Supergen
Dr Lilian Lieber *Supergen ECR Fund Report ECRRF2021–(Call 4)-04* May 2022

Proving a robust approach to assess bio-physical interactions with floating tidal turbines

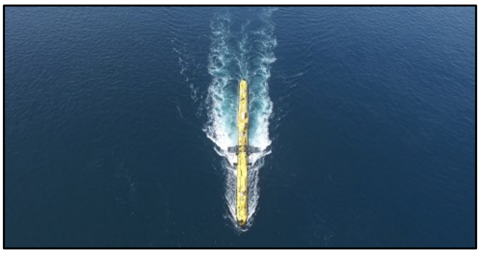

Figure 1 *Orbital's 74 m-long floating tidal energy structure, the O2, moored in the Fall of Warness, Orkney. ©Alex Nimmo-Smith & Lilian Lieber*

Summary

This ECR research fund supported a feasibility study around Orbital's O2 floating tidal energy structure (Fig. 1) located in the Fall of Warness, Orkney, Scotland, to inform on industry-relevant flow measures and environmental interactions, thereby proving a low-cost, robust and reproducible monitoring approach. The overall goal of the project was to generate in-situ, industry-relevant data to be used in flow field characterisation (inflow and wake effects), turbine array spacing modelling, as well as for environmental impact assessments. This was achieved using a combination of vessel-mounted transects equipped with water column sensors, concurrent seabird observations and aerial drone surveys.

Methods & Data Collection

The field work was conducted in the Fall of Warness (FoW), Orkney, on five consecutive days covering spring tides, April 13th - 17th 2022. We performed parallel-line transect surveys onboard the *Green Quest* (Green Marine UK), equipped with an underway current profiler (RDI Workhorse ADCP) mounted on a side pole and a Simrad EK80 echosounder mounted on a moonpool pole, to characterise the flow fields and acoustic scattering (fish and turbulence quantification) around the O2 turbine structure and the wider FoW area, across tidal states (see transect line examples in Fig. 2). Dedicated seabird observations were performed during all transects. Weather-permitting, hourly O2 boat transects were augmented by prior aerial drone surveys (Fig. 3) consisting of drone transects with concurrent marine fauna counts, followed by a series of drone hovers (aerial drone stationary with a downward-facing camera) to map the near-surface velocity fields up- and downstream of the O2. Further, a weather-station and two downward-facing ADCPs mounted on the O2 structure collected near-continuous data throughout the survey period (data provided by Orbital).

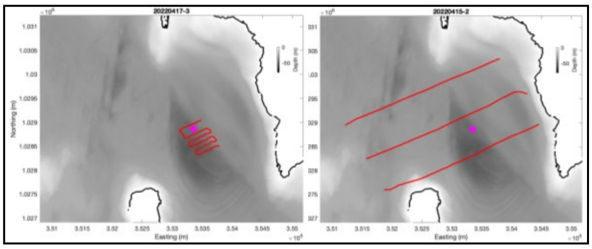

Figure 2 *O2 transects (left; flood tide) & area-wide transects (right)*

Preliminary Results & Next Steps

Sea state varied throughout the survey period, allowing for comparisons of water column data for various wind and wave conditions across the FoW. The area-wide transects within the FoW covered all tidal states and gave us a good understanding of the flow and turbulence dynamics across the site, particularly in reference to tidally-persistent shear lines and EMEC test berth locations. The hourly O2 transects consisted of one upstream and several (4-9) downstream lines and will be used to quantify both the inflow conditions and the scale and intensity of the wake signature of the O2. Figure 4 shows a set of ADCP transect lines around the O2, coloured by current magnitude down through the water column, where warm colours indicate high and cold colours indicate low magnitudes, respectively. The underway velocity and EK80 data will be analysed in combination with the aerial drone data to quantify near-surface velocities and turbulence features in relation to water column measurements. Next steps will involve calculations of lateral shear in the vicinity of the O2 as well as analysing the influence of the shear lines on the main flow in the channel, followed by the quantification of marine fauna distributions.

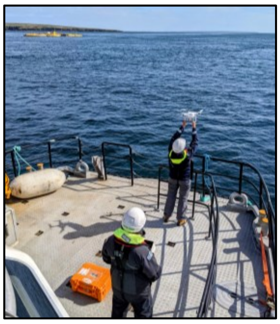

Figure 3 *Aerial drone surveys from onboard the Green Quest ©Shaun Fraser*

Deliverables

Oral presentation of work at the 9th Annual [PRIMaRE] conference in Cornwall, 6th -7th July 2022, followed by paper writing for a peer-reviewed publication and data sharing with industry partners.

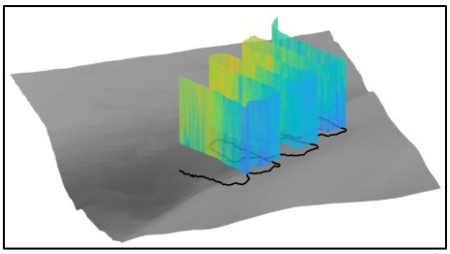

Figure 4 *Water-column velocity magnitude of transects up- and downstream of the O2.*

Acknowledgements

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