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SUBSEA HUB MARINE LICENCE | SUPPORTING INFORMATION

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1 BACKGROUND

On 16th September 2013 MSLOT granted consent for construction and operation of the MeyGen tidal energy project with a generation capacity of up to 86MW under Section 36 of the Electricity Act 1989, subject to conditions. A specific condition limited the initial stage of the development to installation of a maximum of six turbines, which was subsequently increased to eight turbines on 30th June 2017.

Four of the eight permitted turbines have been installed, three Andritz Hydro Hammerfest (AHH) turbines and one Atlantis turbine, the AR1500. These turbines entered into their operations phase in March 2018. Each turbine is connected to the shore by a dedicated subsea cable. At the coast, each cable passes through a bore hole drilled under the shoreline cliffs and into the onshore control centre. The remaining four permitted turbines are consented in the same configuration, with a single export cable per turbine.

2 RATIONALE

To continue the wider development of the array, a step change in cost reduction from tidal power must be achieved. MeyGen has identified a new system architecture which would enable multiple turbines to be connected offshore via a subsea hub with a single export cable connecting the hub to the onshore substation. The new system architecture would have a dramatic impact on reducing the infrastructure and subsequently the cost and environmental impact for future tidal arrays. The requirement for each turbine to have a dedicated subsea cable and its associated drilled borehole will be eliminated.

It is proposed that a single subsea hub is deployed between the AR1500 turbine and its existing export cable in advance of any new turbines being installed. The existing dry mate connector on the AR1500 export cable will be connected to the subsea hub and a new jumper cable will connect the hub back to the lower connection management system (CMS) on the AR1500. The lower CMS on the AR1500 currently connects directly to the export cable.

The installation of the subsea hub will enable two of the remaining four turbines deployed within the initial stage of development to be connected to the subsea hub and power exported to shore through the existing export cable, removing the requirement for any directional drilling and new export cables when these new turbines are installed.

It is essential that the new system architecture is proven in a small-scale array, to demonstrate that connecting multiple turbines offshore through a subsea hub and single export cable is technically and economically feasible, before the new system architecture can be implemented in large scale arrays.

3 SUBSEA HUB DESCRIPTION

The subsea hub, shown in Figure 1, will consist of a gravity-based skid supporting:

- a junction box;
- a dry mate connector receptacle to connect to the existing termination on the AR1500 export cable;
- four sets of wet mate connector receptacles to connect jumper cables to each individual turbine - one for the existing AR1500, two for new turbine connections to be made at a later date and one redundant connector; and
- a smaller wet mate connector receptacle to connect a cable to an instrumentation sled.

The hub will be a painted steel tubular structure with three feet approximating an equilateral triangle that rest on the seabed. The feet will be pointed so that they can slightly penetrate the seabed surface. The spatial envelope of the hub is shown in Figure 1. Its mass is approximately 30te.

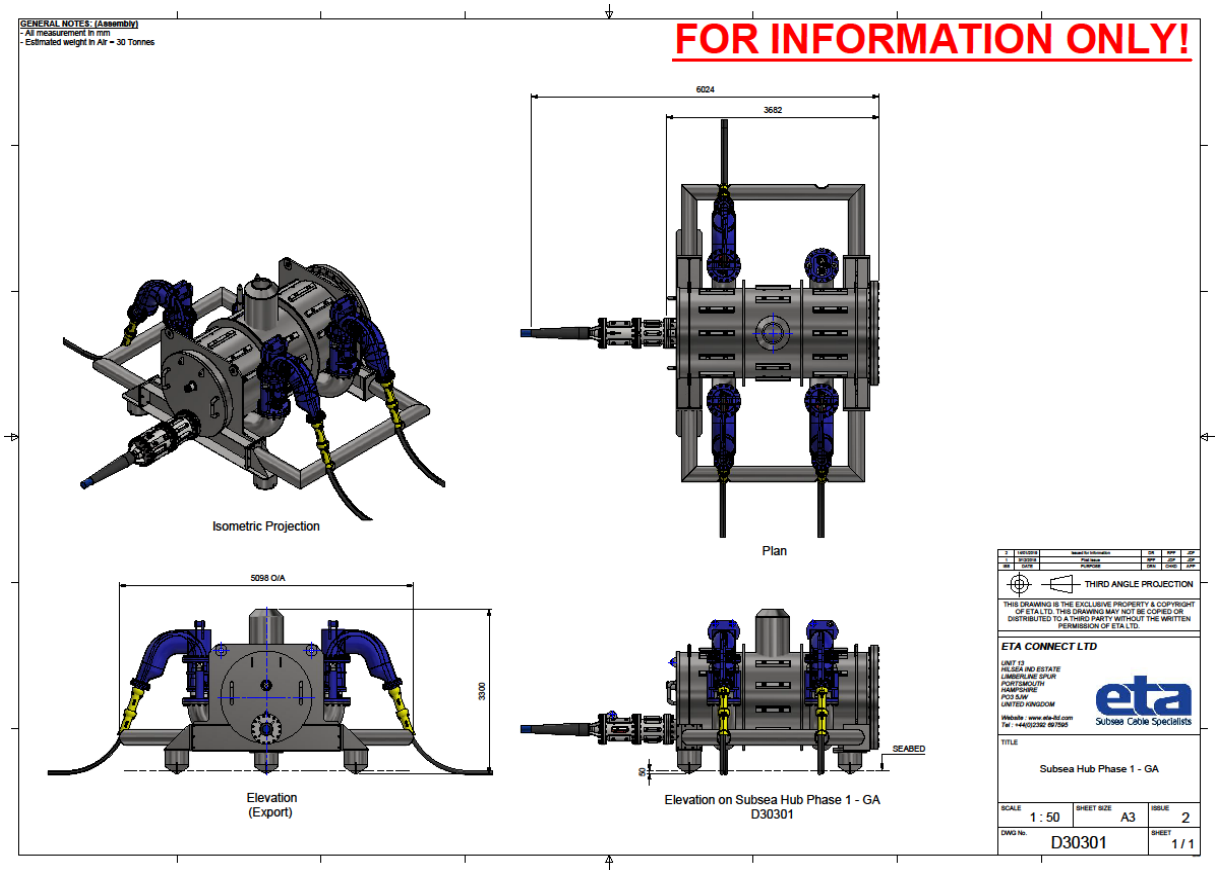

Figure 1 Indicative general arrangement drawing of the subsea hub

Each jumper cable wet mate connector system contains Tronic and Seimens connectors which contain a small amount of oil that is not expected to be resealed during their connection and disconnection. The safety data sheets for these are provided in Appendix 1 and the total volume of oil in the subsea hub is specified in Section 8 of the application form.

A new turbine jumper cable approximately 300m in length will be installed between the subsea hub and the AR1500. It will comprise a wet mate connector plug at one end to connect to the subsea hub and a dry mate connector plug at the other end to connect to the existing lower CMS on the AR1500.

It is intended that the subsea hub and cabling will stay in place for the life of the tidal array project and it will have no parts that require maintenance. However, if there is a fault, the dry and wet mate connection arrangement means that that the subsea hub and/or the cables can be retrieved if necessary. At the end of its life the hub will be recovered and disposed of on shore.

4 INSTALLATION METHOD STATEMENT

The installation method statement for the subsea hub and new AR1500 jumper cable is described below.

The works are located in the North Caithness Cliffs Special Protected Area (SPA). Mitigation for marine species during installation is detailed in the MeyGen Project Environmental Management Plan provided in Appendix 2 (RHK-1A-40-HSE-F-002-EMPConstructionWorks).

There are no known archaeological features in the vicinity of the installation, however details of the reporting protocol for archaeological finds during installation and operation is detailed in the MeyGen Project Environmental Management Plan provided in Appendix 2 (RHK-1A-40-HSE-F-002-EMPConstructionWorks).

Risks to safety of vessels and other sea users during installation and recovery works will be managed under the MeyGen Project Navigation Safety Plan provided in Appendix 2 (MEY-1A-40-HSE-005-F-NSPConstructionWorks).

Notice to Mariners will be promulgated in advance of operations to inform local and national stakeholders that works are taking place. (including UKHO, HM Coastguard, fisheries groups and local harbours and ferries).

1. The subsea hub and AR1500 jumper cable shall be loaded onto a suitable Offshore Construction Vessel with a 250Te active heave compensated crane from the load out site at Nigg Energy Park.

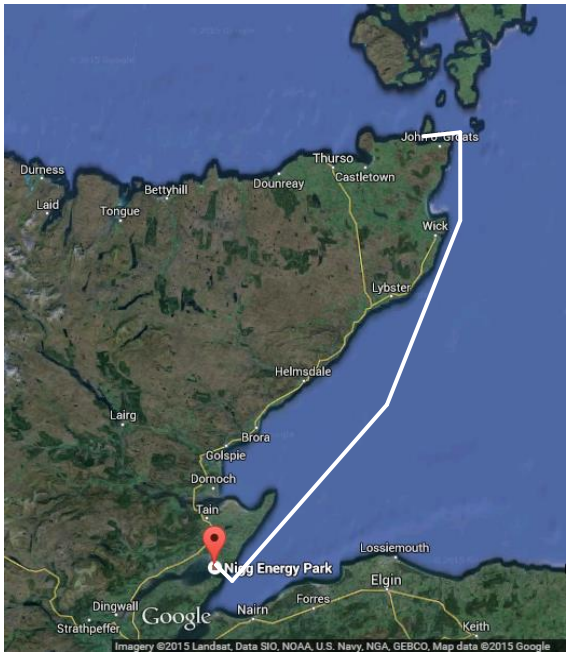

Figure 2 Vessel transit route

2. The vessel shall proceed to the MeyGen site via the transit route shown in Figure 2 and recover the AR1500 to the deck of the vessel, lifting the turbine from the turbine support structure and disconnecting the wet-mates located between the turbine and the lower CMS as show in Figure 3.

Figure 3 AR1500 in suspended from a 250Te AHC crane aboard the Seabed Stingray awaiting slack tide for installation.

3. The lower CMS shall then be recovered from the turbine support structure and along with the export cable shall be recovered to deck as shown in Figure 4.

Figure 4 Lower CMS with export cable attached during installation

4. The export cable dry-mate shall be disconnected from the lower CMS.

5. The export cable dry-mate connector shall then be connected to the subsea hub.

6. The turbine jumper cable dry-mate shall be connected to the lower CMS replacing the export cable dry-mate connector.

7. The turbine jumper cable wet mate shall be connected to the subsea hub.

8. Testing shall then be conducted from onshore to turbine wet-mates on top of the Lower CMS which interface with the AR1500 when subsea.

9. Once testing is complete the turbine jumper cable shall be disconnected from the subsea hub via the wet-mates.

10. Protective covers shall be placed over each of the exposed wet-mate connectors mounted on the subsea hub. These covers are used to provide an increased level of protection to the wet-mate connectors and are removed individually prior to the turbine jumper cables being connected subsea.

11. A portion of the export cable, about 300m, shall be recovered to deck and relayed along a new predefined route to the location for installation of the subsea hub.

12. The subsea hub shall be lifted with a bespoke intervention tool and lowered to a predefined location on the sea bed where a work class ROV will be used for final positioning.

13. Ballast will be added to the subsea hub if necessary, using the intervention tool or standard rigging.

14. Rock bags shall be placed onto the export cable for approximately 500m to ensure it is stable on the seabed.

15. With the turbine jumper cable connected, the lower CMS shall be reinstalled on the turbine support structure

16. The turbine jumper cable shall be laid on to the sea bed along a predefined route to the subsea hub.

17. The protective cover shall be removed from the wet-mate connector and the turbine jumper cable wet-mate connector shall be connected to the subsea hub using the bespoke intervention tool to ensure accurate positioning for connection.

18. The turbine jumper cable shall then be laid to the seabed and rock bags placed on the cable to ensure the cable is stable on the seabed.

19. Tests on shore shall be carried out checking the connection between the subsea hub and the lower CMS

20. The AR1500 turbine shall be reinstalled onto the lower CMS.

21. All turbine installation checks carried out.

5 SCHEDULE OF WORK

The subsea hub is intended to be deployed in October 2019. The work will be scheduled to coincide with slack tides according to the programme below.

Slack tide 1:	Site preparation for cable recovery
Slack tide 2:	Recover the AR1500
Slack tide 3:	Recover the Lower CMS
Slack tide 4:	Recover and relay export cable
Slack tide 5:	Cable works on deck and system testing
Slack tide 6:	Cable works on deck and system testing
Slack tide 7:	Installation of the subsea hub and cable positioning
Slack tide 8:	Installation of the Lower CMS
Slack tide 9:	Connection of the turbine collector cable to the subsea hub
Slack tide 10:	Installation of the AR1500
Slack tide 12:	Cable stabilisation
Slack tide 12:	Cable stabilisation
Slack tide 13:	Cable stabilisation
Slack tides 14:	Cable stabilisation

APPENDIX 1 – WET MATE CONNECTOR SAFETY DATA SHEETS

1. Seimens D060 1000CS
2. T005 Tronic MSDS

APPENDIX 2 – ENVIRONMENTAL MANAGEMENT PLANS

1. MeyGen Project Environmental Management Plan RHK-1A-40-HSE-F-002-EMPConstructionWorks
2. MeyGen Project Navigation Safety Plan MEY-1A-40-HSE-005-F-NSPConstructionWorks