the cable and device will be confirmed by a post-deployment survey and communicated to UKHO. The survey will be repeated 1 month and 2 months following initial deployment, to confirm whether the cable remains stable. If any cable motion is observed then concrete mattresses or other suitable protection methods will be deployed in problem areas to increase the stability of the cable.

2.4 Normal operation, monitoring and control

The rotor rotates in the tidal stream and drives a generator that is housed within the nacelle. The electricity produced by the generator is exported to the grid by the subsea cable to the shore. All electrical power conditioning and control is based onshore at the grid connection point on Cullivoe pier.

Communication to the machines is via a fibre optic cable embedded in the power cable, which can be accessed by a secure ISDN/broadband communications link, allowing each individual turbine to be accessed remotely over the internet. It is therefore possible to control and monitor the turbines locally and remotely.

Environmental management and monitoring
In the event that environmental harm is observed the offending device will be shut down. This can be done remotely from Nova Innovation's offices in Edinburgh or manually on-site. Details of the shutdown protocol are set out in the EMMP.

2.5 Device maintenance

Each turbine nacelle will be periodically removed from its base and taken back to Cullivoe Pier for servicing on land, following which it will be returned to its base. The stages involved in this process are set out below:

1) **Retrieval**: A release mechanism is activated by a sonar signal from a service vessel. This releases the nacelle from the base from where it is lifted to the surface, secured to the vessel and removed to Cullivoe Pier for servicing. Guide chains connected to the base are attached to a temporary marker buoy.

1) **Redeployment**: On completion of servicing, the nacelle is returned to the site; guide chains are recovered from the temporary marker buoy; and the device is lowered onto the base.

2.6 Contingency Plans for Loss of Device

In the highly unlikely event that any of the devices should become detached from their mooring, an alarm is immediately sent to the operator on duty who will co-ordinate retrieval operations. The device is negatively buoyant, so will remain on the seabed in the event of failure. The level of lubricants is minimal and all lubricants are housed within sealed units inside a watertight nacelle – i.e. are doubly contained.

2.7 Decommissioning

Removal of the devices at any time is relatively straightforward due to their relatively small scale. Means for the removal from site of the major sub-components are listed below:

1) **Turbine nacelle** removal follows the maintenance procedure described above. The nacelle will be dismantled onshore for re-use or recycling.

2) **Turbine base** is recovered by a grapple or similar and lifted from the sea bed to the surface by a service vessel. The base is secured to the vessel and taken to shore, where it can be re-used or dismantled for recycling.

3) The **cable** is retrieved by drawing on to a spool on a work boat, reversing the deployment process. Any protection associated with the cable (e.g. concrete mattresses) is recovered at the same time.

4) **Switchgear and control** is housed in a stand-alone, ingress-protected binnacle and will be placed on the pier at Cullivoe; it can easily be removed from the same.

Once the devices and associated structures are removed, the seabed and surrounding locality will return to their natural state with no permanent impact from the devices.

3 Vessel Management Plan

The vessels to be used for offshore operations will be determined in advance of the operation depending on availability. The size and operational capability of vessels will be as follows:

1) Surveying: small local vessel.

2) Deployment and retrieval: Multicat vessel (see Figure 2.1)

The harbour master, Shetland Ports and Harbours and Shetland CGOC will be advised in advance of all operations. All work will be undertaken in compliance with the direction of the harbour master.

All vessels involved in the installation, maintenance and decommissioning of the device will comply with all aspects of the International Regulations for Preventing Collisions at Sea (COLREGS)[1]. All vessels used will carry all equipment as required under the vessels' registration, e.g. the Code of practice for the safety of small workboats and pilot boats[2].

Notices to Mariners will be used to inform stakeholders of offshore operations. During all offshore operations we will adhere to the good practice guidelines associated with the Scottish Marine Wildlife Watching Code.

[1] Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS) (as amended)

[2] https://www.gov.uk/government/publications/small-craft-codes