ADDITIONAL PRODUCT INFORMATION

Regarding purchase of Light sensors Case No. 19/00714

1. BACKGROUND

This document is ment to give additional information to the Procurement document. If there is a conflict between the Procurement document and this document (Appendix 3), the Procurement document will have precedence.

- Scenario of light sampling
- More description for the CTD connection

2. SCENARIO OF LIGHT SAMPLING

During all scientific surveys, conducted by one of IMR's research vessels, we map the environmental conditions in the survey area. This is done by sampling the environmental conditions (temperature, salinity, oxygen, light, chlorophyll, turbidity) from the surface and down to the bottom (vertical profiles trough out the water column). To sample environmental conditions, we use a CTD from Sea-Bird (SBE 911 plus, Sea-Bird Scientific). The CTD itself only measures temperature, salinity and pressure, the other environmental conditions (oxygen, turbidity, chlorophyll and light) are measured by separate instruments, that are connected to the CTD unit.

During a survey we usually have several environmental stations (what we call "CTD-station") which are numbered consecutively. During a typical CTD-station the vessel stays put in one position, while the CTD unit and its connected instruments is lowered from surface down to the bottom and back up to the surface (speed usually 1-2 m per sec). Having CTD stations (environmental stations) at given interval in an area (or on a transect line), able us to say something about how the environmental conditions are in that area (this area could be f. exp. a continental shelf). All marine surveys have CTD stations, how many stations it has, depends on the aim of the survey. We conduct surveys throughout the world's oceans, but most of our effort is within Norwegian waters with depths < 3000 m, thus the light sensor must withstand pressure equivalent to 3000 m depth. We are often in polar areas, but also tropical waters are visited, thus the light sensor must withstand sample temperatures -5 to +40°C, deck/ storing temperatures of -50 to +50°C and direct sunlight.

Sampling when the light sensor is connected to CTD (Sea-Bird):

In our case the light sensor should be mounted on to the SBE 32 Carousel water sampler (in one of the water bottles positions) and connected to the CTD unit by an analog port.

Through this analog port the light sensor will receive power (200mA, 12-15V). Through the same analog port, the light sensor will send real time measurement of total light (integrated intensity across 400 to 700 nm). The analog output from the light sensor will be read by an A/D converter with 12 bits of resolution and a range of 0 to +5 volts. Since the light meter is expected to provide usable output over several orders of magnitude of light intensities, the 0 to +5 volts output on the analog channel likely needs to be an encoded quantity, e.g. for instance log10 (light level).

To able synchronization of light sensor data with CTD data the light sensor must log its light measurements related to date, time and depth. Thus, the light sensor needs an internal time and depth logging. The data output must be in a format that can be compelled with *.cnv* files from the CTD, to able a real-time display of data on the CTD computer onboard the vessel. The (internally stored) data output must be in ascii format with depth in one column and total light (integrated light) in a second column or light per wavelength channel in additional columns, or in a fully specified format that can easily be converted to the above mentioned ascii format.

The integrated light data will give us total amount of light by depth. This information will be enough for most users (scientists). However, some users are interested in how much of this light is bioluminescence (produced by specific organisms at a given depth), and how much is downwelling sunlight. Others are interested in how much light passes through polar ice, and what wavelengths are penetrating the ice cover better than others. Others are interested in the effect of sun, moonlight and twilight on organisms closer to the surface, as well as deep sea organism's response to sunlight and bioluminescence.

Thus, we need our light sensor to have a broad light intensity range (at least from 10^{1} down to 10^{-11} µmol quanta/m^2/s) divided in to at least 10 wavelength channels with good coverage across the entire spectral PAR range (400 to 700 nm).

The CTD units have only one port available per sensor, which constrains real-time transmission of data to deck. The wavelength related data must therefore, most probably, be stored internally until the CTD unit is back on deck. The power supply to the CTD unit is always turned off shortly after returning to deck (for safety reasons). Thus, to avoid wasting power and filling the internal memory with deck measurements, the light sensor should go into standby modus when out of water (maybe one can use the internal depth sensor to trigger this function). The CTD unit's power is off when at deck – the downloading of the wavelength related data from the

light sensor must therefore go directly from the light sensor by blue-tooth or by cable to a PC or laptop. Thus, the light sensors must have a software to read, store, transfer and delete data from a PC / laptop. This software must be user friendly (easy to learn) – and it must be possible for the Customer personal onboard the vessels to upgrade the software when needed.

Most probably the light sensor will need more power than it gets through the CTD connection – needing a battery to keep up its internal data memory, time and date. If so, it must be possible to charge or change this battery without having to disconnect the light sensor from the CTD (e.g. charging though a specific charging cable unit or through the PC/ laptop connection). The battery status must be displayed on the PC or lap-top when downloading data files and by an external indicator light on the sensor itself (the battery indicator light must be cowered by an opaque cover when under water or turned on for a few sec by the use of an magnetic switch when on deck). Usually a new survey team boards the vessel every 4 weeks. Thus, the light sensor must be able to run and be on standby for at least 4 weeks at the time, before recharging and data dumping is needed. This way it can become part of routines to charge, dump and delete data at the end of every 4-week shift. The light sensor must have storing capacity equivalent to 200 hours of data logging. This is to make sure that it will not run out of memory before the 4 weeks survey has finished (4 to 8 CTD station per day. Each station takes ~ 1 hour).

Sampling when the light sensor is standing alone:

The light sensor will also be used on smaller vessels without Sea-Bird CTD units and on ROV's (Remotely operated vehicle). Thus, the light sensors must be able to store all data in its own storage.

For standalone use the light sensor must be able to receive its power from an external or internal battery package. The battery capacity must be at least 10 hours of continuous data logging (as suggested above charging of battery can be solved by the use of a specific charging cable unit or through the PC/ laptop connection). For this type of use, again it must be possible to see when the battery is going low - display on PC/ lap-top when connected and by an external indicator light. Also, it must be possible to turn on and off the light sensor, preferably without having to connect it to a PC or laptop.

3. CTD CONNECTION

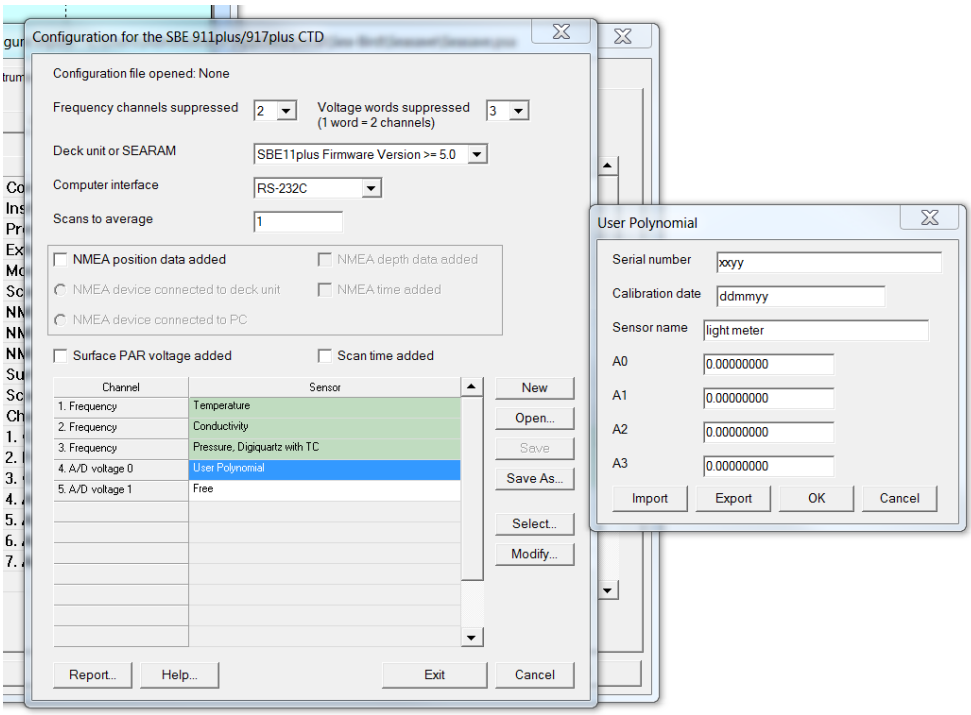
Sea-Bird Scientific

The light sensors must match our existing Sea-Bird wired CTD system. CTD is an abbreviation for "Conductivity", "Temperature", and "Depth" and is an instrument for measuring seawater's physical values such as conductivity, temperature and pressure throughout the water column. Our standard CTD is SBE 911 plus. This is an “SBE 9 plus unit” with an “SBE 11 plus V2 Deck Unit”.

Sea-Bird SBE 911 Plus with water retrieval ring, SBE 32, is part of the standard equipment on the Customer's own seagoing vessels. The light sensor will be mounted on to the retrieval ring (SBE 32) and communicate through an analogy (0-5 volts) port on CTD (SBE 911).

Sea-Bird Connection

This is how it looks in the sensor setup menu. The setup to use to configurate the instrument which are connected to a AUX port (AUX 1 A/D voltage 0 in this example)



If the instrument is not listed when you press “select”, then you can choose user polynomial, and give your instrument a name that you choose. It is just created fictive light meter. To know what to put in the A0, A1, A2, A3 a study of seasoft user manual is recommended.

Link to Sea-Bird manuals:

Sea-bird webpages: https://www.seabird.com/
Link to Sea-Bird SBE 911 Plus, overview, downloads and more:

https://www.seabird.com/profiling/sbe-911plus-ctd/family?productCategoryId=54627473769

https://www.seabird.com/profiling/sbe-911plus-ctd/family-downloads?productCategoryId=54627473769

water-sampler SBE 32

https://www.seabird.com/water-samplers/sbe-32-carousel-water-sampler-frame/family?productCategoryId=54627870416

SBE 911 Plus downloads: