

Campaign – Wind and Metocean resource

Part 1 - Campaign details

2 x Celtic Sea Power Floating LiDAR systems (FLS) were deployed in June 2022 and will run concurrently for a minimum of 12 months to June 2023.

The CSP FLS deployment co-ordinates are:

Zone	deployment	Latitude			Longitude			Lat (Dd)	Long (Dd)
Zone 1A	Primary	50°	57.9724	N	5°	42.0001	W	50.9662	-5.7000
Zone 5	Secondary	51°	12.7058	N	6°	22.5072	W	51.2118	-6.3751

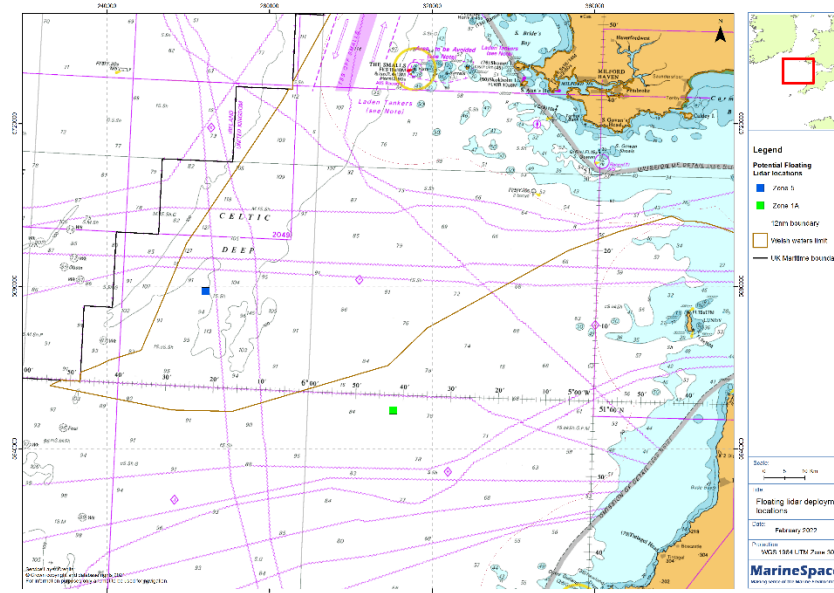


FIGURE 1 CSP FLS LOCATIONS - CELTIC SEA, UK

Part 2 - Commencement Date

Concurrent Deployment data is available from 24/06/2022

Part 3 - CSP Floating LiDAR data specifications

CSP will be utilizing two WINDSEA FLS units provided by Akrocean.

A1 - Data requirements

All data will be provided in units in accordance with ISO/IEC 80000.

All data timestamps shall be referenced to UTC and expressed according to ISO 8601.

All data timestamps shall be time synchronized across sensors through a central single server.

Data will be provided in CSV format.

The vertical datum for all data shall be MSL.

The coordinate reference system shall be WGS84.

The MPDA should be $\geq 85\%$ at nominal hub height 150 m AMSL for all months of the Campaign.

At the end of the Measurement Campaign all the measured data (both raw, processed and quality controlled) will be available through the data portal with a register of all the data files.

Throughout the Campaign, data will be available over the prescribed periods as set out at A9 below. Core averaged data sets are generally available every 6 hours whilst other complimentary metocean data and higher resolution timestamped data will be available quarterly on planned retrieval of the SD card from the FLS.

A2 - Lidar measurements

A single WindCube WLS 866 V2.1 lidar unit will be mounted on each FLS.

The lidar will be new (un-used, with the exception of pre-deployment onshore and offshore verification testing).

The lidar is type-classified, in accordance with Section L.2 in the IEC Standard and meets the stage 2 requirements of the OWA/CT FLD roadmap. The lidar measurement averaging period shall be 10 minutes.

The average lidar data timestamp interval will be 10 minutes. The lidar data timestamp interval available quarterly on retrieval of the SD card from the FLS is 1 second.

For each 10-minute average timestamp at each measurement height, the lidar data shall include:

- Mean wind speed;
- Minimum wind speed;
- Maximum wind speed;
- Standard deviation of wind speed;
- Turbulence intensity;
- Mean wind direction; and
- Mean vertical wind speed.

The lidar data will also include metadata, including:

- CNR / SNR /.sta

The lidar will measure wind data at the heights shown below:

Number	Height AMSL (m)
1	50
2	75
3	100
4	125
5	150
6	175
7	200
8	225
9	250
10	275

FIGURE 2 CSP FLS MEASUREMENT HEIGHTS

A3 - Meteorological measurements

The FLS includes a (MET) Weather station Gill GMX500.

The meteorological measurements includes:

Wind direction, speed, pressure, relative humidity, air temp, latitude, longitude, gust direction, gust speed.

The meteorological measurement averaging period will be 10 minutes. The meteorological data timestamps interval available quarterly on retrieval of the SD card from the FLS is 5 seconds.

A4 - Oceanographic measurements

A4.1 Wave measurements

Wave measurements will be provided at the deployment location via a Wave Sensor 5729 AANDERAA MOTUS unit.

The wave measurement data shall include:

- Significant wave height;
- Maximum wave height;
- Peak wave period;
- Average zero crossing period; and
- Wave direction.

The wave measurement averaging period will be 30 mins and equal to the wave data timestamp interval.

A4.2 Current measurements

Current measurements will be provided at the deployment location from a Nortek Signature 250 (ADCP).

The current measurement data shall include:

- Current depth;
- Mean current speed; and
- Mean current direction.

The current measurement averaging period will be 15 minutes and equal to the timestamp interval.

A4.3 Water level measurements

Water level measurements at the deployment location will be provided by the depth sensor (Altimeter AIRMAR Echorange SS510)

The water level averaging period will be 10 minutes and the water level timestamp interval shall be 5 seconds.

A4.4 Water temperature

Water temperature measurements at the deployment location will be provided via a (MET) Weather station Gill GMX500.

The water temperature averaging period will be 10 minutes with 5 second timestamp interval data available quarterly.

A5 - Ancillary measurements

A5.1 Heading reference system

The FLS includes a primary reference heading sensor Trimble BX992 and secondary (back up) reference heading SCX21 sensors.

The FLS's primary heading reference system is a differential GPS.

The SCX21 is a compass satellite (GPS heading unit) and therefore no in-situ calibration is needed.

A5.2 Motion

The AKROCEAN FLS is equipped with 2 different damping devices; The wave energy converter is used as a passive anti-pitching tank and damps more than 50% of the pitching motion thus reducing acceleration of the whole structure and its equipment. The anti-rolling keel is used as passive anti-rolling device to achieve a reduction of 30% of dynamic rolling movement.

The FLS will include a motion sensor recording at least three degrees of freedom (pitch, roll and yaw) contained within the Wave sensor 5729 Aanderaa Motus.

The monthly data available will include summary motion statistics (including: mean, minimum, maximum and standard deviation).

Unaveraged motion data will be stored on board the FLS and included in the raw data delivered on a hard drive, with a register of all the data files.

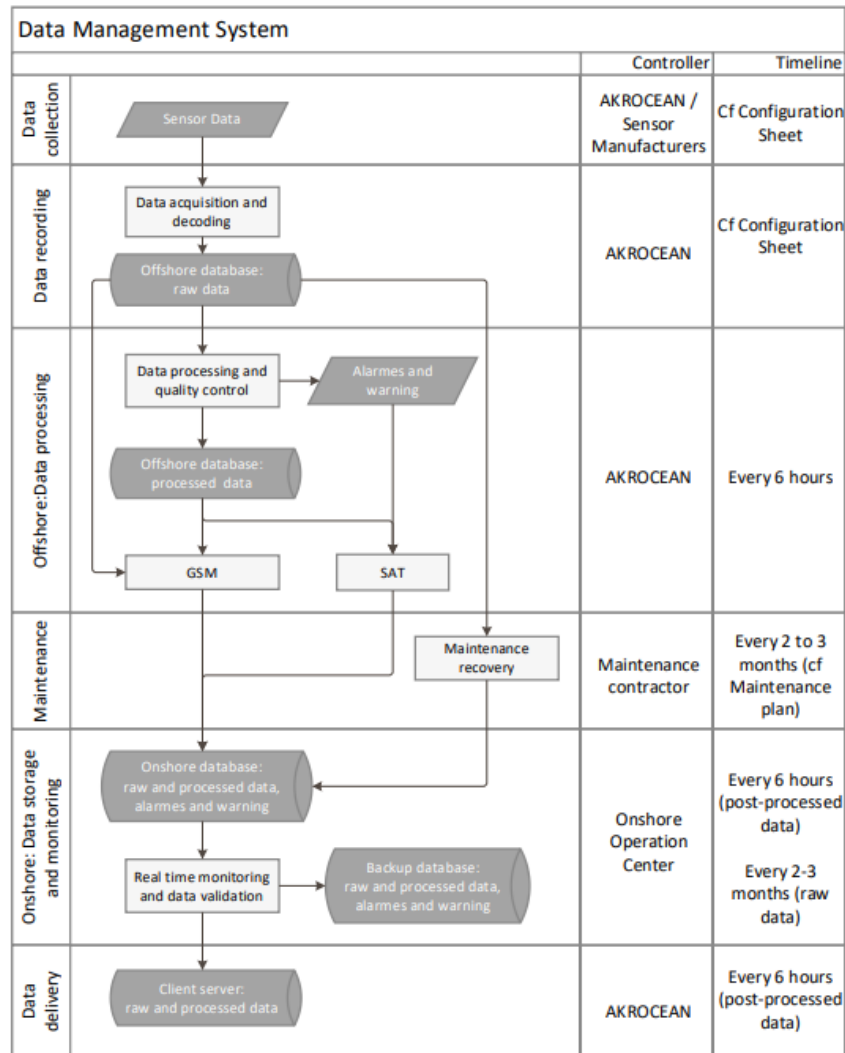
A6 -Data acquisition and storage

The data record is ensured by an embedded industrial and low consumption computer and a data logger from AANDERAA (Smart Guard). The data logger is connected to all sensors via an RJ45 or RS232 connection and also to the satellite modem for communication (sending data and buoy signals). This transmission is needed for remote access to the buoy parameters and stored data. The data logger contains enough flash storage memory to store all campaign measurements.

128GB on board | Dedicated onshore server + back-up server.

A7 - Communications

A stable and robust communication system is in place between the floating platform and the shore in order to send data onto a dedicated onshore server, and to remotely consult with the platforms parameters. This communication enables AKROCEAN to monitor the equipment health and remotely operating parameters of the buoy and receive any alerts/alarms. The data transfer architecture is based on a secured satellite connection between the buoy and the shore. Data will be transferred every 6 hours to enable a near real time visualization.



A8 – Standards

The following standards, guidelines and recommended practices are adhered to within the CSP FLS campaign design:

- 1) Carbon Trust, “Carbon Trust Offshore Wind Accelerator Roadmap for the Commercial Acceptance of FLS Technology” (the OWA Roadmap);
- 2) IEA Wind, “Expert Group Report on Recommended Practices 18. FLS Systems” (the IEA Recommended Practices); and
- 3) IEC 61400-12-1:2017, “Wind power generation systems - Part 12-1: Power performance measurement of electricity producing wind turbines” (the IEC Standard)

A9 – Data availability summary table

Data Campaign	Sensors	Frequency	Data Type	TimeStamp	Size	Unit
Wind and Metocean	ADCP	every 6 hours	Velocity and direction	15 mins	80	KB
	Conductivity Sensor		Conductivity, Temperature	10 mins	8	KB
	Depth Sensor		Depth	10 mins	4	KB
	LIDAR		Wind Speed, dispersion, Direction - 10 heights, +	10 mins	36	KB
	Wave Sensor		Significant Wave Height, Wave Peak, +	30 mins	8	KB
	Altimeter		Water levels	10 mins		
	Weather Station		Wind direction, speed, pressure, relative humidity, air temp, lat, long, gust direction, gust speed	10 mins	8	KB
	WindCube WLS 866 V2.1	Quarterly	Wind Speed, dispersion, Direction - 10 heights, +	RTD data 1 s	1228	MB
	(MET) Weather station Gill GMX500		Wind direction, speed, pressure, relative humidity, air temp, lat, long, gust direction, gust speed, conductivity, temperature, depth	5s	128	MB
	Wave Sensor 5729 AANDERAA MOTUS		Significant Wave Height, Wave Peak, +	30 min	0.9	MB
	Altimeter AIRMAR Echorange SS510		Water levels	5s		
	Nortek Signature 250 (ADCP)		Velocity and direction	PNORS 15 min	0.6	MB

Part 4 – Developer data specification for the wind and metocean resource campaign

Part 5 – CSP sub-licensees for the wind and metocean resource campaign

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Part 6 – Developer sub-licensees for the wind and metocean campaign