IMPACT OF THE OSPAR DECISION ON THE HARMONISED MANDATORY CONTROL SCHEME ON THE OFFSHORE CHEMICAL SUPPLY INDUSTRY

Melanie Thatcher[1], Graham Payne[2]

[1]EOSCA, c/o Baker Hughes INTEQ, Barclayhill Place, Portlethen, Aberdeen AB12 4PF
[2]EOSCA, c/o Briar Technical Services Ltd, 501 North Deeside Road, Cults, Aberdeen AB15 9ES, UK

1 ABSTRACT

By November 2001, the OSPAR Decision on the Harmonised Mandatory Control Scheme (HMCS) should have been in force and operating for nearly a year. The objective of the HMCS is to protect the marine environment by identifying those chemicals used in offshore oil and gas operations with the potential for causing an adverse environmental impact and restricting their use and discharge to the sea. Accordingly, this legislation will drive the development and selection of offshore chemicals that have the lowest impact on the marine environment. A series of associated Recommendations provide guidance on how to compare the potential environmental impact of different chemicals. This involves the generation of an environmental data set (i.e. toxicity, persistence and bioaccumulation potential) and its evaluation using pre-screening criteria and a decision-support tool called CHARM (Chemical Hazard Assessment and Risk Management) Model.

While the Decision provides a standardised framework, those countries having oil and gas operations in the Northeast Atlantic have implemented the requirements in different ways. An account is given of the national schemes operating in the UK, Denmark, Norway and the Netherlands that focuses upon the involvement of the chemical supplier. The paper draws conclusions about the current and future impacts of the HMCS on the offshore chemical supply industry.

2 INTRODUCTION

Contracting Parties to OSPAR, i.e. government agencies representing those countries bordering the Northeast Atlantic are charged with protecting the marine environment of the North Sea. In June 2000, the OSPAR Commission adopted Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals[1]. The aim of this legislation is to establish a consistent framework within which the amount and harmfulness of chemicals used and discharged in the course of offshore oil and gas exploration and production processes can be reduced. These chemicals include those used for drilling, production, cementing, completions and workovers.

The common framework outlined in OSPAR Decision 2000/2 will be incorporated into the National legislation of the contracting parties to OSPAR. The Decision is supported by a number of Recommendations that describe how the Mandatory Control Scheme will work in practice and this is summarised in Figure 1. The responsibilities of the chemical supplier, operating company and regulatory agency differ according to the national sector in which the chemical is to be used and will be clarified later when the different national schemes are described.

Under the HMCS, a chemical developed for use on an offshore installation will not be permitted without authorisation from the authorities of the intended sector of the North Sea. If a new product is to be considered for use, the first step is to complete a standard form known as the Harmonised Offshore Chemical Notification Format or HOCNF which is described in Recommendation 2000/5[2]. The HOCNF requires details of the chemical composition, information on the quantities to be used and discharged, how the chemical will be applied, and the environmental properties of the products including toxicity to aquatic organisms and the fate and effects of component substances.

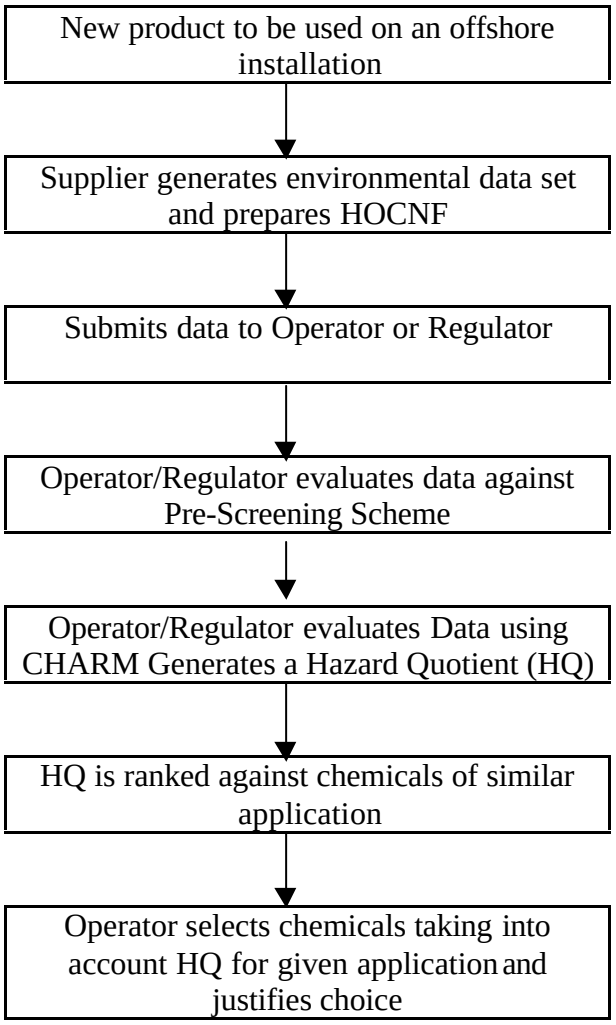

Figure 1 *Outline of the Harmonised Mandatory Control Scheme*

3 ENVIRONMENTAL TESTING

The toxicity tests to be conducted are specified in the guidelines accompanying Recommendation 2000/5. Those marine species selected for the scheme not only represent different physical positions within the marine environment (i.e. water surface, water column and seabed), but also represent links in the food chain i.e. fish feed on crustacea which feed on algae.

The usual toxicity tests conducted for the registration process and their typical costs are given in Table 1.

Test Required	Test protocol	Typical Cost (£)
Algae	72hr EC_{50}: *Skeletonema costatum* ISO/DIS 10253	950
Crustacean	48 hr LC_{50}: *Acartia tonsa* ISO TC147/SC5/WG2	850
Fish	96hr LC_{50}: *Schophthalamus maximus*, juvenile OECD 203 modified for marine species	960
Crustacean – sediment reworker	10 day LC_{50}: *Corophium volutator* PARCOM	900
Biodegradation – Water soluble substances	28 day aerobic, marine OECD 306	660
Biodegradation – Water insoluble substances	28 day aerobic, marine BODIS (BOD for Insoluble Substances)	660
Bioaccumulation Potential	Octanol/water partition co-efficient (log P_{ow}) OECD 117 or 107	400 or 900

Table 1 Environmental Tests required under the HMCS and Typical Cost

The tests on the water-dwelling species (*Skeletonema, Acartia* and *Schophthalamus*) are mandatory whereas the sediment reworker test is conditional upon the possibility that the chemical will reach the seabed. Other test species are permitted and these are outlined in the Draft OSPAR Guidelines for Toxicity Testing of Substances and Preparations Used and Discharged Offshore[3].

Biodegradation data on each deliberately-added organic substance is required in addition to the toxicity tests. Two 28-day aerobic marine protocols are preferred: OECD 306[4] and the BODIS test[5].

Bioaccumulation potential data on each deliberately-added organic substance is also required. Most commonly, the test conducted is the OECD 117[6] HPLC test although OECD 107[7] is also accepted for pure substances, and the blue mussel bioconcentration factor test OECD 305[8] was required for synthetic base fluids for drilling muds.

It is only substances which appear on the PLONOR list[9] (formerly the PARCOM A list) that are not required to be tested as described above. PLONOR substances are those considered to Pose Little Or NO Risk to the environment and their environmental effects are considered to be well known. Over 100 substances appear on this list.

4 PRE-SCREENING SCHEME

Once the HOCNF is complete, it is passed to the Operator or Regulator for appraisal of the environmental profile of the product. The first phase of the assessment will be to evaluate the data against the Pre-Screening Scheme. This is a flow-chart outlined in OSPAR Recommendation 2000/4[10]. There are a number of possible outcomes from the flow-chart. A PLONOR substance will generally receive immediate approval although special features of the receiving environment e.g. fish spawning season, may dictate conditions for use. Conversely, a few substances e.g. those appearing on Annex 2 to OSPAR Strategy with regard to Hazardous Substances[11] may be prohibited from use.

The remaining offshore chemicals will go to one of two other outcomes. Those substances having a low rate of biodegradation, or a combination of this with low toxicity or high potential for bioaccumulation will go to the "Substitute" box. The Operating Company would be expected to try to find an alternative product for the same application, but which has a better environmental profile. If an alternative can not be found, temporary permission for use of the product will be granted. The duration of the temporary permission will range between 6 months and 3 years depending upon the level of concern about the potential environmental effects of the substance.

Those substances which pass through the scheme to the "Ranking" box of the flow-chart and those given temporary permission go to the second stage of the assessment. This involves evaluation by CHARM (Chemical Hazard Assessment and Risk Management) model.

In considering the impact of the pre-screening scheme on the Chemical Supply Industry, we can look to the evaluation that CEFAS (Centre for Environment, Fisheries and Aquaculture Science) performed about a year ago. They reviewed 1990 oilfield chemicals in their database of registered products to determine the proportion of chemicals arriving at each outcome from the flow-chart. This breakdown, which is based upon the current environmental data available for the products is given in Table 2.

Rebrand of Substances or Products containing Substances….	Number of Chemicals	Percentage (%)	Pre-Screening Outcome
PLONOR chemicals	604	30	Permitted for use
Listed on Annex 2 to OSPAR Strategy on Hazardous Substances	43	2	Prohibited for use
Rebrand of inorganic substances (if LC/EC_{50} >1 mg/l)	119	6	Expert Judgement
Products containing inorganic substances (if LC/EC_{50} >1 mg/l)	398	20	Expert Judgement
Biodegrade <20% in 28 days	615	31	Substitute
Meets 2 of the 3 criteria	193	10	Substitute
Go to Ranking	377	19	CHARM Assessment

Table 2 Proportion of oilfield chemicals arriving at different outcomes of the pre-screening scheme

The table indicates that a proportion of chemicals will go to the "Substitute" box. These are predominantly products containing substances having a low rate of biodegradation and are mostly of a polymeric nature. It will be very difficult to find alternatives to these in the short term, but this is the future challenge for the industry.

5 CHARM

The CHARM model comprises a set of calculation rules from which the outcome is a single number that represents the likelihood that a chemical will cause harm when used and ultimately discharged into the marine environment. The outcome is called a Hazard Quotient (HQ) and this represents the ratio of the Predicted Environmental Concentration (PEC): Predicted No Effect Concentration (PNEC).

There are different sets of calculation rules for production chemicals, surfactants, water-based drilling muds, cementing, completion and workover chemicals that reflect the different ways that they are applied on the offshore installation. These are described in the CHARM User Guide[12]. Where a chemical is made up of a number of component substances, a CHARM assessment is run on each substance.

The input information needed to calculate the HQ for each substance comprises only the environmental data, the dose rate and the percentage of the substance in the preparation or mixture. Parameters representing a standard gas or oil platform or drilling rig are kept the same for all assessments of the HQ. The dose given must represent that dose which would provide optimal technical performance under the conditions of the standard platform/rig and so might not reflect actual dosages being used in the field.

Since these "standard installations" do not exist, dose rates for them must be of a somewhat arbitrary nature especially where new and possibly untrialed products are concerned. Where an actual dose rate can be shown to be significantly different from that for the standard installation, then RQs should be generated and compared rather than HQs.

The CHARM model also does not fully cover all offshore operations in which chemicals are used. Activities like downhole scale inhibitor squeeze treatments do not fall easily into the current production chemical usage proforma within CHARM. The CHARM model will need to develop further to encompass such everyday operations as this and others not presently catered for. Involvement of the chemical supply companies in this further development of CHARM is essential if these are to be accurately reflected in the model.

5.1 Hazard Quotient Ranking

The generation of a single number (HQ) for each substance in principle, means that the environmental properties of two substances can be directly compared and gives an Operator visibility to select the chemical having the better environmental performance.

The significance of HQs and the inherent uncertainties in the numbers generated must be fully understood. There will be some who will take the HQs calculated as definitive and will differentiate between products having HQs of, say, 1.3 (being "bad" as it is greater than 1) and 0.7 (being "good" as it is less than 1). Uncertainty analysis for production chemicals has shown that the 90% confidence interval for each HQ can be set at HQ/3 and HQ*3 for the lower and upper limits[13]. For a product with an HQ of 1 these become a range between 0.33 and 3.0. Therefore, to differentiate between products with HQs in this range can not really be justified. Similar uncertainty analysis is being considered for drilling chemicals.

5.2 Justification for Use/Risk Assessment

The operating company must justify the selection of the suite of chemicals to be used on a drilling rig or production platform to the authorities. Of course, the environmental effects of the chemical in the marine environment are only one parameter in a number of considerations that must be given to the selection. Most importantly, the chemical must perform effectively. Factors such as human health effects and cost should also come into the equation.

The CHARM model will permit a site-specific assessment of risk by allowing the user to enter actual rig or platform-specific data. The Risk Quotient (RQ) resulting from this set of calculations can be used to assist the selection process. However, only the UK authorities have stated that the use of the risk assessment module in CHARM will be acceptable as part of the justification process.

6 IMPLEMENTATION OF THE HMCS INTO NATIONAL LEGISLATION

The four countries that have major offshore activities in the North Sea are Denmark, The Netherlands, Norway and the UK. Each is in the process of incorporating the HMCS into their national legislation. Slight differences exist in the way that each country is operating the scheme and this is commented on below. Comments are made on how these differences affect the offshore chemical supply industry.

6.1 Denmark

In Denmark, the Danish Environmental Protection Agency (EPA) and operators are working closely on implementation of the HMCS. This will be initially by administrative action and then via an amended marine law (the present marine law does not allow regulation of chemical use, only discharge). The new law will be laid before the Parliament before the end of this year and the administrative process for all offshore chemicals should be in place by 2002.

The registration process is described in a document entitled "New rules and requirements concerning offshore chemicals used in the Danish Sector of the North Sea[14]. It involves the submission of the completed HOCNF with full composition to the Danish Product Register who assigns a Pr-number if acceptable. The data will be entered into a database which the Danish EPA have access to. Products currently in use must be re-registered over the next three years on a prioritised basis.

For the environmental testing, Denmark is the most strict on requiring toxicity data at the substance level. This has huge cost implications. The testing cost for a demulsifier comprising four component substances would be nearly £20,000.

The chemical supplier will also give an HOCNF with generic composition to the Operating Company. This provides the information the Operator needs to perform the pre-screening and CHARM assessments. Health and Safety criteria will also be integrated into the decision-making process. Permits will be granted to operators for up to three years, depending upon the outcome of these evaluations. These permits would apply across all installations operated and would not include site-specific evaluations. The authorities, however, could still impose site-specific conditions, regulating the use and discharge of chemicals based on their intrinsic properties rather than an assessment of risk to the marine environment.

CHARM is only to be used for generic ranking purposes. Only the "hazard module" is to be used. The site-specific risk assessment module is not permitted for use in justifying the selection of particular chemicals.

6.2 Netherlands

In the Netherlands, implementation of HMCS will be through a new mining law. It is expected to come into force on 1 January 2002 and until then, the HMCS will be implemented by "administrative action". The inspector general (IGM) of the State Supervision of Mines can write a so-called Order in Council that effectively means that use and discharge will be controlled via the HMCS. In 2002, the Inspector General of Mines for the Netherlands will issue a letter stating how the OSPAR Decision is to be implemented. The appropriate OSPAR Decisions and Recommendations will be attached to this letter.

The HMCS will work under the framework of the Environmental Covenant within a broader goal of phasing out harmful substances by 2010. The objectives of the Dutch approach will be to reduce progressively the use and discharge of all chemicals.

Operators in the Netherlands have begun to develop an inventory of chemicals. At this early stage, it is clear that of 35 preparations in use on the Netherlands Continental Shelf, almost 50% of the individual substances are candidates for substitution.

6.3 Norway

The State Pollution Control Authority (SFT) who regulate the Norwegian sector of the North Sea have issued a draft of the new Norwegian regulations incorporating the HMCS within a broader HSE regulatory framework[15]. These new regulations are likely to be implemented at the end of 2001/early 2002.

In Norway, the chemical supply company prepares an HOCNF with the generic composition. On behalf of an operating company, a copy is sent to Novatech who run the KPD Centre. They quality-check the data and enter it into the Chems database that is available to operating companies and the SFT.

In Norway, a full HOCNF is required for each chemical additive even for closed system chemicals i.e. those that will not be discharged such as organic phase drilling fluids and pipeline chemicals. In a drilling fluid, this could amount to more than 50 data points and a cost of over £50,000. The value of all this data has to be questioned. The UK require a reduced data set for organic phase fluids (Toxicity of the whole mud to *Corophium* and aerobic biodegradation on each organic substance) on the whole mud which is considered sufficient to give an indication of the environmental impact in the event of an accidental spillage.

The SFT also require substance level testing for organic substances having a biodegradability of <20% in 28 days.

The operating companies are granted Frame Permits by SFT and within these permits can select chemicals given consideration of their environmental profile. The evaluation will include assessment according to the pre-screening scheme for products containing persistant and bioaccumulative substances in particular, a phase-out plan is agreed between the operating company and the chemical supplier.

CHARM is not as central to the process as in other countries. The operators have developed a more advanced model for performing environmental impact assessments and this is increasingly used in Norway.

6.4 UK

In the UK, the new Offshore Chemical Regulations, 2001 will be issued by the Department of Trade and Industry (DTI) under the Integrated Pollution Prevention and Control Act. Draft Regulations, a Regulatory Impact Assessment and a set of Guidance Notes have been reviewed in a public consultation process. Latest drafts of the Regulations and Guidelines are posted on the DTI website[16]. At present, the expected date for introducing the Regulations is the end of October.

Operators will be required to have a permit for use and discharge of offshore chemicals for each installation. A “grace period” of 3 months starting on the day the Regulations come into force will apply. The new permitting regime will be phased in. All existing

installations will be granted 'deemed permits' (for up to two years) which will be called in for determination according to the size of the operation and the sensitivity of the area in which the operation is taking place. All new activities will need a new permit. Applications will include a 28-day public notice period when applicants have to signal their intention to seek a discharge through an appropriate medium.

Under the UK Offshore Chemical Notification Scheme, the HOCNF with full compositional information is sent to CEFAS. The guidelines for registering products for use in the UK sector are given on their website[17].

In terms of testing requirements, CEFAS are the most strict on having toxicity tests performed at the preparation level, arguing that this takes into account synergistic or antagonistic effects of combining chemicals. Unlike the other authorities, they are more flexible in permitting the submission of freshwater biodegradation data although the result is penalised in the CHARM assessment.

CEFAS will evaluate the data according to the pre-screening scheme and CHARM Hazard Assessment module. The product will be assigned to a colour band depending upon the CHARM HQ. It will be ranked against products having a similar application. The importance of colour banding ensures that, except at boundaries to the bands, small, insignificant differences in HQ are masked.

A "certificate" will be issued to the chemical supplier by CEFAS after completing the quality-check and the environmental assessment. This certificate will contain all the information required to for the operating company to use for in the risk assessment module of CHARM. CEFAS and the Fisheries Research Services in Aberdeen will evaluate the risk assessments.

Fees for data registration would be rolled into those for permit applications and be charged back to Operators applying for permits. For this reason, checks will be made to ensure that products registered under the new scheme are in use in the UK sector as it has been reported that products may be registered in the UK for use elsewhere in the world.

6.5 Other OSPAR Countries

Countries like France, Germany Ireland and Spain who have limited exploration or production activity at present must still implement the HMCS and this may be problematic. For example, French law covers not only 'European France' but also a range of dependent territories where OSPAR regulations were 'inappropriate'. The authorities are asking companies to apply the OSPAR controls on its Atlantic coast. The new French administration will need to find a generic solution to this problem.

7 IMPACT ON THE OFFSHORE CHEMICAL SUPPLY INDUSTRY

The introduction of HMCS will impact upon the chemical supply industry in a number of ways.

The degree of harmonisation achieved by the framework of the HMCS is very positive for the chemical supply industry. Standardisation of the reporting formats (HOCNF),

environmental test protocols, and the use of the pre-screening scheme and CHARM helps chemical suppliers to source the required data more efficiently. The transparency of the system enables suppliers to invest resources into products that will be more successful under the scheme i.e. those with good environmental performance.

On the other hand, the differences encountered in the National schemes lead to confusion for companies which register products for use in more than one country. Frequently, companies (particularly those handling registrations from the USA) believe that if they have registered a product in the UK, they can also sell it in the Netherlands or Norway and this is not the case.

Indeed, it may be the case, that the environmental data generated for registration in one county is not valid for registration in the others. For example, if toxicity data is generated on a preparation for the UK, it may not be accepted in Denmark. Additional testing to satisfy these differences adds to the compliance costs, not to mention the extra weeks needed to generate the data.

The increased cost of environmental testing (for example with the introduction of the mandatory fish test) could result in companies shortening their list of available products for use in the OSPAR area. As seen with the introduction of the Biocide Directive, the HMCS is likely to hinder the development of new products by reducing the level of research and development that companies are willing to invest in. This is contrary to the objectives of continual improvement through the HMCS. However, the cost of regulatory requirements must be out-weighed several fold by the return on sales otherwise companies will not invest.

While greener chemistries do exist, they are much more expensive than traditional products. For example, a “green” scale inhibitor has been developed, but is five times the price of phosphonates or polymers. Unsurprisingly, the industry is still to realise a market for these products.

Some countries e.g. UK are considering publishing the ranking list on the Internet. This is a concern for the chemical supply industry as it could have a significant negative commercial impact if misinterpreted or misused. First, the HQ is generated from a set of calculations using parameters of “standard installations” (water depth, tidal flow rate etc..). The conditions applied to this assessment may, therefore not reflect the actual conditions in which the chemical will be used in the field. The outcome of the standardised assessment may incorrectly suggest the chemical is a bad actor.

Second, the dosage parameter has a very strong influence in the calculation of HQ. Since the dose used is that for the “standard platform” rather than actual dose rate used, it is somewhat arbitrary. Visibility of the HQs of competitive products may enable the manipulation of the estimated dose to give a better HQ for the same product supplied by a different vendor. The dose rate for new products will need to be carefully scrutinised to ensure that it is not out of line with those of a similar composition and application.

8 FUTURE FOR THE OFFSHORE CHEMICAL SUPPLY INDUSTRY

Despite the concerns over testing costs, recent history has frequently shown that the chemical supply industry is developing increasingly environmentally acceptable chemicals. This is sure to continue as the relative positions on the hazard-ranking list will stimulate competition among companies for the best position.

The major challenge for the chemical supply industry is to develop products with high technical performance and good environmental performance. This is particularly difficult for corrosion inhibitors (traditionally comprising fairly toxic chemistries such as imidazolines and quaternary ammonium compounds) and demulsifiers that comprise persistent polymeric chemistries in organic solvents. Given time, alternatives will be found for these oilfield chemicals and others.

While the HMCS provides a common framework for OSPAR countries, it is clear that there are many differences in the way that the national schemes work in practice. In the future, we may see increasing harmonisation at the national level. For example, a common database of environmental data, a common OSPAR ranking list and a single registration authority for the OSPAR area have already been discussed.

References

1. OSPAR 00/20/1-E Summary Record, OSPAR Commission Meeting 26-30 JUNE 2000. http://www.ospar.org/eng/html/welcome.html
2. OSPAR Recommendation 2000/5 on a Harmonised Offshore Chemical Notification Format (HOCNF)
3. OIC 01/6/2-E Draft OSPAR Guidelines for Toxicity Testing of Substances and Preparations Used and Discharged Offshore presented by Denmark at the Oil Industries Committee meeting, February 2001.
4. OECD (1992): OECD Guideline 306 for Testing of Chemicals: "Biodegradability in Seawater – Closed Bottle Test", 17 July 1992.
5. ISO (1991): "BOD Test for Insoluble Substances – Two Phase Closed Bottle Test", TC/147.SC5/WG4 N141.
6. OECD (1989): "Partition Coefficients (n-octanol/water). High Performance Liquid Chromatography (HPLC) Method". OECD Guideline 117 for Testing of Chemicals, 30 March 1989.
7. OECD 107
8. OECD (1984): Guidelines for Bioaccumulation Testing 305A-E.
9. PLONOR list (1999-9) OSPAR List of Substances/Preparations Used and Discharged Offshore, which Pose Little or No Risk to the Environment (PLONOR)
10. OSPAR Recommendation 2000/4 on a Harmonised Pre-screening Scheme for Offshore Chemicals
11. OSPAR Strategy with regard to Hazardous Substances (1998-16). Annex 2: OSPAR List of Chemicals for Priority Action
12. Thatcher, M, L Henriquez and M Robson (2001): CHARM: User Guide. Ref http://www.ogp.org.uk/publications/index.html choose Non-OGP publications.
13. Karman, C.C and H.PM. Schobben (1996). CHARM Technical Note 42. "Uncertainty Analysis of the CHARM model".

14. New rules and requirements concerning offshore chemicals used in the Danish sector of the North Sea. Letter to all suppliers of offshore chemicals in Denmark, dated 15 January 2001.
15. Draft Norwegian Regulations http://www.sft.no/english/
16. Draft UK Regs and Guidelines http://www.og.dti.gov.uk
17. Guidelines for UK Offshore Chemical Notification Scheme http://www.cefas.co.uk/ocns/index.htm