

## 附件

### 一、竣工實際經緯度及浮標迴轉半徑

| 名稱    | 地點 | WGS84    |           | TWD97        |               | 浮標<br>迴轉半徑 |
|-------|----|----------|-----------|--------------|---------------|------------|
|       |    | 緯度       | 經度        | X            | Y             |            |
| GF-01 | 臺中 | 24.47972 | 120.11953 | 160752.83096 | 2708436.76346 | 227 m      |
| GF-02 | 新竹 | 24.95437 | 120.67826 | 217511.66994 | 2760762.43354 | 254 m      |

### 二、竣工圖及原廠型錄



圖 1 新竹海氣象浮標(GF-02)竣工實場圖(完成佈放日：111 年 11 月 10 日)

## 附件



圖 2 台中海氣象浮標(GF-01)竣工實場圖(完成佈放日：111 年 11 月 17 日)

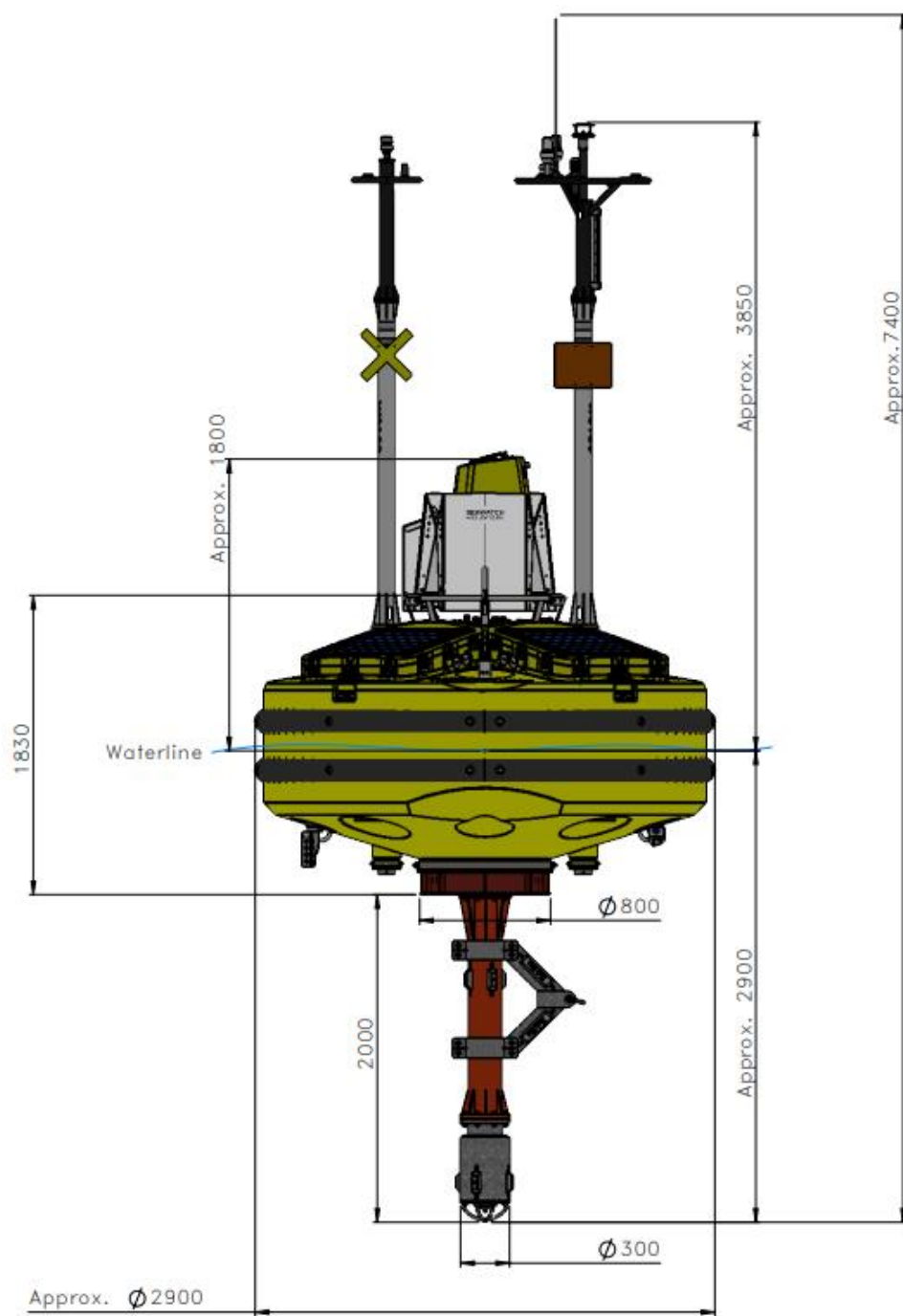


圖 3 海氣象浮標外觀示意圖

## 附件

- 原廠型錄

### EQUIPMENT FLYER



## FUGRO SEAWATCH WIND LIDAR BUOY

The SEAWATCH Wind LIDAR Buoy is a cost-effective and reliable solution for measuring wind profiles, waves and current profiles.

### WIND PROFILE, WAVE AND CURRENT MEASUREMENTS

The SEAWATCH Wind LIDAR Buoy represents the next generation of multi-purpose buoys tailored for the renewable energy industry.

The buoy accurately measures the speed and direction of wind across the diameter of wind turbine rotors, whilst also providing a complete package of meteorological and oceanographic parameters such as ocean directional waves and current profile.

### FEATURES

- Combined directional wave, metocean and wind energy assessment platform in one compact buoy
- Collects wind profile data for wind resource assessments for bankable purposes and engineering design data
- Configurable LIDAR wind profile measurements at 10 levels from 12.5 m up to 300 m
- Independent mast wind at 4 m
- Integrated directional motion and wave measurements as well as sea current profiles
- Full onboard time synchronized processing of all measured data
- Two-way real-time communication link for data telemetry and control
- Real-time web-based data presentation
- Flexible configuration of instrumentation



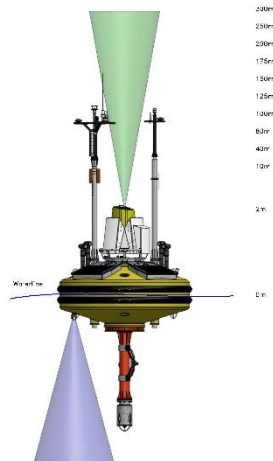
Accurate measurement of wind profile using SEAWATCH Wind LIDAR Buoy

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SEAWATCH Wind LIDAR Buoy towed in Frøya.



#### FEATURES

- Safe and easy handling, deployment and recovery
- Robust and reliable in extreme weather
- Independent position tracker for redundant mooring monitoring
- Single point oceanographic mooring system enables safe and quick deployment within 30 minutes at site
- Dual GPS as primary heading source for true wind direction.
- Wavesense3 as secondary heading source
- AIS AtoN to alert nearby vessel traffic of buoy position
- Qualified in January 2015 as "Pre-commercial Stage 2" in accordance with Carbon Trust OWA Roadmap
- In use for wind energy assessment for approximately the equivalent of 21 years of combined continuous measurements

#### PROVEN PLATFORM AND TECHNOLOGY

The SEAWATCH Wind LIDAR Buoy is based on the SEAWATCH Wavescan platform which has been deployed for a large number of satisfied clients in the most hostile oceanographic environments since 1995.

The well proven SEAWATCH technology includes:

#### Wavesense3™ wave sensor controller and datalogger

- Onboard processing and time synchronized sampling of all instrumentation
- Onboard wave measurements processing to give ready to use wave statistics over telemetry
- Medium agnostic Telemetry & Control Protocol, transmitting data over all available transmission mediums (Inmarsat, Iridium, Insat, Argos, 4G/3G, GPRS)
- Supports a large number of instrumentation protocols
- Configurable instrumentation sampling regime and duty cycle

#### Intelligent Power Management Unit (PMU):

- Automatic monitoring of battery state of charge and health, solar charge, and fuel cells
- Charging and battery protection for rechargeable battery bank
- Automatic fallback to high energy density lithium battery pack in the event of insufficient charging
- Transmit status information over telemetry

#### The ZX300M by ZX Lidars

- Selected from a comprehensive motion sensitivity analysis comparison of commercial alternatives in collaboration together with NOWITECH, Christian Michelsen Research (CMR) and Equinor (formerly Statoil)
- CarbonTrust OWA Roadmap validated wind speed and direction on the SEAWATCH Wind LIDAR Buoy in three met-mast validations and more than ten pre-deployment validations at Frøya



#### UNIQUE COST-EFFICIENT SOLUTION

The SEAWATCH Wind LIDAR Buoy is a cost-efficient way to measure wind data at heights of modern offshore wind turbines for wind resource assessments and engineering design.

It's the first single compact buoy capable of measuring:

- Wind profiles across the blade span of the largest offshore wind turbines to estimate Rotor Equivalent Wind Speed (REWS)
- Ocean wave height and direction
- Ocean current profiles from the surface to the seabed
- Meteorological parameters
- Water level (tide)
- Other oceanographic parameters as required

The SEAWATCH Wind LIDAR Buoy is a proven ocean monitoring solution and is easy to handle, deploy and relocate by towing or lifting on board vessels depending on distance.

This is a cost-effective alternative to existing wind profiling solutions such as fixed met masts or larger floating buoys.

#### OFFSHORE TESTING/ VALIDATION

The SEAWATCH Wind LIDAR Buoy has been tested and validated at the Ijmuiden met mast in Dutch waters. The wind profile measured by the SEAWATCH Wind LIDAR Buoy were compared with anemometers mounted at three heights on the met mast up to 90 m, and data from a fixed ZX LIDARs mounted on the met mast platform measuring the wind profile above 90 m.

An intercomparison showed almost no bias and a squared correlation close to unity. The validation test was performed in close cooperation with DNVGL. In addition, an uncertainty analysis was done by Ecofys concluding negligible sensitivity to sea states for wind speed and direction - and an overall measurement uncertainty of 3.3%. More recent comparison with an offshore met mast has shown uncertainty ~2%.

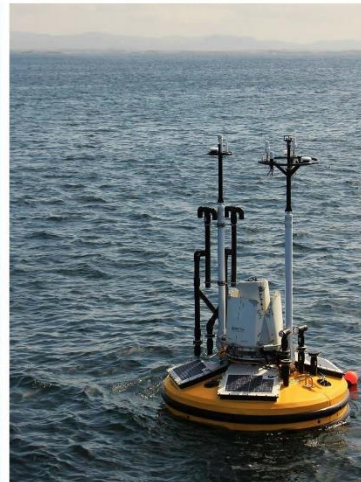
In 2016, a second six months validation test was successfully performed against the Mast EA1B at East Anglia One Wind Farm in accordance with the OWA Roadmap (Carbon Trust).

#### FRØYA OFFSHORE VALIDATION SITE

The Oceanor test facility at Frøya in Norway is used as the pre-deployment validation location for the SEAWATCH Wind LIDAR Buoy. The test site has been recommended for the purpose of validating offshore floating lidar buoys by DNVGL. The test site is established next to the NTNU owned tall met masts where the well known Frøya wind profile was established as part of the NORSOK standards.

#### SUCCESSFUL COLLABORATION

The SEAWATCH Wind LIDAR Buoy is the result of a successful joint industry R&D project, utilising offshore and wind technology expertise from Norwegian universities, research institutes and the energy company Equinor (formerly Statoil).



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## EQUIPMENT FLYER



## SEAWATCH WIND LIDAR BUOY

## Technical Specifications

## General

|             |  |
|-------------|--|
| Material    | Polyethylene, Aluminium, Stainless Steel   |
| Flash light | LED based, range 1-5 nM standard / up to 7nM model optional<br>IALA recommended characteristic |
| Positioning | GPS (Inmarsat-C, Iridium, Standalone Receiver)<br>AIS Tracker                                  |

## Buoy Dimensions

|                              |         |
|------------------------------|---------|
| Weight (approx) <sup>1</sup> | 2200 kg |
| Overall height               | 6.75 m  |
| Diameter                     | 2.8 m   |
| Net buoyancy                 | 3500 kg |
| Mast height (above water)    | 4.0 m   |

Power Supply <sup>2,3</sup>

|                                      |                  |
|--------------------------------------|------------------|
| Solar panels                         | 180 W            |
| Lead-acid battery bank (operational) | Up to 248 Ah     |
| Lithium battery bank                 | Up to 4896 Ah    |
| Fuel cells                           | Approx. 290 days |

## Processing

4GB data storage - one year of raw data storage  
Real-time operating system (Linux)  
Large number of serial and analogue inputs  
Flexible data acquisition software

## Data Communication

|             |   |
|-------------|---|
| Short range | GSM / GPRS / 3G / 4G<br>UHF / VHF radio (two-way)<br>WiFi |
| Long range  | Inmarsat-C and Iridium (two-way)<br>ARGOS (one-way)       |

## Wind Profiler - ZephIR 300 M LIDAR

|   |                  |
|---|------------------|
| Measurement height (configurable)       | 10 m – 200 m     |
| Probe length at 10 m                    | 0.07 m           |
| Probe length at 100 m                   | 7.7 m            |
| Number of simultaneous heights measured | Up to 10         |
| Sampling rate                           | 50Hz             |
| Average period (configurable)           | 1 second upwards |
| Scanning beam angle                     | 30°              |
| Wind speed accuracy                     | < 0.5%           |
| Wind speed range                        | < 1 m/s to 70m/s |
| Wind direction accuracy                 | < 0.5°           |

## Oceanographic Sensors

Wave height, period and direction  
Current velocity and direction profile  
Water temperature  
Conductivity / Salinity  
Water level (tide)

## Meteorological Sensors

Wind speed/direction  
Air pressure  
Air temperature and humidity

<sup>1</sup> Various additional sensors are available on request

<sup>2</sup> With fuel cells and methanol cartridges

<sup>3</sup> All values are nominal ratings

<sup>4</sup> The buoy consumes roughly 150 Ah per day. Exact power consumptions will be made for each case

## 附件

### 三、警示燈相關資訊

本計畫採用海氣象浮標特殊浮標，為航路標識設置技術規範 10.2.1 訂定之海洋資料蒐集及偵測設施。採用特殊浮標之外觀概要如下所示：

- 外觀尺寸：浮標型載具（直徑約 2.9 公尺，水面上高度約 3.85 公尺），如圖 1 所示
- 外觀顏色：黃色(German RAL Color: RAL1023 – Traffic Yellow) ，如圖 1 所示，符合航港局航路標識設置技術規範附件二之規定
- 頂標型式：黃色X形 ，如圖 1 所示

其附屬之航路標識種類、位置、燈質、及設備規格臚列如下：

- 燈光型式：Gill SL-07 (Model: Windsonic)
- 燈質：黃色燈光，其閃爍頻率設定為IALA flash code is FL(5) 20S:

| IR     |            |            |             |     |     |     |     |     |     |     |     |     |      |
|--------|------------|------------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| SWITCH | Controller | FLASH CODE | ON          | OFF | ON  | OFF | ON  | OFF | ON  | OFF | ON  | OFF | ON   |
| 9      | E          | 158        | FL (5) 20 S | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 11.0 |

- 見距：1－5 海浬

### 四、AIS 顯示名稱及 MMSI 號碼

AIS: 除燈光外，本計畫亦裝設航標用自動辨識系統(AIS Aid-to-Navigation)。AIS 採用通過 IEC62320-2(Ed. 2.0, 2016) 型式認證通過之設備，並具有發射及接收訊息功能。使用上則依 IALA Recommendation A-126 之建議為原則。本計畫與國家通訊傳播委員會(NCC)申請 MMSI 之指配如下。

- (一) 994161074 (設備編號: GF-01)
- (二) 994161075 (設備編號: GF-02)

## 附件

### 五、本計畫緊急連絡人員

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海事工程公司：國海輝固股份有限公司 Fugro IOVTEC

| 職位                        | 公司           | 連絡人員       | 連絡電話                     |
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