OSPAR COMMISSION

Assessment of the possible effects of releases of oil and chemicals from any disturbance of cuttings piles *(2009 update)*

Offshore Industry Series

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.

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Executive Summary

The disturbance of cuttings piles raises concern

Cuttings piles arise from drilling operations where the drilled cuttings and associated drilling fluids are discharged at the location of the well. Old cuttings piles may contain organic-phase drilling fluids and have been identified as possible sources of hydrocarbon releases into the marine environment, due to remobilisation of residues of oil still found in the piles and natural leaching in to the water column. Concerns arose over the potential remobilisation of cuttings piles due to disturbance from other activities, *i.e.* trawling and decommissioning activities.

Research studies have investigated possible impacts on the marine environment

The United Kingdom and Norway have carried out several research studies to assess the potential for impacts arising from the re-distribution of contaminated cuttings due to disturbance. OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles aims at reducing to a level that is not significant, the impacts of pollution by oil and/or other substances from cuttings piles.

No major impacts on the marine environment have been detected

A Norwegian study assessing the level of hydrocarbon loss due to dredging activities concluded that leaching from dredging (water phase hydrocarbons) and leaching from a pile left undisturbed are small compared to the potential loss due to particle bound hydrocarbon losses during a dredging operation. However, the authors warned that the estimates presented within the report must be treated with care and be regarded as indications only.

A study undertaken in the United Kingdom using trawling operations to disturb a cuttings pile concluded that although contamination was spread, it was not in amounts or at rates likely to pose serious wider contamination or toxicological threats to the marine environment. The act of spreading will encourage, albeit at a slow rate, increased aeration of deposited material which will enable its further degradation by natural processes. Further studies undertaken in the United Kingdom looked at the possible impacts from the removal of contaminated cuttings piles using suction devices. They have indicated that the disturbance of cuttings piles by suction equipment results in relatively low secondary pollution with the oil generally remaining bound to the drill cuttings.

There is no need to develop additional OSPAR measures

It can be concluded that no OSPAR measure on this subject should be developed at this time. However, OSPAR Contracting Parties should reassess the situation and possible impacts in the meeting cycle 2013/2014, in the light of the results of further post-decommissioning environmental surveys.

Récapitulatif

Les perturbations dues aux piles des déblais de forage inquiètent

Les piles de déblais de forage proviennent des opérations de forage où les déblais de forage et les fluides de forages associés sont déversés à l'endroit du puits. Les anciennes piles de déblais peuvent contenir des fluides de forage à phase organique et ont été identifiées comme des sources potentielles de libération d'hydrocarbures dans l'environnement marin en raison de la remobilisation des résidus de pétrole qui se trouvent toujours dans les piles et qui s'infiltrent naturellement dans la colonne d'eau. Les inquiétudes sont survenues sur le potentiel de remobilisation des piles de déblais en raison des perturbations venant d'autres activités, c'est-à-dire chalutage et activités de démantèlement.

Les recherches ont examiné les impacts possibles sur l'environnement marin

Le Royaume-Uni et la Norvège ont entrepris plusieurs recherches pour évaluer le potentiel de l'impact survenant de la redistribution des déblais contaminés à la suite de perturbations. La recommandation d'OSPAR 2006/5 sur un régime de gestion des piles de déblais de forage offshore vise à réduire, à un niveau non significatif, les impacts de la pollution par les hydrocarbures et/ou par d'autres substances provenant de piles de déblais de forage.

Aucun impact majeur n'a été détecté sur l'environnement marin

L'étude norvégienne évaluant le niveau d'hydrocarbures relâchés lors des activités de dragage, a conclu que les infiltrations dues au dragage (hydrocarbures en phase aqueuse) et les infiltrations d'une pile laissée non perturbée sont faibles comparées au potentiel de perte dû aux particules retenant des hydrocarbures perdues pendant l'opération de dragage. Cependant, les auteurs préviennent que les estimations présentées dans le rapport doivent être traitées avec précaution et être considérées seulement comme des indications.

Une étude entreprise au Royaume-Uni utilisant les opérations de chalutage pour perturber les piles de déblais a conclu que bien que cette contamination se soit répandue, elle n'était pas assez importante ni assez rapide pour poser des problèmes de contamination plus large ou des menaces toxicologiques pour l'environnement marin. L'action de répartition encouragera, malgré un rythme faible, l'augmentation de l'aération des substances déposées qui permettront leurs futures dégradations par un processus naturel. D'autres études entreprises au Royaume-Uni ont observé les impacts potentiels d'un enlèvement des piles de déblais contaminées utilisant des appareils d'aspiration. Elles ont indiqué que les perturbations des piles de déblais par un équipement aspirant donnent lieu à une seconde pollution relativement faible avec le pétrole subsistant sur les déblais de forage.

Il n'est pas nécessaire de développer une nouvelle mesure OSPAR

On peut conclure qu'aucune mesure OSPAR sur ce sujet ne devrait être développée pour le moment. Cependant les Parties Contractantes à OSPAR devront réévaluer la situation et les impacts potentiels lors du cycle de réunions 2013/2014, à la lumière des résultats des prochaines études environnementales post-démantèlement.

1. Background

Cuttings piles arise from drilling operations where the drilled cuttings and associated drilling fluids are discharged at the location of the well. Cuttings may contain traces of the drilling fluids used in the wells from which they are derived. Drilling fluids are categorised into either water-based or organic-phase fluids. Old cuttings piles may contain organic-phase drilling fluids and have been identified as possible sources of hydrocarbon releases into the marine environment, due to remobilisation of residues of oil still found in the piles and natural leaching into the water column. There have been concerns raised over the potential remobilisation of cuttings piles due to disturbance from other activities, *i.e.* trawling and decommissioning activities. Cuttings piles do not occur in many Contracting Parties' jurisdictions and contributions to this assessment were invited from Denmark, Germany, the Netherlands, Norway and the United Kingdom.

OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles aims at reducing to a level that is not significant, the impacts of pollution by oil and/or other substances from cuttings piles. It establishes a regime which is divided into two stages. Stage 1 involves initial screening of all cuttings piles. Stage 2 involves a BAT and/or BEP assessment, *inter alia* taking into account potential disturbance due to decommissioning or other legitimate uses of the sea. Contracting Parties have undertaken screening assessments as part of Stage 1 which indicated that the rates of leaching were low and no immediate action was required (OSPAR, 2009a).

The OSPAR Joint Assessment and Monitoring Programme (JAMP) requires assessments of progress against the objectives of the offshore strategy as contributions to assessments of the general quality status of the marine environment. Assessments are intended to consider the extent to which parts of the maritime area are, or are being, adversely affected by offshore activities, in particular those resulting from the natural redistribution of waste which was disposed of in the past. Assessments should also conclude on the need for further action such as the development of programmes and measures for the restoration, where practicable, of marine areas which have been adversely affected.

The JAMP OA-2 Assessment of the possible effects of releases of oil and chemicals from any disturbance of cuttings piles was first published in 2007. The United Kingdom was tasked to update this assessment and its conclusions in the light of Contracting Parties' implementation reports for OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles (OSPAR, 2009a). The implementation reports indicated that there was no evidence of substantial loss of oil, however, but provided little additional information on disturbance of cuttings piles. The update of the JAMP OA-2 Assessment was therefore based on additional information from research and technical reports.

Reviewed studies include:

- A study on the interaction of fishing gear and piles (FSR-ML 2000);
- The United Kingdom Offshore Operators Association (UKOOA) Joint Industry Project (JIP) on cuttings pile management (UKOOA 2002);
- Reports on the Ekofisk, and Albuskjell cuttings piles (DNV 2006),
- A study on the N W Hutton cuttings pile (CEFAS 2001);
- A study on the Hutton Tension Leg Platform cuttings pile (ERT 2004).

The assessment contributes to the overall assessment of the impacts of the offshore oil and gas activities to the North-East Atlantic (OSPAR, 2009b) and the Quality Status Report 2010.

2. Research Work

2.1 Fishing Gear Interaction

This experiment was designed to measure the extent of contamination spread using a fluorescently labelled surrogate for cuttings material. It involved the deposition of frozen sediment blocks, over-fishing using a monkfish trawl and subsequent sampling of sediment by traps and grabs.

The comparison of direct observations of fluorescence spread with modelled assumptions suggested that trawling activity disturbed relatively little material to a significant height into the water column. As a result, contamination spread is expected to be modest and to have little environmental significance.

The Fisheries Research Services (FRS) study (FSR-ML 2000) was conducted in the outer Moray Firth at an abandoned single well location drilled with a unique synthetic oil based mud characterised by having a simple and readily identifiable gas chromatograph and mass spectrometer signature. The site was in 70 m water depth and its contamination history was well known as a result of previous monitoring. The experiment protocol comprised trawling over the site at varying degrees of intensity with a heavy monkfish trawl, followed by targeted monitoring of sediments by Day grab using the Fisheries Research Services Marine Laboratory (FRS-ML) research vessel, *FRV Scotia.* In addition, sediment traps were set at 2000 m downstream in the residual tidal direction to collect disturbed sediment at varying times and at varying heights in the water column after discrete disturbance events. Information on seabed currents was collected using vessel-mounted and moored acoustic doppler current profiler arrays.

Monitoring of a surrogate for contaminated cuttings material was undertaken by tracking the dispersion of especially formulated particles tagged with a fluorescent label designed to mimic finer material in expectation of its greater susceptibility to disturbance and in recognition that smaller particles will carry a proportionally greater overall contamination per unit of mass. Laboratory settling velocity trials on the manufactured material had the same settling properties as contaminated sediments. The surrogate material was thoroughly mixed with contaminated sediments from the drill site to ensure, as far as possible, that the fluorescently labelled particles had the same surface active properties as the contaminated material. A streak of labelled sediment 50 m long by an estimated one metre wide was laid and inspected by Remotely Operated Vehicle (ROV) after deposit.

Trawling operations used a heavy monkfish trawl, to maximise disturbance, with position indicator equipment to confirm that the tagged sediment location was being hit. The centre of the initial tracer location was passed over 17 times in a 9 day period, an intensity which compares with the highest estimated averaged frequency of over-trawling of 3 times annually per square metre in the southern North Sea.

A 3D mathematical model was used to simulate the movement of re-suspended sediment particles following trawling. Particles were injected into the model at 5 minute time steps and were moved, in simulation, in three dimensions by processes of advection (horizontal) due to tide and current; dispersion (horizontal) due to turbulence; mixing (vertical) due to turbulence; and fall out (vertical). The resultant footprint was compared with the measured distribution of particles in the field.

At 6 stations, tracer was found at low concentration outwith the predicted footprint. A total of 31 stations with higher observed tracer concentrations lay within the footprint. The stations with the highest counts were observed within 2 km of the origin and the general pattern of distribution of observed particle concentrations closely matched those predicted by the model.

The results indicated that the dispersal of contaminated cuttings material arising from over-trawling will not be of measurable environmental significance. Contamination will be spread, but not in amounts or at rates that are likely to pose serious wider contamination or toxicological threats to the marine environment. The act

of spreading will encourage, albeit at a slow rate, increased aeration of deposited material which will enable its further degradation by natural processes.

2.2 Ekofisk and Albuskjell

The cuttings piles at Ekofisk 2/4A and Albuskjell 1/6A were investigated as part of the 2005 Environmental Monitoring Survey in Region I – Ekofisk. Laboratory analyses of sedimentation, oil content, grain size distribution and leaching were carried out on a deep sediment core sample from the cuttings material from Ekofisk 2/4A. Potential hydrocarbon losses were estimated if a volume of 2700 m^3 is dredged, based on the hydrocarbon concentration in the sample and leaching behaviour. Hydrocarbon losses due to trawling were compared to losses if there is no disturbance. The sedimentation test showed that a large amount of the material sinks one metre within a short time span and the rate was much higher than expected for individual clay and silt grains. The heaviest fraction sinks first and the lighter fraction (clay and silt) will sink last. Total hydrocarbon (THC) will be more associated to the clay and silt fraction of sediment due to electrochemical charges and to a lesser degree to coarser sediment like sand. This is important with regards to possible spreading of contaminated sediment during a dredging operation where the fine fraction should be the main concern. This fraction has the highest potential to spread during a dredging operation.

The report (DNV 2006) points out that the type of dredging equipment is significant as different equipment may mean variations in the amounts of total mass and grain sizes introduced to the water column during operation. It was not possible to give an exact value for the amount of material introduced to the water column during a dredging operation but experience values were used to estimate spreading of particles due to dredging operations (for example Suspended Sediment FATE (SSFATE) model developed by the US Army Corps of Engineers, Water Experiment Station). Det Norske Veritas (DNV) drew on the investigations of the loss of hydrocarbons due to trawling during UKOOA JIP drill cuttings study (UKOOA 2002). It was estimated that trawling over medium sized oil based cuttings pile would make a 20 cm deep trench in the pile and disturb about 600 m^3 of cuttings, of which 20 m^3 is suspended and 5 m^3 settles outside the cuttings pile. The authors estimate the loss of hydrocarbons from the cuttings pile at Ekofisk 2/4A at 1900 m^2 on the basis of the loss estimated on the UKOOA study for a medium sized pile of 0.28 kg/m^2 year. Table 2.1 compares estimates of hydrocarbon losses from the different scenarios against a baseline assumption that all dredged material is lost.

Table 2.1 Estimates of hydrocarbon losses

Scenario	**Loss of hydrocarbons (tonnes)**
All dredged material lost	114
30% of dredged material lost	34
10% of material lost	11
Leaching of hydrocarbons from dredged (particulate) material	0.003
Loss due to trawling	0.2
Loss per year without man made disturbance	0.5

The report concludes that leaching from dredging (water phase hydrocarbons) and leaching from a pile left undisturbed are small compared to the potential loss due to particle bound hydrocarbon losses during a dredging operation. The authors warn that the estimates must be treated with care and be regarded as indications only. The sedimentation and leaching test is based on only one sample. Norway has pointed out that their National Experts Group do not agree with some of the conclusions in the DNV report (DNV 2006) because they are not convinced that the measurements of THC in the Ekofisk pile are reliable and the rate of oil loss may therefore be higher.

2.3 N W Hutton Cuttings Recovery Project

An offshore trial of a drill cuttings recovery system was carried out on the N W Hutton platform as part of the UKOOA JIP Drill Cuttings Inititative (UKOOA 2002) and a comprehensive environmental monitoring package was deployed around the platform to quantify any disturbance of the pile and any release of contaminants to the local environment (CEFAS 2001). A variety of MiniLanders were used as monitoring stations to record any suspended sediment plumes and samples were taken for chemical analysis. Cuttings recovery was performed by a work-class ROV with a dredge arm. The arm was used to sweep back and forth and in and out to recover cuttings from the pile. A centrifugal dredging pump located on the seabed transferred cuttings to the platform via a fixed hose. A rotating cutter head fitted to the dredging arm created a visible but relatively small plume during operation but no significant plume was seen when a suction head was fitted. Shutting down and backflushing resulted in significant re-suspension of cuttings material.

Results indicated that plume generation and drifting of re-suspended material was low during dredging operations. Levels of oil contamination on the disturbed cuttings were found to be similar to those that would have been expected from generic undisturbed oil cuttings. It was concluded that during dredging operations the majority of oil remains bound on cuttings and that the low level of oil in the water associated with the dredged material was possibly due to the high ratio of water recovered with the solids.

Contaminant analysis confirmed that the background levels of barium and total hydrocarbons were not increased significantly in the seawater samples at the monitoring stations as a result of the dredging operation. Levels of alkyl phenol ethoxylates and barium were higher in the recovered water at the platform topsides. Low specific activity (LSA) levels in the recovered cuttings material were low and similar to background levels. There was no detectable oil in the plumes generated during the trial.

The trial indicates that disturbance of the cuttings pile by the dredging equipment results in relatively low secondary pollution with the oil generally remaining bound to the drill cuttings. Little secondary pollution was discernable at a distance of 100 m from the dredging operations and no effects were seen at the surface.

2.4 Hutton Field Cuttings Pile

The Hutton Field in UK block 211/28a was decommissioned in 2002/2003 when the Tension Leg Platform (TLP) was removed together with the associated foundation and well templates (ERT 2004). The TLP was a semi-submersible installation with six columns anchored by 16 tension chains fixed to seabed foundations. Between 1981 and 2000, 32 two wells and 13 side tracks were drilled through a template beneath the TLP using water-based, diesel-based, low-toxicity oil-based and synthetic muds. Estimated quantities of cuttings material discharged were 18 000 m^3 of dry rock plus 18 000 m^3 of mud giving a total volume discharged of 36 000 m^3. During decommissioning it was necessary to clear the redundant foundation and well templates of any overlying cuttings material to enable removal operations. This involved the use of high-pressure water jets and caused the suspension of significant amounts of oil contaminated cuttings into the water column and re-deposition on the seabed.

A post decommissioning sampling survey was carried out in 2003 (ERT 2004), based on a pre-abandonment survey in 2001, thus allowing an assessment of any changes in the pattern of cuttings deposition on the seabed. A number of new sampling stations were added relatively close to the TLP location to provide a more detailed picture of the spatial extent of the area of seabed impacted by the periphery of the cuttings pile.

The data obtained from in situ measurements and observations of the sediments around the TLP site in 2003 suggested the presence of a distinct layer of cuttings on the seabed out to a distance of approximately 200 m from the TLP. The information from the physical and chemical analyses of the seabed sediments indicated the presence of significant quantities of cuttings derived material on the seabed at stations within 300 m of the TLP location. Concentrations decreased with increasing distance from the TLP location out to approximately 1000 m beyond which there was little or no evidence of cuttings derived components.

Comparison of the results in 2003 with pre-decommissioning data suggested that decommissioning activities have had little effect on the distribution of surface sediment cuttings contamination at stations located greater than 220 m from the TLP site.

In June 2003, following decommissioning of the TLP, the macrobenthic communities were shown to be highly modified up to 500 m from the centre of the Hutton site. At distances of about 500 m the community was observed to be intermediate between the highly modified and background communities (≥1000 m). As with previous surveys this disturbance of the benthic communities could be attributed to the deposition of hydrocarbon contaminated cuttings on the seabed.

Comparison with 2001 data indicated that the process of decommissioning had little or no real discernible effect. The most notable change between 2001 and 2003 was the presence of hydrocarbon tolerant taxa at a previously azoic station. These species have been able to exploit this area since the cessation of cuttings deposition and are typical of the primary colonization of an area high in hydrocarbon pollution.

Quantitative analysis of all previous surveys of the Hutton area showed that there have been natural long-term fluctuations in the background macrobenthic communities. Since the commencement of drilling, the communities within about 500 m of the centre have been affected and controlled by the levels of hydrocarbon pollution. Comparisons with this long-term historical data have also indicated increases in community diversity and changes in community structure that suggest that these communities are in transition towards a community that is less indicative of disturbance.

The conclusions from the study were that disturbance of the cuttings pile due to decommissioning activities at the Hutton site had no major effect on the spatial distribution of cuttings contamination or the biological communities present in the seabed located greater than 100 m from the original location of the installation.

3. Conclusions

The information available to date suggests that disturbance of cuttings piles does not appear to lead to increased impacts on the marine environment. It can be concluded that no OSPAR measure on this subject should be developed at this time. However, OSPAR Contracting Parties should reassess the situation in the meeting cycle 2013/2014, in the light of the results of further post-decommissioning environmental surveys.

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