Technical Guideline No. 05– The use of fluorimetric and other techniques for the in-situ determination of hydrocarbons in the water column

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To be used in conjunction with:

GUIDELINES FOR THE ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENT ASSOCIATED WITH SUBSEA OIL RELEASES AND DISPERSANT USE IN UK WATERS

1 Purpose and Scope

There are two main ways in which *in situ* fluorimetry can be used within the scenario under consideration within this project:

1. To establish concentration gradients in the open water column as a function of distance and direction from source, to investigate the concentrations to which organisms are being exposed across wide areas and at different depths in the water column. This was the way in which fluorimetry was used in monitoring studies which followed both the *Braer* and *Sea Empress* oil spills in 1993 and 1996. One limitation of the area which can be covered is the speed of the towing vessel, but short tows can be made and the instrument recovered for movement to another area, and the process repeated.
2. Used in either towed or profiling mode, to establish the vertical and horizontal concentrations across a subsea plume of oil and the changes with increasing distance from source.

Thus it will help to identify areas of potential impact and inform continued dispersant use and, if repeated over time, will allow the return to pre-existing background oil concentrations to be monitored.

This document supports and should be used in conjunction with environmental monitoring guidelines for subsea oil releases (Law et al., 2014).

2 Health and Safety considerations

In routine use, these mainly apply to the precautions to be taken when deploying gear from and onto the deck of a vessel at sea in varied weather conditions. Electrical voltages, both those sent to the units to power them and the signal returns, are low, and present no particular hazards. Depending on the method(s) used for calibration of the instrument, these processes may involve the use of solvents and other chemicals and should be subject to CoSHH assessment prior to use. Such assessments will outline the necessary use of personal protective equipment, local exhaust ventilation and other precautions deemed necessary. In earlier studies, calibration standards were prepared by homogenising a known quantity of oil directly in seawater by means of an Ultra-Turrax homogeniser, followed by serial dilution to produce a series of calibration solutions of known concentrations (Hurford et al., 1989).

3 Equipment

In situ fluorimeter

Suitable vessel for deployment

Towed fish to mount it in (e.g.plankton sampling unit)

Profiling frame for vertical sections (or a rosette sampler)

On-board equipment for powering unit and reception of signals and data handling and storage

Slip-ring winch to facilitate electrical connections between the fluorimeter and the on-board equipment

4 Procedure

Fluorimetry can provide a sensitive and rapid method for determining the concentrations of oil in the water column. *In situ* fluorimeters, an example is the Chelsea Instruments UV Aquatracka, make rapid measurements (0.5 Hz in that case, or once every 2 seconds) which can be transmitted to a surface vessel for near real-time concentration profiling. Alternatively, if used from ROVs or AUVs, data can be stored and downloaded on return to the parent vessel. Their use is envisaged both for dissolved oil and dispersed oil plumes in the scenario under consideration within this project. A depth sensor should be deployed alongside the fluorimeter and the signals from this also relayed to the vessel via a CTD unit, which acts as a reporting hub.

In the case of the UV Aquatracka, the response is linear at low concentrations (< 20 µg/l oil generally) but thereafter begins to curve due to a degree of self-absorption of the fluorescence signal. In the investigation of plume structure, it would also be very useful to incorporate oxygen sensors and the deployment of an LISST (Laser In Situ Scattering and Transmissometry) instrument. The former allows oxygen sags due to microbial activity to be detected; the latter uses laser diffraction to determine particle size distributions with a subsea plume (for oil which has been chemically dispersed effectively, this is likely to be within the range of 10 – 100 µm across, while natural dispersion will generate larger droplets). For information regarding LISST-DEEP deployment at depths of up to 3,000 m, see www.sequoiasci.com accessed 5 June 2014. Other useful information regarding use and deployment can be found in Agrawal et al. (1991), Agrawal and Pottsmith (2000), Fuller et al. (1013) and O'Neill et al. (2013). The combination of fluorimetry and LISST can provide strong evidence that dispersant application is proving effective, by providing both high oil concentrations and an identification of small-sized particles at locations within the water column. The particle size information will also be useful as an input to help refine models.

5 References

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