

# STEMM-CCS Instrumented Seabed Lander *Requirements Specification*

## **1. Introduction**

An instrumented seabed lander is required for gathering various sub-sea environmental data as described in this specification document. The lander will form part of a suite of instrumentation required to support the EU Horizon 2020 project “Strategies for Environmental Monitoring of Marine Carbon Capture and Storage” (STEMM-CCS) that is to be carried out in the North Sea during 2017 to 2019.

Tendered proposals shall contain a **Basic Configuration** model and, if available, an optional upgraded model to the **Extended Configuration** described below.

## **2. Scope**

The successful tenderer will deliver to NOC Southampton and demonstrate an integrated, fully functioning system in accordance with this specification. This will include:

- a. Design and fabrication of the lander platform and its associated deployment and handling fixtures, e.g. lifting eyes, tie-down points, grab bars, and recovery system.
- b. Sourcing and delivery of all sensors.
- c. Sourcing and delivery of data-logging systems for all sensors.
- d. Sourcing and delivery of remote data transmission systems; satellite telemetry and acoustic modem pair. (Acoustic modem pair required for Extended Configuration only – see below)
- e. Sourcing and delivery of electrical power source(s) and power distribution system(s).
- f. Assembly of all components and full system integration.
- g. Comprehensive testing of fully integrated system.
- h. Demonstration of fully integrated system to be witnessed by client (acceptance test). This need not be in a full-depth sub-sea environment but should be in an ‘immersed’ environment. (NOC may be able to offer access to its immersion test tank for this purpose – details available on request). The acceptance test should include successful demonstration of acoustic and/or satellite data telemetry as appropriate.
- i. Provision of calibration certificates for all sensors as appropriate.
- j. Provision of pressure test certificates for all systems as appropriate (e.g. electronic housings, cable harnesses).
- k. Provision of mechanical load test certificates for all lifting and securing points as appropriate.
- l. Spares kits as appropriate.
- m. Training on operation and maintenance of the lander system for NOC personnel (competent oceanographers and marine technicians).

Tenderers are also requested to provide:

- n. A delivery plan.
- o. A quality management plan.
- p. Details of any post-sales support.

The tender will not include:

- q. Deployment equipment, e.g. lifting wires, winches, cranes, etc.
- r. Provision of satellite, e.g. Iridium, 'airtime'.

### **3. Statement of Requirements**

- a. The lander system shall be able to be deployed from and recovered to an oceanographic research ship without the use of a remotely operated vehicle (ROV).
- b. Nominal deployment depth will be 120 m.
- c. Seabed water temperature is expected to be 7 – 8 °C.
- d. Seabed currents are expected to be  $<0.51 \text{ m s}^{-1}$ .
- e. Seabed sediments at the intended deployment site comprise "clayey silty fine sand" with undrained shear strength of 5 – 25 kPa to a depth of up to 0.5 m. The sediment surface is generally flat and level.
- f. The lander system will remain deployed and fully functioning for up to 16 months.
- g. In design, consideration should be given to minimising the possibility of unintentional trawling.
- h. The system shall operate as a standalone unit with sufficient on-board power and data storage capacity to remain fully functional for at least the minimum deployment period.
- i. All gathered data will be stored in non-volatile memory on the lander for retrieval once the lander has been recovered.
- j. It will be possible for all sensor clocks to be synchronised.
- k. Additionally, stored data (except for hydrophone data in the Basic Configuration) will be remotely telemetered to NOC at least once every 3 months throughout the full deployment duration. This may be achieved with pop-up beacons or similar system.
- l. As a minimum [**Basic Configuration**], the lander system will be equipped with sensors to gather the following parameters to the stated minimum specifications:

#### **i. Conductivity**

|                  |                          |
|------------------|--------------------------|
| Range:           | 0 to 7 S/m               |
| Accuracy:        | $\pm 0.0003 \text{ S/m}$ |
| Stability:       | 0.0003 S/m per month     |
| Resolution:      | 0.00001 S/m              |
| Sampling period: | Every 20 minutes         |

**ii. Temperature**

|                  |                     |
|------------------|---------------------|
| Range:           | -5 to +35 °C        |
| Accuracy:        | ± 0.002 °C          |
| Stability:       | 0.0002 °C per month |
| Resolution:      | 0.0001 °C           |
| Sampling period: | Every 20 minutes    |

**iii. Depth**

|                  |                   |
|------------------|-------------------|
| Range:           | 0 – 200 m         |
| Accuracy:        | ± 0.1% FS         |
| Stability:       | 0.05% FS per year |
| Resolution:      | 0.002% FS         |
| Sampling period: | Every 20 minutes  |

**iv. Water current**

|                      |                     |
|----------------------|---------------------|
| Type:                | Upward-looking ADCP |
| Range:               | 100 m               |
| Accuracy:            | ± 1%, ± 0.5 cm/s    |
| Velocity resolution: | 0.1 cm/s            |
| Velocity range:      | ± 10 m/s            |
| Vertical resolution: | 2 m                 |
| Sampling period:     | Every 20 minutes    |

NOTE: The upward-looking ADCP head should be mounted as close to the seabed as reasonably practicable to maximise near-seabed coverage.

**v. Underwater acoustics (hydrophone)**

|                     |  |
|---------------------|--|
| Frequency range:    | 500 Hz – 50 kHz                        |
| Sensitivity:        | To be clearly specified in the tender. |
| Sampling frequency: | 250 kHz                                |

NOTE: For this **Basic Configuration**, acoustic data need not be included in telemetry nor acoustic modem transmissions; hydrophone may be self-logging only. The logging should be programmable to be either continuous for short deployments or, for example, 5 minutes every hour for longer deployments.

m. CTD and ADCP data to be sampled synchronously.

n. As an optional upgraded model [**Extended Configuration**], the lander system will be additionally equipped with the following:

- i. **Underwater acoustics** (a second hydrophone positioned on the lander frame as far distant as reasonably possible from the first hydrophone specified in the Basic Configuration. **The two hydrophones must sample synchronously.**)

Frequency range: 500 Hz – 50 kHz  
Sensitivity: To be clearly specified in the tender.  
Sampling frequency: 250 kHz

NOTE: For this **Extended Configuration**, summary acoustic data (daily average spectra or similar) must be included in telemetry and acoustic modem transmissions in addition to being stored on the lander. The logging should be programmable to be either continuous for short deployments or, for example, 5 minutes every hour for longer deployments.

- ii. **Additional third party sensor connectivity**

Provision shall be made for the integration of six NOC supplied sensors (nitrate, phosphate, pH (x2), dissolved oxygen, salinity). These sensors will require:

Energy (electrical): 5.7 kJ hr<sup>-1</sup>  
Total data generated and stored: 12000 bytes hr<sup>-1</sup>  
Data to be telemetered: 360 bytes hr<sup>-1</sup>  
Physical dimensions: Available on request

o. In the **Extended Configuration**, stored data (including hydrophone data) will additionally be remotely interrogated and recovered as and when required via acoustic modem link with a suitably equipped surface vessel. In this configuration, the tendered proposal will therefore include an acoustic modem fitted to the lander and a ship-side modem, e.g. dunker and deck unit.

- p. To enable rapid turnaround of lander (in both Basic and Extended Configurations):
- i. Duplicates of battery pack(s) and all sensors (calibrated) are to be provided.
  - ii. Mounted battery pack(s) and all sensors to be readily accessible and easily replaced.

#### 4. Timetable

- a. All deliverables to be completed by end March 2017. It is recognised that this is a tight deadline; if you think this is unrealistic, please indicate your best delivery date within Question PROJ6.2.