



CLIMATE AND
POLLUTION
AGENCY

Report

Decommissioning of offshore installations

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1. Foreword

This report was drawn up by the Climate and Pollution Agency, with input from the Norwegian Petroleum Directorate, the Directorate of Health, the Directorate of Fisheries and the Norwegian Radiation Protection Authority, and deals with the environmental impacts associated with the decommissioning of offshore installations. We would like to thank ConocoPhillips and Total for sharing the experience they have gained from the Ekofisk and Frigg decommissioning projects respectively. In addition, we would like to thank the staff at AS Miljøbase Vats and Aker Stord for arranging very successful visits to the two decommissioning yards and providing a thorough review of their activities.

New legislation on the handling and storage of radioactive substances came into force 1 January 2011. This version of the report is updated to reflect this new regulation and will therefore in some chapters differ from the Norwegian version. The table 5.1 comparison of some elements of the permits held by the four decommissioning facilities is also updated.

Climate and Pollution Agency, Oslo, February 2011

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Source: Aker
Stord

Figure 1 The Frigg field showing decommissioning in progress

Contents

1.	Foreword	2
2.	Summary	4
3.	Introduction	7
3.1	The assignment.....	7
3.2	Background.....	7
4.	Projections for decommissioning of offshore installations	10
4.1	Timeframe and weight estimates.....	10
4.2	Weight estimates and decommissioning capacity in other countries.....	13
4.3	Types and quantities of waste material for recycling.....	15
4.4	Low specific activity (LSA) material from decommissioning of offshore installations.....	16
5.	Decommissioning capacity	19
5.1	Current decommissioning capacity.....	19
5.2	Decommissioning capacity in the future.....	23
6.	Environmental concerns	25
6.1	Offshore.....	25
6.2	Onshore.....	26
7.	Other concerns	30
7.1	Public health.....	30
7.2	Fisheries and aquaculture.....	32
7.3	Financial considerations.....	34
8.	National legislation	35
8.1	The Petroleum Activities Act (Ministry of Petroleum and Energy).....	35
8.2	Provisions of the Pollution Control Act relating to permits for demolition and recycling (County Governors' offices).....	36
8.3	Provisions of the Pollution Control Act relating to import and export of waste (Climate and Pollution Agency).....	38
8.4	The Act relating to ports and navigable waters (municipalities/Norwegian Coastal Administration).....	39
8.5	The Planning and Building Act (municipalities).....	39
8.6	Municipal Health Services Act.....	41
8.7	New legislation relating to radioactive material.....	41
9.	International rules	43
10.	Recommendations and proposals for further work	45

2. Summary

The Ministry of the Environment commissioned the Climate and Pollution Agency to examine the environmental impacts associated with the decommissioning of offshore installations (demolition and recycling). This has involved an assessment of the volumes and types of waste material and of decommissioning capacity in Norway now and in the future. This report also presents proposals for measures and instruments to address environmental and other concerns that arise in connection with the decommissioning of offshore installations.

At present, Norway has four decommissioning facilities for offshore installations, three of which are currently involved in decommissioning projects. Waste treatment plants of this kind are required to hold permits under the Pollution Control Act. The permit system allows the pollution control authority to tailor the requirements in a specific permit by evaluating conditions and limits for releases of pollutants on a case-to-case basis, and the Act also provides for requirements to be tightened up in line with the development of best available techniques (BAT). The environmental risks posed by decommissioning facilities are much the same as those from process industries and other waste treatment plants that are regulated by means of individual permits. Strict requirements are intended to ensure that environmental and health concerns are taken into account. The review of the four Norwegian decommissioning facilities in connection with this report shows that the degree to which requirements need to be tightened up varies from one facility to another. The permit for the Vats yard is newest and contains the strictest conditions.

The Climate and Pollution Agency recommends a number of measures and requirements that should be considered in the regulation of decommissioning facilities for offshore installations. These facilities need sound expertise to be able to identify and deal with different types of waste, including hazardous waste such as heavy metals, other hazardous substances, low specific activity (LSA) radioactive material and asbestos. Facilities must be designed to allow safe handling of such waste, with no risk of runoff or infiltration into the soil. In addition, a decommissioning facility should have an effective collection system and an on-site treatment plant for contaminated water, including surface water. Each facility must have a sampling and analysis programme to monitor releases of the most relevant pollutants. The need for an environmental monitoring programme to follow developments in the recipient should also be considered. Other factors that must be closely monitored include noise and releases to air in connection with metal cutting and other operations. Moreover, decommissioning contracts must ensure that the costs of handling hazardous waste are met by the offshore operators.

When decommissioning facilities for offshore installations are being sited, other interests must also be taken into account; for example, the use of nearby areas for housing, holiday housing or recreation. In addition, the implications for other sectors such as fisheries and agriculture must be taken into consideration. These are important issues that the municipalities must consider when preparing zoning plans and drawing up environmental impact assessments.

In many cases, a regional authority is in a better position than a national one to make overall, cross-sectoral assessments of developments within the region. Nevertheless, the report recommends transferring the authority for regulating decommissioning facilities for offshore installations from the County Governors to the Climate and Pollution Agency. Regulating these facilities requires special expertise and overall assessments, and is best dealt with at

central level. When new regulations have entered into force, the Norwegian Radiation Protection Authority will be responsible for regulating radioactive releases and waste from the same facilities under the Pollution Control Act. This will require close coordination between the two agencies and makes it more important to transfer authority to the Climate and Pollution Agency. In addition, decommissioning of offshore facilities involves the oil and gas industry and may involve the import and export of waste, both areas where the Climate and Pollution Agency is already the competent authority.

Norway's current decommissioning capacity will be sufficient to handle the projected decommissioning volumes in the period up to 2020, about 50 000–80 000 tonnes of steel a year. Around 2020, there is expected to be a steep increase, so that about 200 000 tonnes of steel a year will need to be dismantled and recycled. At this stage, it may be appropriate to establish new decommissioning facilities. There is a great deal of uncertainty associated with the timing of decommissioning of installations from the different fields. This depends on many factors, including oil prices, maintenance costs and the development of new technology for extracting oil and gas. The trend today is for the lifetimes of fields and installations to be extended beyond what was originally planned.

The costs of decommissioning the roughly 500 installations on the Norwegian continental shelf are uncertain, but a preliminary estimate suggests that the overall cost will be about NOK 160 billion. This estimate does not include the removal of fixed concrete substructures, since the costs of this are very uncertain at present. At present, the Norwegian state covers about 80% of the costs through tax deduction arrangements and its ownership interests in oil and gas fields. The costs will depend among other things on general cost trends in the industry and when decommissioning projects start.

Steel installations should be dismantled and recycled since they consist largely of high-quality steel, which can be profitably recycled at present. In addition, it is sound environmental and resource policy to clean up industrial sites once activities have ceased. The total weight of Norwegian concrete installations is about 5 million tonnes, corresponding to about 70% of the total weight of installations on the Norwegian continental shelf. Decommissioning of these installations should be further reviewed, for example whether concrete substructures can be left in place once they are stripped of equipment. The Norwegian Petroleum Directorate will take the initiative for a joint project together with other relevant authorities to consider future problems and measures in connection with the removal and decommissioning of concrete installations.

Installations should not be left in place for too long after cessation of production, since they rapidly deteriorate. Experience shows that the necessary steps to ensure worker safety before demolition starts become more costly as installations are left standing for longer. The Climate and Pollution Agency therefore recommends that a maximum time limit, for example five years, should be introduced for decommissioning of installations. This should be included in the decision on disposal for a field and in the Petroleum Act. Although plans for development and operation and plans for installation and operation include decommissioning procedures, these procedures should be reviewed further to improve field closure and decommissioning projects. This will ensure the retention of relevant documentation and transfer of operating experience.

So far, about four tonnes of radioactive waste (scale, sludge and sediments) with an activity concentration of 10 Bq/g or more has been found in each offshore installation

decommissioned in Norway. The installations decommissioned have been large, with a steel jacket or concrete substructure, and include structures from both the Norwegian and the UK sectors of the continental shelf. Radioactive scale is deposited inside oil and gas pipelines and associated equipment. New legislation on the handling and storage of radioactive substances from decommissioning of offshore installations came into force on 1 January 2011.

The Municipal Health Services Act includes a chapter on environmental health protection measures. In most municipalities, responsibility for these measures has been delegated to the municipal medical officer. The chapter on environmental health protection is not primarily designed to regulate enterprises prior to their establishment, but to deal with specific factors that may have a negative impact on health. It therefore includes provisions making it possible to carry out investigations or require the party responsible to remedy the situation or suspend activities. In principle, the Municipal Health Services Act applies alongside regulation under other legislation such as the Pollution Control Act, the Radiation Protection Act and the Planning and Building Act. Health effects must be taken into consideration when decisions are made under other legislation. The permit system under the Pollution Control Act ensures that health concerns are taken properly into account by setting requirements relating to releases of pollutants and noise levels.

The problems that decommissioning of offshore installations may cause for the fisheries and aquaculture are primarily related to the possible negative impacts of pollution, restrictions on access to areas, and installations and pipelines that are left in place on the continental shelf. Current practice means that pipelines in particular may be left in place. This can interfere with fishing activities in an area after oil and gas activities have ceased. The Directorate of Fisheries is concerned about the possible ecological impacts of losses of fishing gear, and dangerous situations that may occur if gear becomes snagged on installations.

3. Introduction

3.1 The assignment

On 22 October 2009, the Ministry of the Environment commissioned the Climate and Pollution Agency (then the Norwegian Pollution Control Authority), in cooperation with other relevant authorities, to examine the environmental impacts associated with the decommissioning of offshore installations (demolition and recycling).

More specifically, the following issues were to be considered:

1. Projections of the volume of offshore decommissioning in the years ahead, and the quantities of different waste materials to be recycled.
2. The decommissioning capacity available today, and Norway's needs in the future, based on the timing of decommissioning on the Norwegian continental shelf and projections of the import of installations for decommissioning.
3. The environmental implications of decommissioning large installations of this type, and whether the authorities need to introduce requirements or take action specifically related to the companies involved in these activities (specific techniques to be used, monitoring, control, etc).
4. Implications of these activities for other sectors (health, fisheries, land use, etc).
5. Which Norwegian legislation applies to decommissioning of offshore installations, and which authorities are involved in licensing, etc.
6. Which international rules are applicable to these activities.
7. Proposals for new measures and instruments at national or international level to address the impacts of decommissioning operations.

The Ministry of Petroleum and Energy, the Ministry of Health and Care Services and the Ministry of Fisheries and Coastal Affairs also received copies of the letter commissioning this report. The Climate and Pollution Agency has worked with the Directorate of Health, the Directorate of Fisheries, the Norwegian Petroleum Directorate and the Norwegian Radiation Protection Authority in drawing up this report. A visit to the Vats and Stord decommissioning yards also provided useful input.

3.2 Background

Some of the fields on the Norwegian continental shelf have already ceased production or will soon do so, and the installations will have to be decommissioned. According to OSPAR Decision 98/3, disused offshore installations must normally be removed and disposed of on land. The Storting (Norwegian parliament) has granted exemptions for two installations to be left in place on the Norwegian continental shelf. These are the Ekofisk tank and its protective concrete barrier, and the concrete substructure of the Frigg TCP2 module. As a general rule, pipelines and cables may be left in place provided that they do not constitute a nuisance or risk for bottom fisheries. Guidelines for this were set out in a white paper on the disposal of

disused pipelines and cables on the Norwegian continental shelf (Report to the Storting No. 47 (1999–2000)). The OSPAR Convention does not apply to pipelines and cables.

Under the Norwegian Petroleum Act, a decommissioning plan, including an impact assessment and plans for public consultation, must be submitted between two and five years before an installation is finally taken out of use. The Ministry of Petroleum and Energy makes final decisions on disposal. A decommissioning plan must contain proposals for continued production or shutdown of production and the disposal of installations. Disposal may mean further use in petroleum activities, other use, complete or partial removal or abandonment of installations.

If installations are not left in place (concrete substructures) or re-used directly (for example signal buoys, wind turbines), they must be removed to shore and delivered to approved waste treatment plants. If an installation is to be transported from the Norwegian sector of the continental shelf to another country, or imported, an export application must be sent to the competent authority in the dispatch state, and this process should be started between two and six months before the planned start of the operation.

Several methods are in use for dismantling installations:

- “piece small”: the installation is dismantled offshore and cut into small sections that are shipped onshore in containers
- heavy lift: whole modules are removed in the reverse of the installation sequence and loaded on to flat-top barges or a crane vessel for transport to the decommissioning yard
- single lift: the topsides and/or jacket are removed in one piece and transported to the decommissioning yard (rarely used)



Source: AF Decom offshore

Figure 2 Heavy lifting operation: modules being delivered to the Vats decommissioning yard by a crane vessel

Installations may also be dismantled into smaller sections while anchored in a fjord off the decommissioning yard, before the sections are taken ashore. Such activities require a separate permit under the Pollution Control Act.

Some parts of the installations can be re-used in the petroleum industry or for other purposes. However, experience so far has shown that there is a very limited market for re-use of installations on the Norwegian continental shelf. The steel column from the Frigg platform has been re-used as a breakwater at Tau, while the topside has been used as a training centre for offshore personnel. Esso's Odin steel platform was split into three modules and taken ashore at Stord (3).

Two decommissioning projects are under way in Norway at present. Structures from part of the Ekofisk field (6) with a total weight of about 108 000 tonnes are being decommissioned at AF Decom Vats. This project is expected to be completed in 2015. At Aker Stord, the Frigg decommissioning project is almost completed, and structures with a total weight of 90 000 tonnes have been decommissioned. The waste recovery rate is about 98% for both projects.

The sale and re-use of various parts of the installations and types of equipment is desirable, and motors, turbines, cranes, pumps and other such equipment should in principle be relatively easy to sell. However, in practice re-use is not of much significance because much of the material is old and out-of-date. It is generally more economical to purchase new rather than repair old equipment, but some equipment from the two ongoing projects has been sold for re-use.

In the Frigg decommissioning project, re-use of the concrete substructure as an artificial reef or a foundation for wind turbines or a bridge was considered. None of these options was found to be financially sound, and there was also a great deal of uncertainty about the practical aspects of using the structure in such ways.

4. Projections for decommissioning of offshore installations

Decommissioning of offshore installations is expected to generate large quantities of waste in the years ahead. Quantities are expected to rise particularly sharply in the period up to 2020, but it is difficult to judge when there are likely to be peaks. Some offshore installations are expected to be imported from other North Sea countries for decommissioning. Most of the waste is steel, which can be recycled.

4.1 Timeframe and weight estimates

In this report, the timeframe for decommissioning of the different installations on the Norwegian continental shelf has been estimated on the basis of the information the Norwegian Petroleum Directorate currently has on the oil and gas industry. However, there are many elements of uncertainty associated with both when fields are expected to cease production and when decommissioning of installations will take place. The weight estimates are largely based on figures reported directly by the operating companies. Factors such as completed or planned modification of installations, the addition of new installations and the possible re-use of installations result in a certain degree of uncertainty in the figures.

Uncertainties relating to the timeframe for decommissioning

The time when production ceases on different fields and installations will depend on a number of factors, some of them variable, but primarily oil prices, expected trends in production, operating and maintenance costs and the technical condition of installations. Historically, estimates of the lifetime of fields have varied with oil prices, but the overall trend today shows that lifetimes are being extended. In addition to the possibility that the date for cessation of production may deviate from that originally planned, the starting date and duration of the decommissioning project itself may be uncertain. There are considerable differences between fields in size, complexity and the number of installations. Development and operation may take place in several phases, so that certain installations are being decommissioned while others are still on stream. In many cases, the removal process will be affected by other factors such as the timing of well plugging, disconnection of pipelines or whether third parties are using installations. The method chosen for dismantling will influence both the timeframe and the types of waste transported to land. In some cases, an installation is transported ashore in one piece or a few large sections for dismantling (single or heavy lift, while in other cases dismantling is carried out offshore (piece small).

Other considerations

The figures for decommissioning costs provided by the operators have been used as part of the basis for estimating the timeframe and scale of decommissioning operations. It is reasonable to assume that different operators have used different approaches in drawing up their estimates. As more experience of decommissioning projects is gained, the estimates will become more accurate. The capacity of the supply industry is another important element of uncertainty.

The availability of heavy lift vessels, the development and use of new technology for removing installations, and the capacity of decommissioning yards will all affect the implementation of the different decommissioning projects. The removal of offshore installations is also dependent on suitable weather conditions, so that many activities can only be carried out during the summer months. To present realistic estimates of decommissioning

activity, we have chosen to use a stochastic model to estimate the timeframe for different decommissioning activities. However, new fields will also be developed in the years ahead, so that this report cannot provide a complete overview of future decommissioning activities.

Uncertainties associated with the weight estimates

A comparison of weight estimates based on the databases available showed considerable variations. To provide a better basis for the calculations, the Petroleum Directorate therefore asked the largest operators to provide data on weight calculations for their installations. This material was reviewed and supplemented with other available information. Installations are often modified during their lifetime – some modules may be replaced and new ones added. In many cases, the substructure is filled with ballast material after the installation is in place offshore. Marine fouling on the jacket and grout in the legs are other factors that affect the overall weight of material to be removed. It is reasonable to assume that a weight estimate will change when a decommissioning plan is drawn up for an installation, since this requires a detailed review of the structure and planning of the operations.

The concrete installations on the Norwegian continental shelf are an important source of uncertainty as regards the weight of material that will be taken ashore for decommissioning. There are twelve fixed and two floating concrete installations on the Norwegian shelf. Three of these were not designed to be removed, and two (the Frigg TCP2 module and the Ekofisk tank) have already been abandoned in situ after removal of the topsides and other steel structures. A number of technical, safety and environmental factors relating to the remaining fixed concrete installations will have to be considered before a final decision is made on their disposal.

Categories of installations

Table 4.1 shows the numbers of installations of different categories and the total weight of each category, excluding installations that have already been decommissioned. The weight of concrete substructures and topsides is given separately for concrete installations, and the total weight for other categories. The weight of concrete includes reinforcement materials.

Table 4.1 Number and total weight of different categories of installations currently standing on the Norwegian continental shelf

Category	Number	Total weight, tonnes
Concrete installations	12	480 000 (topsides)
		4 600 000 (concrete substructures)
Fixed steel installations	88	1 000 000
Floating installations (not concrete)	19	715 000
Subsea systems	348	118 000

The timeframe for decommissioning is very uncertain. Given the limitations of the data set, it is sensible to assume that the uncertainty range is large. This has been done in Figure 3, where the weight of steel for decommissioning is shown within an 80% confidence interval. The probability of the uncertainty as regards timing has been modelled, assuming a greater probability that installations will be removed later rather than earlier than the estimated times for the start of decommissioning.

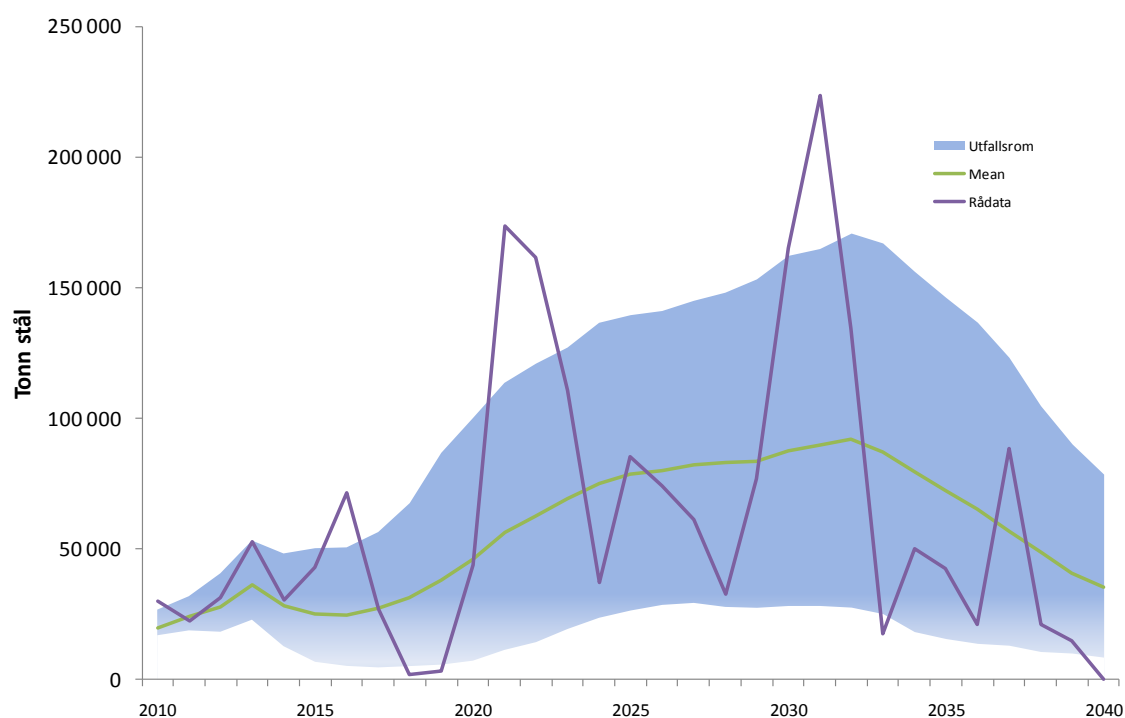


Figure 3 Estimated quantities of steel waste that will be generated in the period 2010–40.

In 2002, DNV (1) drew up an overview of installations on the Norwegian continental shelf that were to be closed down and removed. The report split the installations into several categories: steel jacket platforms, floaters, floating production, storage and offloading units (FPSO), and concrete gravity base platforms, and gave projected figures for the two five-year intervals between 2010 and 2020. Table 4.2 shows the results presented in DNV's report.

Table 4.2 Number of installations to be closed down in the period 2010–20 on the Norwegian continental shelf, from DNV's report (1)

Type	Number of installations	
	2010–15	2015–20
Steel jacket platforms	10	12
Floaters	2	1
FPSOs floating production, storage and offloading units	1	1
Concrete gravity base platforms	1	4
Total	14	18

This table gives an estimate of the number of installations to be decommissioned in the period up to the first peak, which is expected in 2010. Norway is at an earlier stage of its decommissioning programme than the UK (see Table 4.3).

Disposal of concrete substructures

There are major challenges associated with the removal and demolition of concrete substructures. The Norwegian Petroleum Directorate intends to establish a joint project with other relevant authorities to provide a better basis for evaluating problems that may arise in this area and necessary action.

4.2 Weight estimates and decommissioning capacity in other countries

Several North Sea countries are interested in sending their offshore installations to Norwegian decommissioning facilities. There are many more offshore installations in the UK sector than in the Norwegian sector that will need to be decommissioned in the near future. Table 4.3 shows UK projections up to 2020.

Table 4.3 Planned numbers of installations to be closed down on the UK continental shelf, 2010–20, according to Kristing, 2008 (2).

Type	Number of installations	
	2010–15	2015–20
Large steel jacket or concrete gravity base platforms	3	13
Small steel jacket platforms	54	90
Subsea systems	41	38
Other	8	16
Total	106	157

Figures provided by Scottish Enterprise (4) in 2005 confirm that the UK has a much larger number of offshore installations than other North Sea countries. They estimate that there are in all 815 installations in the North Sea, of which 447 belong to the UK, 160 to the Netherlands, 151 to Norway, 49 to Denmark, five to Ireland and three to Germany. However, the way the number of installations is calculated may vary from country to country. For example, a subsea system is sometimes considered to be a separate installation, whereas in other cases it is considered to be part of a larger installation on the field in question.

In the period 2005–09, the Climate and Pollution Agency has approved the import of about 20 installations for decommissioning, most of them from the UK. For example, the Maureen Alpha platform was towed to Stord for decommissioning, and the Kittiwake loading buoy was decommissioned at the Vats yard. Vats has also secured agreements to decommission installations from the Inde field on the UK shelf.

There are currently two decommissioning yards for offshore structures that we are aware of in the UK. One is Able on Teesside, which in 2009 took delivery of structures from North West Hutton for decommissioning. The other is the Greenhead Base on Shetland, which has decommissioned structures from Frigg. In addition, AF Decom plans to build a base at Dales Voe north of Lerwick in Shetland, modelled on their Vats facility.

In considering total decommissioning capacity in the years ahead, developments in other countries around the North Sea must also be taken into account. So far, there is a tendency for other countries to look at capacity in Norway because the Norwegian facilities have the advantage of deep fjords and deep-water quays, and can therefore be used by deep-draught installations. We know less about offshore decommissioning capacity in the more southerly North Sea countries (Denmark, the Netherlands and Germany). The DNV report (1) mentions

a facility in Rotterdam and one in Esbjerg (Denmark). Nevertheless, it seems likely that these countries will be interested in using Norwegian decommissioning yards.

The UK Department of Energy and Climate Change provides a long-term forecast for cessation of production on its decommissioning pages (8). Based on existing information, the forecast shows that the peaks will be in the period 2014–20. This is earlier than in Norway, largely because the fields are older.

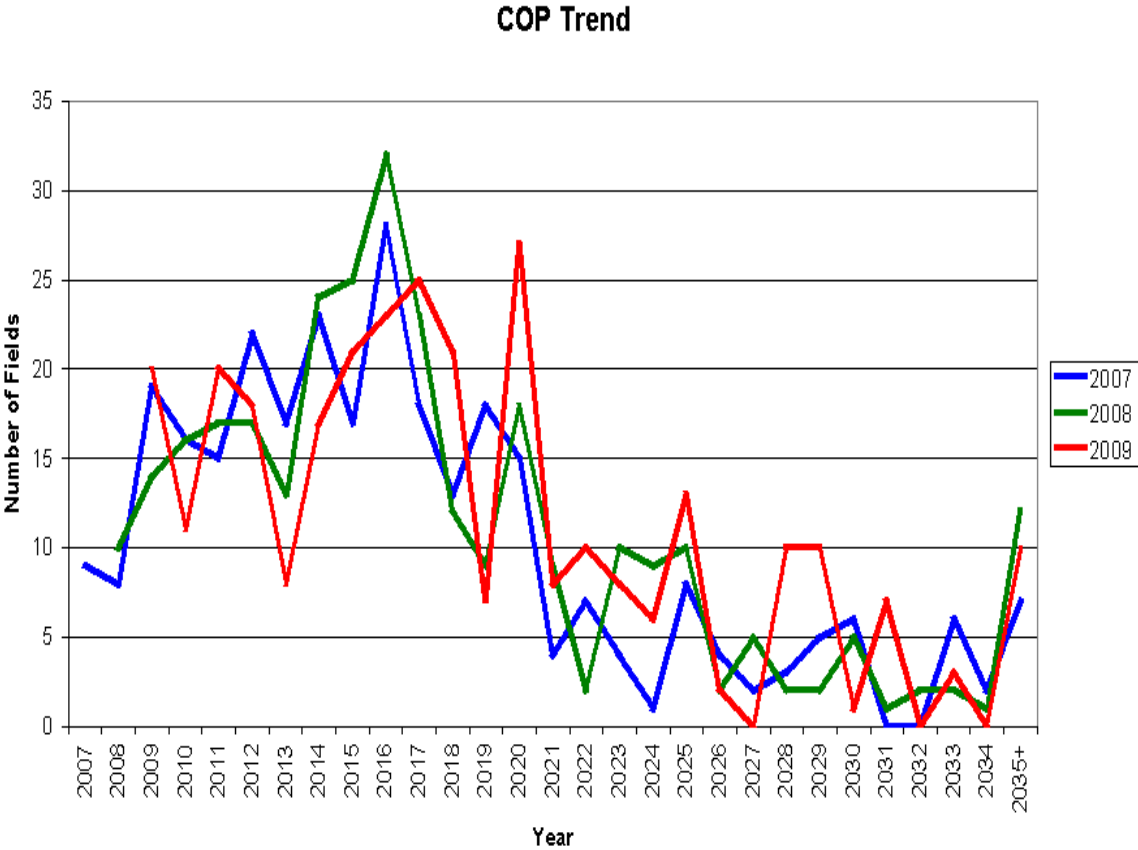
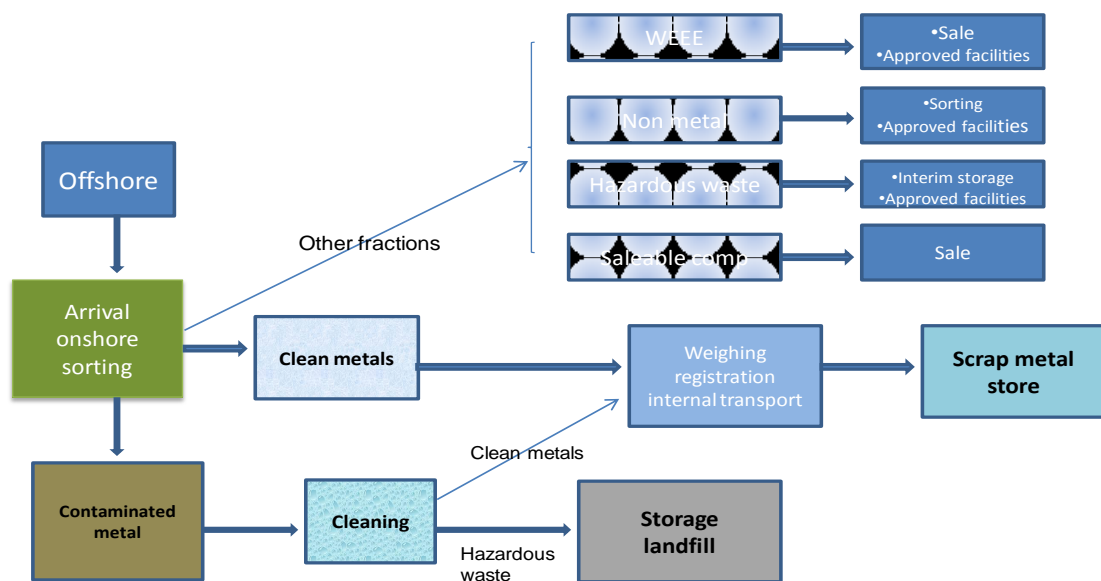


Figure 4 UK forecast of cessation of production (COP)

4.3 Types and quantities of waste material for recycling

Various types of waste are generated when disused offshore installations are transported to land for decommissioning. The waste consists largely of steel, 98% of which can be recycled, but there are also other types of waste that must be handled and treated in specific ways.

Material flows at decommissioning facilities



WEEE - Waste electrical and electronic equipment

Figure 5 Material flows at decommissioning facilities

The figure above shows the main material flows at a decommissioning facility.

Depending on the removal method chosen, whole sections or modules may be transported to shore, or the installation may be partly dismantled at sea and smaller sections transported to shore in containers.

Common methods of removing scale that may contain pollutants (heavy metals, low specific activity (LSA) radioactive material, etc) are high-pressure water jetting and mechanical scraping or scrubbing. In some cases, chemical cleaning methods may be used. Sandblasting is also used to clean large structures such as tanks.

The materials that were used in an installation depend partly on its age. Modules built 30–40 years ago contain more hazardous substances and materials with undesirable properties whose use is now prohibited. Modules built more recently must meet other requirements as regards materials. Many of the newer installations are subsea structures that consist largely of steel. Examples of hazardous waste fractions from decommissioning are:

- Asbestos
- Zinc anodes
- Batteries
- Flame retardants, for example brominated flame retardants
- Diesel
- Waste electrical and electronic equipment (WEEE)
- Phthalates (plasticisers in flooring and cables)
- Hydraulic oil, grease and lubricants
- Isocyanates from polyurethane paints
- CFC and HCFC gases released from cooling agents
- Chemicals
- Chloroparaffins
- Mercury
- Low specific activity (LSA) material
- PCBs (polychlorinated biphenyls)
- PFOS (perfluorooctyl sulphonate)
- PVC (polyvinyl chloride)
- Organotin compounds from anti-fouling systems
- Heavy metals

Hazardous waste must be delivered to approved facilities for treatment before energy recovery or final disposal at approved landfills. The costs of treating hazardous waste are high, and it is important to clarify the responsibilities of waste treatment plants and offshore operators. Since the quantity and type of hazardous waste to be dealt with will be uncertain, contracts must be drawn up in a way that ensures that the operators cover the costs.

4.4 Low specific activity (LSA) material from decommissioning of offshore installations

So far, about four tonnes of radioactive waste (scale, sludge and sediments) with an activity concentration of 10 Bq/g or more has been found in each offshore installation decommissioned in Norway (5). The installations decommissioned have been large, with a steel jacket or concrete substructure, and include structures from both the Norwegian and the UK sectors of the continental shelf. In general, larger quantities of LSA material are to be expected in installations from oil fields than those from gas fields. This is because radioactive scale is deposited together with barium sulphate originating from seawater that precipitates out from produced water.

Radioactive scale is deposited inside oil and gas pipelines and associated equipment. No radioactivity has been detected in any of the waste from decommissioning of the small installations from the Inde field in the British sector. No data is available on the content of

radioactive substances in waste from subsea structures. There is therefore a very high level of uncertainty in estimates of the quantities of waste containing radioactive substances per installation. The estimates are based on figures from a small number of installations, which were in areas where the ^{226}Ra concentrations in produced water are relatively low. The quantities of radioactive substances deposited as scale would therefore be expected to be relatively low. In areas where the concentration of radionuclides in produced water is higher, the quantity of LSA material in scale is also larger. It is therefore reasonable to use a value in the upper part of the range to estimate the quantities of radioactive waste that will be generated by future decommissioning projects. In the calculations described below, it has been assumed that decommissioning of a large platform will generate three tonnes of radioactive waste, and decommissioning of a smaller platform or subsea structure will generate one tonne of radioactive waste.

The numbers of installations to be decommissioned are taken from Table 4.2 and 4.3 for the Norwegian and British sectors respectively.

The 2002 DNV report (1) does not give any figures for decommissioning of subsea systems on the Norwegian continental shelf. More recent information suggests that some fields with subsea structures may cease production in the period 2010–20, but no figures are available.

Using the estimated quantities of radioactive waste (over 10 Bq/g) per platform arrived at above (three tonnes for large platforms, one tonne for small platforms and subsea systems) and the numbers of installations to be decommissioned, it is possible to estimate the overall quantities of LSA material from scale in pipelines and equipment that will be generated by decommissioning of installations from the Norwegian and British sectors of the continental shelf. The results of the calculations are presented in Table 4.4.

Table 4.4 Estimated quantities of radioactive waste (scale with an activity concentration exceeding 10 Bq/g) from decommissioning of offshore installations from the Norwegian and UK sectors in the period 2010–20.

Norway	Quantity radioactive scale (tonnes)		Total quantity 2010–20 (tonnes)
	2010–15	2015–20	
Large platforms	42	54	96
Small steel jacket platforms	0	0	0
Subsea systems	No data	No data	No data
Total Norway	42	54	96
UK	Quantity radioactive scale (tonnes)		Total quantity 2010–20 (tonnes)
Large platforms	9	39	48
Small steel jacket platforms	54	90	144
Subsea systems	41	38	79
Total UK	104	167	271

Analyses of radioactive scale removed from various components of offshore installations can also be used to estimate the distribution of samples between different levels of activity

concentration, including concentrations below 10 Bq/g. This distribution is shown in Table 4.5.

Table 4.5 Scale samples from offshore installations split between different ²²⁶Ra activity concentration categories

Activity concentration category	²²⁶ Ra/Ra-226 activity intervals (Bq/g)				
	Total number of samples	More than 10	5–10	0.5–5	Less than 0.5
Number of samples	408	206	64	123	15
Fraction of samples	1.0	0.505	0.157	0.301	0.004

Using the quantities of radioactive scale with an activity concentration exceeding 10 Bq/g given in Table 4.4 and the distribution between categories from Table 4.5, it is possible to estimate the quantities in the other categories as well, see Table 4.6. However, it is important to realise that corrosion products and other deposits containing radioactive substances in process equipment can be difficult to distinguish from similar materials that do not contain radioactive substances during onshore cleaning processes. This means that the quantities of waste that must be treated as radioactive, particularly in the category 0.5–5 Bq/g, may in practice be considerably larger than the calculations presented in Table 4.6 suggest.

Table 4.6 Estimated annual quantities of radioactive scale in different activity concentration categories from decommissioning of offshore installations from the Norwegian and UK sectors of the continental shelf

NORM (naturally occurring radioactive materials) activity categories	Calculation method	Quantity of scale (tonnes)
More than 10 Bq/g	Mean annual quantity 2010–20 from Table 4.4	Norway: 10 UK: 27
5–10 Bq/g	Quantity over 10 Bq/g multiplied by 0.31 (0.157/0.505), derived from the distribution shown in Table 4.5	Norway: 3 UK: 8
0.5–5 Bq/g	Quantity over 10 Bq/g multiplied by 0.6 (0.301/0.505), derived from the distribution shown in Table 4.5	Norway: 6 UK: 16

There is considerable uncertainty associated with these figures, but they provide a first estimate of how much radioactive material can be expected in each of the three categories. The quantity of waste taken ashore from the British sector will be about three times as high as from the Norwegian sector for all three categories.

5. Decommissioning capacity

There will be sufficient capacity in Norway to handle the installations from the Norwegian continental shelf that are expected to be decommissioned in the next 10 years. After 2020, more installations will be transported onshore for decommissioning, and the establishment of new decommissioning facilities, preferably further north, should be considered. It is uncertain how many installations may be imported to Norway for decommissioning from the British sector or other oil-producing North Sea countries.

5.1 Current decommissioning capacity

Four facilities have permits to decommission offshore installations in Norway today:

1. AF Miljøbase Vats (Rogaland)
2. Aker Stord (Hordaland)
3. Scanmet AS (Hordaland)
4. Lyngdal Recycling (Vest Agder).

The first three of these are currently involved in decommissioning projects. The county governors are the competent authority for waste treatment plants and therefore also responsible for issuing permits under the Pollution Control Act to enterprises involved in decommissioning of offshore installations.

AF Miljøbase Vats

The current permit for the Vats yard is from 9 June 2009, and was issued by the County Governor of Rogaland. It applies to the reception and handling of disused marine structures, and includes specific limits for releases of pollutants to the sea and for noise levels, and requirements for the collection of marine fouling. The total weight of the structures the facility has received for decommissioning in the past five years is about 60 000 tonnes. Under the terms of the permit, up to 50 000 tonnes of waste may be stored at the decommissioning yard. This includes both waste stored on land and waste stored on vessels/floating installations at the quayside. Up to 500 tonnes of waste electrical and electronic equipment (WEEE) and up to 300 tonnes of hazardous waste may be stored at the facility. The Vats yard is located in an industrial complex where a number of the Norwegian oil platforms were originally constructed.

The figures for the next few years are uncertain, but the firm estimates that about 22 000 tonnes of disused installations will be delivered to Vats annually. This will include an estimated 230–500 tonnes of hazardous waste a year. According to the annual report for 2009, the quantity received that year was 15 500 tonnes, 305 tonnes of which was hazardous waste.

AF Decom has a contract with ConocoPhillips for the removal and decommissioning of several installations from Ekofisk in the next few years. The company also has a contract with Shell to remove and decommission six platforms from the Inde field in the British sector of the North Sea.

AF Decom has been approved by the Norwegian Radiation Protection Authority to handle and store radioactive waste from decommissioned offshore installations.



Source: AF Decom offshore

Figure 6 The Vats decommissioning yard

Aker Stord and Scanmet

These two facilities are on the same site, and have been cooperating on the decommissioning of structures from the Frigg field. Aker Stord is the contractor to which the offshore installations are delivered, and Scanmet AS is a subcontractor. Hazardous waste is delivered to SIM næring AS, which is located in the same industrial complex. Both Aker Stord and Scanmet AS hold discharge permits from the Climate and Pollution Agency for decommissioning of offshore installations, dated 5 August 1997 and 7 October 2001 respectively. The authority to issue permits to this branch of industry was delegated to the county governors in 2004, so that the County Governor of Hordaland is now the competent authority. In 2009, Aker Stord took delivery of about 30 000 tonnes of offshore material, about 36 tonnes of which was hazardous waste.

Scanmet AS has a contract to decommission the floating loading platform Draugen FLP (Shell). This will be transported to land in 2010 and weighs 4 600 tonnes. Aker Stord/ Scanmet have previously decommissioned installations from Odin (Esso) and Maureen Alpha (Phillips) and the Brent flare structure (Shell).

These facilities are not authorised to handle and store radioactive waste at present, but Scanmet AS has applied for authorisation.



Source: Aker Stord

Figure 7 The Aker Stord and Scanmet yards, Stord

Lyngdal Recycling

On 5 September 2007, the County Governor of Vest Agder issued Lyngdal Recycling with a permit to decommission marine structures, which includes limits for releases to water and noise levels. The facility has not handled any decommissioning projects for more than four years. It has decommissioned two large installations, most recently in 2003–04. The company expects to be involved in such projects in the future, and believes that there will be a growing need for decommissioning facilities. Lyngdal Recycling is not currently authorised to handle and store radioactive waste.

The table below provides a comparison of the conditions set out in the permits held by the four decommissioning facilities.

Table 5.1 Comparison of some elements of the permits held by the four decommissioning facilities

	Vats	Lyngdal Recycling	Scanmet	Aker Stord
Permit issued	Rogaland County Governor, 9 June 2009	Vest-Agder County Governor, 5 September 2007	Climate and Pollution Agency, 7 September 2004	Climate and Pollution Agency, 5 August 1997 and project-based (Maureen etc)
Limits for releases to water	Yes (oil, Fe, Pb, Hg, Cd and pH)	Yes	No	No quantitative limits, general duty to avoid pollution of water and sediments
Limits for releases to air	No	No, but VOC emissions to be calculated	No	Yes (solvents, dust from indoor sandblasting)
Noise	Yes	Yes	Yes	Yes
Marine fouling	To be collected	No	No	Regulated in project-based permits
Restrictions on waste storage	Up to 50 000 tonnes waste, 500 tonnes WEEE, 300 tonnes hazardous waste	No	No	No
Permitted operating hours	Mon-Fri 7-23, 24-hour operations on 30 days a year	24-hour operations, but normally no nighttime activities	No	No
Requirements relating to specific areas	Yard split into area classes A, B and C, different requirements for each class	No	No	Activities that may entail pollution must be carried out on an impermeable surface
Requirement for an impermeable surface	Yes	Yes	No	Activities that may entail pollution must

				be carried out on an impermeable surface
Requirements for treatment of washing/process water	Yes	Yes	No	No quantitative limits, general duty to avoid pollution of water and sediments
Approval from Norwegian Radiation Protection Authority	Yes, GP08-10-1	No	No	No

The table shows that the permit for the Vats yard contains stricter conditions than the other permits.

5.2 Decommissioning capacity in the future

In 2002, DNV (1) was commissioned by the Norwegian Oil Industry Association to evaluate Norway's decommissioning capacity for offshore installations for the period 2001–20. The report concluded that existing decommissioning capacity in Norway was 160 000 tonnes per year, which at the time meant there was considerable surplus capacity. However, a number of the facilities considered in the report are no longer operating.

Several of the facilities now being used as decommissioning yards have previously built offshore installations. If Norway needs to expand its decommissioning capacity, it is likely that other facilities of this kind that are in suitable locations (fjords) and have deep-water quays, can be adapted as decommissioning yards. The Vats and Stord facilities have adequate capacity at present, and both could expand by about 30% using areas that are already zoned for industrial use.

The existing facilities appear to provide satisfactory decommissioning capacity for the next few years. One challenge they have to address is that most of the material for decommissioning is delivered during the summer months, since reasonable weather conditions are needed when handling the large modules. Large crane and cargo vessels are very costly (up to NOK 6-7 million per day for crane vessels), and it is therefore important to make maximum use of them during the period for which they are hired. Large onshore areas are needed to store the modules before demolition can start. Sound logistics planning and planning for demolition operations to take place throughout the year are therefore essential.

The level of activity at these facilities also depends on the supply of installations for decommissioning, which varies from one year to another and during a year. This can make it difficult to plan how much labour is needed, and the situation can be so unpredictable for the companies that workers sometimes have to be laid off. If the volume of work is too unpredictable, it can also be difficult to maintain a large enough workforce with the necessary expertise.

As the volume of installations to be decommissioned increases in the years ahead, a few more decommissioning yards may be needed in Norway. These should preferably be situated further north, where they are suitably located to deal with installations from the Norwegian Sea and in the longer term from the Barents Sea.

6. Environmental concerns

There are many environmental concerns to be taken into account throughout the decommissioning process, from planning and carrying out shutdown operations on a field or an installation to waste disposal. Experience so far shows that most of the unexpected environmental problems arise when demolition starts onshore. Some issues may need to be considered during both the offshore and the onshore phases, for example how to deal with fouling by marine organisms and scale in pipelines.

6.1 Offshore

On the platform

Before any demolition work starts, it is important to carry out a thorough review of the whole decommissioning process. The operator, preferably with the help of personnel with local knowledge of the specific installation, should identify waste types, hazardous substances and other environmental problems that may arise on the platform. It is useful if experts from the decommissioning facility on land can be present during this process. Any hazardous waste that is accessible offshore must be labelled and safely packaged for transport to shore. Pipelines and other equipment on the platform must be inspected to ensure that no gas or oil is left in the system before pipelines are plugged.

Below the waterline – marine fouling

Various marine organisms start to grow on platform legs and other subsea structures after they have been in the sea for only a few months, and the quantity of fouling is much larger after 30–40 years in the sea. Mussels, barnacles, benthic algae and sea cucumbers quickly colonise installations, followed by soft corals and after some years colony-forming stony corals. The species that colonise a particular installation will depend on a number of factors such as recruitment potential, currents, water depth, distance from land and latitude.

In some cases, the quantity of fouling organisms on underwater structures has been somewhat overestimated when calculating the weight to be lifted. However, it is clear that large quantities of organic material are involved. Much of the material has a very high water content (for example sea cucumbers and soft corals) and dries out/decomposes quickly, but calcareous shells and skeletons of organisms such as mussels and stony corals may be deposited in the recipient at the decommissioning facility, on land or in a landfill.

Marine fouling should be removed from the installation while it is still offshore if this is technically possible. The open sea usually functions as a satisfactory recipient where the material decomposes naturally. Studies have also shown that disposing of fouling material in open fjords does not cause problems. In more enclosed, shallow waters, however, this may result in an excessive load of organic material and oxygen depletion on the seabed. Disposal of the material on land and composting is a possibility, but often results in odour problems.

On and below the seabed

There are mounds of drill cuttings contaminated with oil-based or synthetic drilling fluids under several of the old platforms that are to be removed in the years ahead. In some cases, these mounds have buried parts of the installation that need to be lifted and removed. To

ensure stability while lifting the jacket sections, drill cuttings and sediments that have buried parts of the structures must be removed first. Unless the legs can be cut from the inside 1-2 metres below the seabed, the sediment around them must be removed. Moving contaminated sediments releases pollutants and such operations reacquire a permit from the Climate and Pollution Agency setting out specific conditions to be met. Environmental monitoring of these operations is necessary to learn more about their environmental impact.

In the oil or gas reservoir

Oil and gas reservoirs always contain substances that are unwanted in the production stream. The oil stream, and the produced water stream that gradually becomes more and more dominant as a field ages, both contain naturally occurring radioactive material (low specific activity (LSA) material), heavy metals and organic substances. A proportion of the pollutants is carried to oil refineries and gas terminals with the production streams, while some are discharged with the produced water after it has been treated. Some of the contaminants are also deposited as scale on the inside of pipelines and other production equipment. We need to learn more about where and when this happens. This is a major problem, and means that it is necessary to be prepared to deal with a variety of substances during the demolition phase.

6.2 Onshore

Before an onshore facility can start on the demolition phase of decommissioning, a number of possible risks have to be considered. It may be necessary to take steps to ensure worker safety before demolition starts. Experience gained at the Vats yard shows that the longer the delay between cessation of production and demolition of the installation, the more needs to be done before demolition starts to ensure the safety of the workforce. Maintenance is often given less priority, resulting in lower standards, in the period immediately prior to cessation of production. More than 30 years' exposure to the harsh climate in the North Sea results in a great deal of wear and tear on most materials. The building materials, paints and other materials used in modules built 30-40 years ago were different from those used nowadays, which gives rise to various problems during decommissioning. There may be hazardous waste in construction elements that are inaccessible before dismantling, so that it is difficult to gain an overview of what an installation contains before it is transported to land.

Asbestos

Asbestos is the name used for any one of a group of crystalline silicate minerals that are fibrous and may be carcinogenic. Asbestos was previously widely used because of its unique properties: it is hard-wearing and chemically inert (resistant to corrosion by acids and bases), and stable at high temperatures. In addition, it is elastic, nonflammable, a poor conductor of electricity and an effective insulator.

Inhalation of even relatively small amounts of certain types of asbestos dust has proved to entail an elevated risk of several diseases, including asbestosis and cancer. The use of asbestos has been prohibited in Norway since 1980, and it is unlikely that newer installations contain asbestos. Information on the use of asbestos can be found in documentation and materials inventories from the construction period.

In offshore installations, asbestos has been used in various heat insulation and surface materials: for example in fireproof walls, floors and ceilings, indoor insulation, and insulation

for pipelines and exhaust gas systems, piping, weather stripping, and so on. Experience so far shows that asbestos has been used for more purposes than was realised before decommissioning started. This means that extra care must be taken during inspection of materials before installations are demolished.

Materials that contain asbestos are classified as hazardous waste and must be delivered to approved waste facilities. Waste containing asbestos must be packaged and labelled in accordance with the asbestos regulations and must be delivered to an approved landfill.

Mercury

Mercury is a heavy metal that is found both in the pure state and as inorganic and organic compounds. The latter are particularly toxic. It is particularly important to avoid any health problems that might arise from exposure to mercury during the demolition of platforms. Kidney damage, damage to the nervous system and allergies are some possible effects. Mercury compounds can have chronic effects even in low concentrations.

Mercury may occur naturally in the reservoir, and the scale deposited in pipelines and equipment may contain some mercury (mainly as mercury disulphide). Only small amounts of mercury are involved, varying from one field to another. According to the 2010 report on efforts to achieve the zero-discharge goals, the oil and gas industry was responsible for about 1.8% of mercury releases from Norwegian industry in 2008. Material contaminated with mercury should be identified before removal of the platform starts, and it should be sealed before transport. Mercury is removed by high-pressure water jetting, and any mercury-contaminated waste from the cleaning process must be declared as hazardous waste and delivered to an approved facility.

Comments have been received from one of the offshore operators that further clarification of the rules on landfilling of mercury-contaminated waste is needed, including requirements for leaching tests, limit values for hazardous waste and harmonisation of the criteria for delivery of metals for remelting. The Climate and Pollution Agency will consider further whether specific, more stringent limit values should be introduced for the classification of waste contaminated with mercury (in Chapter 11 of the Waste Regulations).

Low specific activity (LSA) material

The radioactive substances that are relevant in the context of decommissioning are the same as those that accompany produced water and form radioactive scale during the oil and gas operations on the continental shelf – the radium isotopes ^{226}Ra and ^{228}Ra and the lead isotope ^{210}Pb . However, data are only available for the content of ^{226}Ra in waste from platforms that have been removed from the continental shelf, and all calculations have therefore been carried out on the basis of data on the occurrence of this isotope in waste.

During demolition work, it is important to safeguard worker health and to avoid or minimise radioactive releases to water, air and soil. Employees must use suitable protective clothing during this work. It is especially important to avoid inhalation of radioactive particles in dust from various sources, since the radioactive substances that may be present pose the greatest risk when absorbed by the body. To protect the external environment, it is particularly important to avoid the spread of particles. Particles may be deposited on vegetation or in water, and thus enter various stages of the food chain, where they may raise the level of radioactivity in meat and fish used for human consumption.

Naturally occurring radioactive substances in scale, sludge and other deposits on oil and gas platforms may be found in many different parts of the processing equipment, including valves, wellheads, risers, separators, hydrocyclones and piping. They may also be present in subsea systems and pipelines from such systems to the processing installation they are linked to. The same applies to wellhead platforms.

Paints and other coatings

A wide variety of anti-corrosion coatings are used on the steel structures on installations. These products may have properties that necessitate special precautions when the installations are demolished. Paints may contain toxic components such as PCBs (polychlorinated biphenyls), heavy metals (for example lead, barium, cadmium, chromium, copper, zinc) and pesticides. Paints that contain metal compounds are often used as anti-corrosion coatings. Biocides such as tributyltin (TBT) and other organotin compounds have been used on risers, in the splash zone and under the water surface on floating installations to prevent marine fouling. In addition, two-component epoxy paints have been used, with a polyurethane top coat (1).

“Paints” containing a mixture of asbestos and bitumen have also been used. It may be necessary to remove paint from areas where cutting machines are to be used if the paint contains components that release toxic gases during heating or combustion. For example, toxic isocyanates are used as hardeners in polyurethane paints, and can be released if the paint is heated. This is mainly a working environment problem.

Paints containing PCBs (chlorinated rubber-based paints) were used on oil installations and pipeline constructions before 1975. Waste containing more than 50 ppm PCBs produced by sandblasting or other techniques used to remove paint is classified as hazardous waste. Paint on large metal surfaces is not normally removed before the metal is delivered for remelting. Any toxic components in the paint will end up partly as contaminants in the remelted metal and partly as waste in the slag. Smelting works that deal with the metal are responsible for controlling the release of toxic waste gases.

Other considerations

Decommissioning facilities must be equipped to deal with many different types of waste. In addition, they must be able to control releases of pollutants to air, water and soil, including:

- releases from metal cutting operations
- dust
- runoff to water and soil.

Decommissioning of smaller offshore units at in wet or dry dock has also been tested. Experience so far shows that there is often more moisture to contend with in this situation than on a flat impermeable surface because of seawater intrusion and accumulation of rain water, with subsequent water treatment problems. Unpleasant odours are also more likely to be a problem in dry dock, and the method is not recommended by the decommissioning yards in operation today.



Source: Aker Stord

Figure 8 Steel jacket being tipped at the Aker Stord yard

7. Other concerns

In addition to the environmental concerns described in the previous chapter, a number of other concerns also need to be dealt with, both offshore and onshore at decommissioning yards. These are related to public health issues, fisheries and aquaculture, and the question of safe seafood. Onshore, there are also questions relating to land use and the financial aspects of decommissioning processes.

7.1 Public health

Health issues

Decommissioning yards may have an impact on public health in surrounding areas as well as environmental impacts. The extent of these impacts will depend on how far it is from the decommissioning yard to housing, institutions, etc., the types of activities that will be carried out, the pollutants that will be released to air and water, noise and radiation levels, and so on. Possible health impacts must be assessed for the construction and operating phases.

In Norway, the legal basis for environmental health protection measures is provided by the Municipal Health Services Act (section 1-4 and Chapter 4a). The Act requires the municipal health services to maintain an overview of the health situation in the municipality and the factors that may affect it, and to use their knowledge to propose health-promoting and preventive measures. They must also seek to ensure that other public agencies take health considerations into account if their activities are relevant to the health sector's work. Thus, the municipalities are responsible for both preventive and health-promoting measures under the Act, and they must take steps to prevent circumstances from arising that may have a negative impact on health. The Act also provides the municipalities with a number of tools that can be used if circumstances do arise that may have a negative impact on health, or there is a risk that they will do so. The municipal authorities may require a health impact assessment, require the party responsible to provide information remedy the situation or suspend activities, or decide to carry out investigations. In the event of non-compliance with an order to remedy the situation, the municipality can impose a coercive fine.

The rules on environmental health protection generally apply whenever circumstances may have an impact on public health. Their scope also includes areas that are regulated by other authorities, so that in some cases, there is an overlap between the responsibilities of the environmental health authorities and authorities in other sectors. In the worst case, this can result in contradictory decisions or a failure to deal with a case because both authorities assume that the other should take action. If circumstances that have arisen that may have negative impacts on health, the municipality can take action if this is necessary to prevent ill-health and disease, even in areas for which another authority is responsible. The Municipal Health Services Act and regulations under the Act also describe how the environmental health authorities are expected to collaborate with the competent authorities in other sectors.

Cooperation with competent authorities in other sectors

In areas that are the responsibility of other competent authorities, the legislation requires the environmental health authorities to provide advice and cooperate with the relevant authorities. These may be municipal, county or central government authorities in a range of sectors. Collaboration between authorities is intended to ensure that health considerations are incorporated into licensing procedures, planning processes and so on at an early stage.

Precisely how collaboration is organised or advice given, for example during public consultations on applications under the Pollution Control Act, will vary from case to case.

The legislation requires the environmental health authorities to provide advice and cooperate with authorities in other sectors so that the latter can take health considerations into account in their work. The different sectors also have an independent responsibility, since they often know more than the environmental health authorities about environmental factors that have an influence in a specific field. They are therefore in a position to ensure ongoing efforts to integrate health and other relevant considerations into their work on the basis of overall assessments. However, it is important that the health authorities are also involved, and that the health situation is assessed by the environmental health authorities rather than another sectoral authority, since the health authorities are best qualified to evaluate the health impacts of different measures.

According to the Norwegian Directorate of Health, the environmental health service should be cautious in exercising its authority in areas where there are other competent authorities, and should inform the competent authorities so that they can address any problems. In cases where circumstances within the sphere of responsibility of another authority are having a negative impact on health, the environmental health service should assess its own competence and authority on the basis of the following:

- whether another authority has already considered the matter under its own sectoral legislation. To provide predictability, the environmental health authorities should show restraint in making decisions under Chapter 4 of the Act in cases where permits have already been issued or impact assessments carried out under other legislation, and health concerns have been considered during these processes.
- whether the environmental health authorities have already had the opportunity to give their opinion under the health legislation, and whether sufficient weight has been given to their comments. If the environmental health authorities have already made an assessment of health effects and their conclusions have been considered and taken properly into account by another competent authority, they should only intervene later if there is good reason to do so. This could be the case, for example, if the situation does not develop as predicted. In areas that are the responsibility of other authorities, the legislation on environmental health protection will function as a safety net. This does not mean that the environmental health authorities should be passive and leave it to other sectors to evaluate health concerns and take them into account. It is essential that the environmental health authorities are involved at an early stage and that other sectoral authorities take their assessments seriously. If health concerns are not given sufficient weight, the environmental health authorities can require changes.

Local routines

It is important for municipalities to establish routines that ensure satisfactory and appropriate cooperation and follow-up routines for enterprises that could have negative impacts on health and the environment. In the current context, this means that:

- municipalities must themselves build up the necessary expertise and capacity to maintain an overview of the health situation and local factors that may influence this, or acquire it in other ways (for example through intermunicipal cooperation), so that they can make a proper assessment of the impacts of establishing and operating decommissioning facilities for offshore installations

- municipalities must establish routines that will ensure that health issues are taken into account at an early stage of planning processes, and that there is regular control and monitoring of such facilities and their releases to the environment
- municipalities must ensure satisfactory follow-up in the event of complaints about noise, releases to air or water, etc, so that decisions can be made under health legislation or other legislation governing the facility, for example a permit under the Pollution Control Act, zoning provisions, etc
- municipalities should base their assessments of health issues on generally accepted norms and standards: these are detailed in a publication by the Norwegian Institute of Public Health on environmental factors and health (report no. 2009:2, *Miljø og helse – en forskningsbasert kunnskapsbase*).

7.2 Fisheries and aquaculture

Decommissioning of offshore installations can cause problems both for the fisheries and for aquaculture industry, including fish farming, but of rather different kinds. For the fisheries, any problems are largely related to the offshore phase of decommissioning, and include restrictions on access to areas, the impacts of pollution (including noise), and interference with fishing activities if installations and pipelines are left in place. For aquaculture, potential problems are largely related to onshore activities, and include restricted access to areas and the impacts of pollution (including noise).

Risks to the reputation of fish products on different markets could be a problem both for the fisheries and the aquaculture. Reputation is a sensitive factor, and easily influenced in a negative direction. Pollution incidents could have a major impact, especially at local level. Experience shows that it takes a long time to restore a good reputation. There are no special arrangements for compensating for this type of loss other than the normal compensation rules. This issue should therefore be taken into special consideration if permits are to be issued for areas where fisheries and aquaculture are important.

Removal of installations from oil and gas fields

There is a safety zone around each offshore installation where fishing activities are prohibited. These will be maintained until removal of the installations is completed. Thus, no particular problems are anticipated for fishing activities in nearby areas during the removal of installations.

Nevertheless, removal operations such as pipeline removal may in some cases involve areas outside safety zones. Conflicts between fishing activities and removal operations may therefore occur. However, the scale and duration of such operations is likely to be limited, and it is reasonable to assume that any problems can be dealt with through discussions between the affected parties.

Transport to onshore facilities and anchoring en route

Transport operations are of short duration and will take place along designated routes. Any negative impacts on the fisheries are therefore expected to be very limited. There may be conflicts with fisheries interests if an installation has to be kept at anchor en route for some

time before decommissioning operations can continue. The extent of the problems will depend on the size of the restricted area, how long restrictions last for, and the geographical position. Similar problems may arise if barges are anchored while waiting to be unloaded.

The question of anchoring installations and/or barges must be dealt with during the planning phase. Sufficient areas must be set aside for this purpose. The use of such areas must be regulated in a way that minimises the areas where there are negative impacts on fisheries and how long these last for.

Installations and pipelines that are left in place

As long as installations and pipelines are in use, there are statutory requirements for their maintenance, including trenching and burial where possible to avoid conflict with fishing activities.

Under the existing rules, pipelines do not necessarily have to be removed when they are no longer in use. This means that they may be left in place and no longer be maintained. According to the Norwegian Directorate of Fisheries, this may result in serious problems for fisheries using bottom gear such as trawls, gill nets, long lines and Danish seines. A pipeline gradually corrodes and becomes deformed. This increases the risk that fishing gear will become snagged on the pipeline and lost, causing financial losses for fishermen. Lost gear, especially gill nets, can continue to catch fish for a long time. This is known as ghost fishing, and is a serious ecological problem because it results in substantial unregistered fish mortality. Pipelines also move over time, which may result in the development of free spans. If a trawl becomes snagged on a free pipeline span, this can be dangerous for the fishing vessel.

Siting of decommissioning facilities, restrictions on the use of areas

If new decommissioning facilities are established close to the shoreline in areas that have not previously been used for industrial purposes, this may result in conflicts with the fisheries. This is a particular risk if new facilities will overlap with or disturb fishing grounds, spawning areas or sites used for anchorage of lock seines (where fish such as sprat are stored live before delivery). The establishment of new facilities in such areas may also result in conflict with aquaculture interests.

Impacts of pollution on fisheries and aquaculture

Pollution, including noise pollution, may have both short- and long-term impacts on fishing activities and aquaculture. In the long term, recruitment to fish stocks may be impaired and aquaculture sites damaged. In the short term, pollution may make an area unsuitable for fishing activities.

7.3 Financial considerations

The costs of decommissioning the roughly 500 installations on the Norwegian continental shelf are uncertain, but a preliminary estimate suggests that the overall cost will be about NOK 160 billion. This estimate does not include the removal of fixed concrete substructures, since the costs of this are very uncertain at present. The state will cover about 80% of the costs through tax deduction arrangements and its ownership interests in oil and gas fields. The costs will depend among other things on general cost trends in the industry, when decommissioning projects start, and the capacity of the decommissioning facilities.

It can be difficult to calculate the total cost of a decommissioning project at the time when an operating company and a decommissioning company sign a contract, which may have an impact on the profitability of projects. It is particularly important to clarify who is to meet the costs of dealing with hazardous waste. The quantity of hazardous waste in a project is often larger than estimated. The price of recycled steel is particularly important for the financial position of the company that owns the decommissioning facility.

Recycling of steel is also important in environmental and natural resource terms. If the greenhouse gas inventory for recycled steel is more favourable than for virgin steel production, this can be an additional argument for recycling.

One possible problem in the years ahead is that new operators may take over fields at a late stage to make use of tail-end production opportunities. They may know too little about the fields they take over and about experience the previous operators have gained about the fields. Under section 10-14 of the Petroleum Activities Act, the original licensees have certain financial obligations that still apply on fields that they are no longer operating. Nevertheless, there is a risk of financial uncertainty with respect to decommissioning if new owners take over.

8. National legislation

Several Norwegian acts and regulations apply to decommissioning of offshore installations, and authorities in several sectors are involved in decommissioning. Dismantling of installations offshore is considered to be part of “petroleum activities” and is regulated by the petroleum legislation. Once modules have been loaded on to a barge, they come under the rules for maritime transport. Demolition and recycling are regulated by other legislation.

8.1 The Petroleum Activities Act (Ministry of Petroleum and Energy)

Section 5-1 of the Petroleum Activities Act requires the licensee to submit a decommissioning plan when production on a field and the use of the facilities is to cease permanently. The plan must include proposals for the fate of the facilities after production ceases. Proposals may include continued use in the petroleum industry, other uses, complete or partial removal or abandonment in situ. Any exceptions from removal of the facility must be assessed and grounds given for this option: these cases must also be presented to OSPAR before the Storting makes a decision. Decommissioning plans must consist of two parts, a disposal section and an impact assessment, as set out in sections 43–45 of the Petroleum Regulations. The Climate and Pollution Agency is one of the bodies consulted in these matters, and can provide input on ways of reducing pollution. Activities that may result in pollution during dismantling offshore and that are not covered by the general permit for the field must be dealt with separately by the Climate and Pollution Agency.

Under section 5-1 of the Petroleum Act, the licensee must draw up a comprehensive plan that gives an account of relevant disposal options; these follow from OSPAR’s 1998 decision. The submission of a decommissioning plan does not exempt the licensee from requirements to obtain permits or consent under other legislation, see also section 1-5 of the Petroleum Act.

Decisions on disposal are made by the Ministry of Petroleum and Energy under section 5-3 of the Act. Such decisions need not necessarily correspond to the plan submitted by the licensees – in other words, the Ministry does not merely rubber stamp the operators’ proposals. Section 5-1 of the Petroleum Act also includes provisions on the implementation of decisions on disposal and identifies who has obligations under these provisions. Furthermore, the Act authorises the Ministry to take action on behalf of the party responsible if its decisions are not implemented within a fixed time limit.

In some cases, it may be difficult to decide what comes within the definition of petroleum activities, and this must be evaluated in the individual case. Dismantling of installations offshore is considered to be part of petroleum activities. Once modules have been loaded on to a barge, they come under the rules for maritime transport. Demolition and recycling are regulated by other legislation.

8.2 Provisions of the Pollution Control Act relating to permits for demolition and recycling (County Governors' offices)

An onshore decommissioning yard for offshore installations is classed as a waste treatment plant, and is therefore required under section 29 of the Pollution Control Act to hold a permit under section 11 of the same Act. When the pollution control authority decides whether to issue a permit or lay down conditions in a permit under section 16 of the Act, it is required to consider any pollution-related nuisance that is expected against other advantages and disadvantages of the project. In other words, an overall assessment of all advantages and disadvantages of the project is required. The authority to issue permits to waste treatment plants, including decommissioning facilities, was delegated from the Climate and Pollution Agency to the County Governors in 2004. Projects of limited duration, such as dismantling of installations at sea, may also require a permit under section 11 of the Pollution Control Act.

Issuing a permit under the Pollution Control Act is a relatively extensive form of regulation, and all industrial enterprises and waste treatment plants above a certain size and potential for causing pollution are required to hold permits. When an enterprise applies for a permit, whether it is an aluminium plant, a pulp and paper plant, or a decommissioning facility for offshore installations, all relevant factors in the case are considered before a decision is made. All releases of pollutants that may cause health or environmental damage are thoroughly assessed.

Some branches of industry are regulated by means of standardised requirements set out in regulations. This form of regulation is used for smaller enterprises, where the picture is simpler. A larger enterprise must draw up a detailed application giving an account of all factors of importance for health and the environment. This is followed by a public consultation process, and the proposal is published locally so that all interested parties can make their views known. The municipality is invited to express an opinion and to provide information on local factors that should be taken into account when a decision is made, including health and environmental issues (see Chapter 7.1 on the relationship to the Municipal Health Services Act), zoning plans, interested parties in the vicinity, neighbours, etc.

A waste treatment plant that is large enough to be used as a decommissioning yard for offshore installations will also be subject to the EU Directive concerning integrated pollution prevention and control (the IPPC Directive, 96/61/EC). It must therefore comply with the specific rules for such enterprises set out in Chapter 36 of the Pollution Regulations. These include requirements relating to the content of applications, for public consultation on applications, and for the conditions set to be in accordance with the principle of applying the best available techniques (BAT). The EU is drawing up BAT reference documents (BREFs) for many branches, which describe the techniques that are considered to be BAT and provide guidelines for national authorities. No BREF has been drawn up for decommissioning facilities for offshore installations. The Norwegian authorities will therefore evaluate what is considered to be BAT on a case-to-case basis or for the branch of industry as a whole.

The permit system under the Pollution Control Act allows the pollution control authority to tailor the requirements in a specific permit by evaluating limits for releases to air and water

and requirements relating to waste management and noise on a case-to-case basis. Limits for releases to a fjord, for example, are set on the basis of an evaluation of the environmental status of the fjord as a recipient. Noise limits are set on the basis of the distance to neighbours who will be affected. When an application is approved, various conditions are laid down for the enterprise's activities. Limits are set for releases of pollutants such as heavy metals. Over 30 years' experience of the regulation of industry in Norway has shown that this gives good results in environmental terms. Strict requirements are set, based on the principle of applying BAT. Technology is constantly being developed and improved, and the pollution control authority can re-evaluate individual companies or whole branches when this is considered necessary, so that requirements can be tightened up.

The Pollution Control Act and the permit system provide a dynamic system for regulating Norwegian industry. The pollution control authority can alter a permit and set new, stricter requirements if new technology is available, or new information indicates that this is necessary. The pollution control authority often re-evaluates a whole branch of industry. The review of the four Norwegian decommissioning facilities in connection with this report (see Chapter 5) shows the requirements in their permits vary. In the Climate and Pollution Agency's opinion, this indicates that the requirements in the permits for all the facilities need to be reviewed to ensure consistency and the application of BAT at all the facilities.

Important elements that should be considered in the regulation of decommissioning facilities for offshore installations include the following:

- suitability of the site (deep-water quay, satisfactory recipient, distance from neighbours, good infrastructure, any conflicts between industries, etc)
- impermeable surface (asphalt, concrete, membrane)
- water treatment plant (waste water, storm water)
- emergency response systems (environmental risk assessment, emergency response analysis, notification)
- releases to air (metal cutting, other)
- releases to water (concentrations and quantities from waste water treatment plants and other sources)
- noise (noise levels, noise suppression)
- operating hours
- environmental monitoring (recommend as necessary)

In addition to regulating pollution and the risk of pollution, permits may include requirements for recycling of material from decommissioning operations. The environmental risks posed by decommissioning facilities are much the same as those from process industries and other waste treatment plants that are regulated by means of individual permits.

Enterprises that are required to hold permits under the Pollution Control Act must also provide annual reports to document that they are complying with the conditions in their permits. The pollution control authority regularly inspects such enterprises to control compliance with the requirements.

The Climate and Pollution Agency recommends a number of measures and requirements that should be considered in the regulation of decommissioning facilities for offshore installations. These enterprises need sound expertise to be able to identify and deal with different types of waste, including hazardous waste such as heavy metals, other hazardous substances, low

specific activity (LSA) material and asbestos. Facilities must be designed to allow safe handling of such waste, with no risk of runoff or infiltration into the soil. In addition, a decommissioning facility should have an effective collection system and an on-site treatment plant for contaminated water, including surface water. Each facility must have a sampling and analysis programme to monitor releases of the most relevant pollutants. The need for an environmental monitoring programme to follow developments in the recipient should also be considered. Other factors that must be closely monitored at decommissioning facilities include noise and releases to air in connection with metal cutting and other operations. Moreover, decommissioning contracts must ensure that the costs of handling hazardous waste are met by the offshore operators.

8.3 Provisions of the Pollution Control Act relating to import and export of waste (Climate and Pollution Agency)

Offshore installations that are no longer in use and are removed from the continental shelf are considered to be discarded objects and therefore defined as waste under section 27 of the Pollution Control Act. The movement of a disused installation or part of one across the border between two countries (for practical purposes, this is most likely to happen between the British and Norwegian sectors in the North Sea) is governed by EU Regulation No. 1013/2006 on waste shipments, which has been incorporated into Norwegian legislation in Chapter 13 of the Waste Regulations. Installations consist of a number of different waste fractions (non-listed or amber waste categories), and consent will be required from the competent authority in both the dispatch state and the destination state before transport can take place.

The Climate and Pollution Agency considers a number of issues before giving its consent to the import of offshore installations for decommissioning in Norway. One of these is the requirement for a financial guarantee, which is set out in Article 6 of the directive. The guarantee must among other things cover the costs that arise if a shipment or the recovery or disposal operations cannot be completed as intended. It is also a condition for export that the waste is sent to a facility that has the necessary permits to handle the waste. Waste treatment and disposal may take place in several steps at facilities at different sites. Facilities that pre-treat waste before it reaches the main treatment facility are called interim facilities. Placing an offshore installation at an approved site on the coast or in a fjord in the country of destination to be dismantled before it is taken ashore is an example of an interim operation. Consent to the import or export of waste may include certain conditions relating to facilities that are to carry out interim recovery or disposal operations (see Article 15 of the directive).

8.4 The Act relating to ports and navigable waters (municipalities/Norwegian Coastal Administration)

Under the Act relating to ports and navigable waters, a permit is required for many different types of works in the sea. Works in a municipality's sea areas require a permit from the municipality under section 27 of the Act. If an onshore decommissioning facility is built, the construction of quays and pipelines in the sea will for example require a permit from the municipality. On 12 March 2009, regulations were adopted under section 27 of the Act requiring a permit from the Norwegian Coastal Administration for towing or anchoring offshore installations. Thus, a permit is required whenever an installation is towed to the coast for onshore decommissioning, whether it is from the Norwegian sector or has been imported for decommissioning. Furthermore, a permit is required to anchor the installation on the way to or outside the decommissioning yard.

8.5 The Planning and Building Act (municipalities)

Zoning plans

The municipalities are the planning authority under the Planning and Building Act, and thus have the main responsibility for preventing and resolving conflicts relating to land-use, both between business interests and the general public, and between different business interests. Zoning plans are a key tool in connection with the establishment of onshore decommissioning facilities. According to section 12-1 of the Act, zoning plans must be drawn up for major construction projects and other projects that may have significant effects on the environment and society. A zoning plan will normally have to be prepared when a new decommissioning facility is to be established, unless one already exists for the area. The municipalities have wide powers under section 12-7 of the Act to set limits for enterprises through provisions in zoning plans.

Environmental impact assessment

Regulations relating to environmental impact assessment (EIA) have been adopted under the Planning and Building Act, and these specify the types of plans and projects for which an EIA is mandatory before planning decisions are made or permits issued under other legislation. The provisions of Chapter II of the regulations determine whether or not an EIA is required for a particular plan or project. The regulations distinguish between projects and plans for which an EIA is always mandatory (listed in appendix I) and those that must be evaluated on the basis of how significant an effect they will have on the environment and society (listed in appendix II). The establishment of a decommissioning facility for offshore installations will not be defined as an appendix I project, but will fall within the criteria for Appendix II, items 11 and 22. It will be reasonable to assert that a project of this kind will result in a substantial increase in pollution (criterion listed in section 4 g) of the regulations) and that an EIA must therefore be carried out.

The municipalities are the competent authority for EIAs, both in cases where a zoning plan must be drawn up and in the case of projects for which a permit is required under other legislation, and for which an EIA is mandatory. During the impact assessment process, all relevant aspects of the matter must be reviewed. The process provides a basis for drawing up a zoning plan if required and for issuing any permits required from other authorities

(Norwegian Coastal Administration, Norwegian Radiation Protection Authority, County Governor).

Land use

The municipalities are responsible for land-use planning under the Planning and Building Act, including EIAs prior to the preparation of zoning plans and development projects. Various factors, including environmental effects, must be evaluated during this stage. Risk and vulnerability assessments must be obtained or carried out to determine whether the area is suitable for the purpose in question.

Important elements that should be considered in selecting sites for this type of facility include the following:

- deep-water quay, water depth at least 30 metres
- suitability of the recipient, currents and water exchange, sills
- distance to other buildings and outdoor recreation areas
- noise, possibility of using noise screens
- area available, possibility of expansion
- possible advantages if other industry already established (joint emergency response and fire-fighting systems, etc)
- infrastructure, including facilities to which waste can be delivered
- distance to drinking water sources and food production, including fish farms and agricultural areas



Source: Aker Stord

Figure 9 Efficient use of space at the Aker Stord yard.

8.6 Municipal Health Services Act

The Municipal Health Services Act makes the municipalities responsible for environmental health protection. The municipalities must seek to prevent circumstances from arising that may have a negative impact on health. These responsibilities are set out in the Act and in regulations under the Act adopted in 2003. If such circumstances do nevertheless arise, the Act gives the municipal authorities powers to intervene. Thus, environmental health protection has both a preventive and a “restorative” element, since steps may be taken to prevent, reduce or eliminate environmental factors that are or may be harmful to health.

The Act confers powers on the municipal councils, but in practice this is often delegated to the municipal medical officer, who is responsible for advising the municipal authorities on medical matters. In principle, the Municipal Health Services Act applies alongside regulation under other legislation such as the Pollution Control Act, the Radiation Protection Act and the Planning and Building Act. In areas where there are other competent authorities, the environmental health authorities should exercise caution in applying the health legislation. The environmental health authorities should inform the competent authorities of any problems so that they can address them.

8.7 New legislation relating to radioactive material

New regulations on the applicability of the Pollution Control Act to radioactivity from radioactive substances and radioactive waste and new radiation protection regulations came into force on 1 January 2011.

Under the new regulations, all enterprises whose activities involve the use of ionising radiation sources or whose employees may be exposed to radiation must have authorisation from the Radiation Protection Authority, in the same way as at present.

However, releases of radioactivity and radioactive waste management will be regulated under the Pollution Control Act, and the Radiation Protection Authority will have the authority under the Pollution Control Act to issue permits for activities that entail or may entail pollution in the form of ionising radiation. The new regulations also include provisions on the handling, storage and final disposal of radioactive waste. The new regulations also specify minimum activity concentrations for the classification of waste as radioactive. For the three nuclides that are likely to be found in waste from the oil and gas industry, the limits are as follows:

^{226}Ra	1.0 Bq/g
^{228}Ra	1.0 Bq/g
^{210}Pb	1.0 Bq/g

The new regulations on the applicability of the Pollution Control Act to radioactive substances include a provision requiring all waste from the oil and gas industry in which the activity concentration is 10 Bq/g or more to be disposed of in special repositories. So far, only

one such repository has been established in Norway, in Gulen (Sogn og Fjordane). Authorisation from the Radiation Protection Authority will also be necessary for the handling and final disposal of waste with a lower activity concentration. However if an enterprise has a permission to handle hazardous waste, they could also handle radioactive waste with activity below 10 Bq/g.

The new regulations also include provisions on the export and import of radioactive waste, which maintain the requirement for authorisation from the Radiation Protection Authority. There are also special rules regarding export and import of offshore installations. When the new regulations on the applicability of the Pollution Control Act to radioactive substances came into force, other regulations under the Pollution Control Act were also amended. These included the Waste Regulations, where a new chapter on radioactive waste was introduced with provisions regulating radioactive waste in a similar way to the provisions of Chapter 11 on hazardous waste.

The new requirements for handling and disposal are shown in Table 8.1.

Waste from most of the fields on the Norwegian continental shelf contains higher concentrations of ²²⁶Ra than of other nuclides, and the limits for this nuclide are therefore used in Table 8.1.

Table 8.1 Categories of radioactive waste by activity concentration and requirements relating to handling and disposal

Activity concentration	Less than 1.0 Bq/g	1.0–10Bq/ g	More than 10 Bq/g
Requirements	No specific requirements	Classed as radioactive waste, to be handled in accordance with the Waste Regulations, must be declared, final disposal at an approved facility	Classed as radioactive waste, to be handled in accordance with the Waste Regulations, final disposal in a special repository

9. International rules

Two international regimes are particularly relevant at present in connection with the decommissioning of offshore installations. The most important is the OSPAR Convention, in which Norway is an active participant, but some IMO guidelines are also relevant to the offshore industry. In the long term, the EU's Marine Strategy Directive may also have an influence on the oil and gas industry.

OSPAR Convention

Under the OSPAR Convention (the Convention for the Protection of the Marine Environment of the North-East Atlantic), it is prohibited to dump disused offshore installations or leave them wholly or partly in place within the area covered by the convention. The decision specifying this (OSPAR Decision 98/3) recognises that certain types of structures may be difficult to remove, and it is therefore possible to apply for derogations from the general rule in these cases. However, this is not an automatic process, and operators must remove installations completely if they cannot provide good reasons in physical, health and environmental terms for leaving substructures in place. If an application for a derogation is submitted, a consultation procedure is held in the OSPAR system. Derogations are usually granted to leave "stripped" concrete platforms and steel footings weighing more than 10 000 tonnes in place. On the Norwegian continental shelf, two derogations from the OSPAR Decision have been granted, allowing the Ekofisk tank with its protective concrete barrier and the concrete substructure of the Frigg TCP2 module to be left in place.

Other Norwegian concrete structures for which derogations from the OSPAR Decision may be sought are Gullfaks A, B and C, Statfjord A, B and C, Draugen, Oseberg and Troll A.

According to the OSPAR Offshore Oil and Gas Industry Strategy, the list of categories of disused installations for which it is possible to obtain derogations is to be revised and if necessary supplemented by 2013.

The OSPAR Convention does not prohibit the disposal of disused pipelines and cables at sea. In areas under Norwegian jurisdiction, final decisions on the disposal of oil and gas installations, including pipelines, are made by the Ministry of Petroleum and Energy.

IMO (International Maritime Organization)

In May 2009, IMO adopted the International Convention for the Safe and Environmentally Sound Recycling of Ships. This will also be relevant to offshore installations. However, it will not enter into force until a certain number of states constituting a specific proportion of the world's merchant shipping fleet have ratified it.

The Convention defines the term "ship" in a way that includes offshore installations: Ship means a vessel of any type whatsoever operating or having operated in the marine environment and includes submersibles, floating craft, floating platforms, self elevating platforms, Floating Storage Units (FSU), and Floating Production Storage and Offloading Units (FPSO), including a vessel stripped of equipment or being towed."

The Convention includes provisions on the types of ships to which it applies and on dismantling and recycling activities. The Norwegian Maritime Directorate, with the assistance of the Climate and Pollution Agency and the Norwegian Labour Inspection Authority, reviewed the Convention in 2009 and discussed its implications for the Norwegian authorities, ships and decommissioning facilities. The report was commissioned by the Ministry of the Environment.

The Marine Strategy Directive

The EU's Marine Strategy Directive was adopted in June 2008 and applies to the economic zones of the member states and their territorial waters outside the baselines. Its main objective is for good environmental status to be achieved in all marine waters by 2020. Each EU member state is required to develop a marine strategy for its marine waters. The first step in this process is for all the member states to make an initial assessment of environmental status and of the main pressures and impacts in its waters. In addition, environmental targets and indicators are to be established. Monitoring programmes are to be implemented by 2014, and programmes of measures by 2016.

As the marine strategy is implemented in the EU, it is expected that there will be more focus on environmental efforts related to marine waters and associated commercial activities (including the offshore oil and gas industry). This is important for Norway, which in many cases is a "downstream" country, a recipient of pressures and impacts caused by human activity in other countries. The Norwegian authorities and the EU are now considering the way Norway as a part of the European Economic Area should be associated with the directive. Regardless of the result, the directive will be important for management of the marine environment in Norway, and particularly for the North Sea, which we share with the other North Sea countries.

The Norwegian management plans for the Barents Sea–Lofoten area and for the Norwegian Sea are structured in such a way that they to a large extent satisfy the requirements of the directive. They are good examples of the type of integrated management planning that is required under the directive. The management plan for the North Sea is organised in the same way. This makes it possible to consider Norway's national efforts in the context of EU efforts, regardless of whether or not Norway is directly associated with it or not.

Cooperation under the OSPAR Convention will be a key platform for further coordination of implementation of the directive at regional level. For the moment, it will also be the most important forum for following up international commitments relating to the oil and gas industry.

10. Recommendations and proposals for further work

The Ministry of the Environment asked for proposals for new measures and instruments at both national and international level to address the impacts of decommissioning of offshore installations. We have received input from various quarters during the preparation of this report, and have identified issues relating to offshore operations and onshore decommissioning facilities that should be further considered. This chapter presents proposals for measures that should be introduced or further reviewed. It may be appropriate to amend the existing legislation.

The Climate and Pollution Agency is recommending various measures and requirements that should be considered in the regulation of decommissioning facilities for offshore installations. These enterprises need sound expertise to be able to identify and deal with different types of waste, including hazardous waste such as heavy metals, other hazardous substances, low specific activity (LSA) material and asbestos. Facilities must be designed to allow safe handling of such waste, with no risk of runoff or infiltration into the soil. In addition, a decommissioning facility should have an effective collection system and an on-site treatment plant for contaminated water, including surface water. Each facility must have a sampling and analysis programme to monitor releases of the most relevant pollutants. The need for an environmental monitoring programme to follow developments in the recipient should also be considered. Other factors that must be closely monitored at decommissioning facilities include noise and releases to air in connection with metal cutting and other operations. Moreover, decommissioning contracts must ensure that the costs of handling hazardous waste are met by the offshore operators.

The Climate and Pollution Agency recommends the following measures relating to onshore decommissioning facilities:

- The authority to regulate decommissioning facilities for offshore installations should be transferred back to the Climate and Pollution Agency
- The requirements for the facilities that hold permits for decommissioning should be reviewed to ensure that they are consistent and that the best available techniques are applied at all facilities
- Evaluation of whether requirements relating to the qualifications of personnel who handle hazardous waste at the decommissioning facilities should be included as conditions in the permits
- Evaluation of whether requirements should be introduced to ensure that the operators meet the costs of further treatment of hazardous waste fractions

The Climate and Pollution Agency will:

- Evaluate whether there is a need to introduce specific, more stringent limit values for classification of waste containing mercury (in Chapter 11 of the Waste Regulations)
- Investigate how the reception of waste at onshore bases is organised (inspection campaigns are being planned)

Important elements that should be considered in the regulation of decommissioning facilities for offshore installations:

- Releases to water (concentrations and quantities from waste water treatment plants and other sources)
- Releases to air (metal cutting, other)

- Noise (noise levels, noise suppression)
- Impermeable surface (asphalt, concrete, membrane)
- Water treatment plant (waste water, storm water)
- Emergency response systems (environmental risk assessment, emergency response analysis, notification)
- Operating hours
- Environmental monitoring (recommend as necessary)

We consider that transferring the authority to regulate decommissioning facilities for offshore installations back to the Climate and Pollution Agency and following the other recommendations above will satisfy the need to ensure consistency in the regulation of these facilities. The Norwegian Radiation Protection Authority will be responsible for regulating radioactive releases and waste from the same facilities under the Pollution Control Act. This will require close coordination between the two agencies and reinforces the need to transfer authority to the Climate and Pollution Agency as proposed.

Recommendations for consideration by the petroleum authorities

- Disposal of installations should be completed within five years of their closure (amendment of the Petroleum Act or Regulations will be required)
- Early planning of cessation of production and decommissioning, preferably when field development and operation is planned
- Relevant documentation should be retained (materials used, construction drawings, equipment lists, etc)
- Transfer of experience from personnel who have worked on an installation is important early in the demolition phase
- Pipelines and other equipment should be inspected to ensure that no gas or oil is left in the system

Other recommendations

- Marine fouling should preferably be removed while the installation is still offshore
- Oil, scale, structural water and ballast water should if possible be removed while the installation is still offshore
- Hazardous waste must be suitably packaged, pipelines must be plugged, and good routines must be in place for labelling, packaging and sorting waste

Measures that should be further considered

- Use of dry dock as opposed to an unenclosed impermeable surface for manual operations onshore
- Other options than demolition of installations should be considered further (e.g. use in artificial reefs, offshore wind farms)
- Establishment of a joint project together with other relevant authorities to consider future problems and measures in connection with the removal and decommissioning of concrete installations

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Climate and Pollution Agency

The Climate and Pollution Agency reports to the Ministry of the Environment and has 325 employees, based mainly in Oslo. We implement government policy on pollution. We act as advisers guardians and stewards for the environment. Our most important fields of work include climate change, chemicals, marine and freshwater environment, waste management, air quality and noise. Our vision is a future without pollution.

We are working to

- **reduce greenhouse gas emissions**
- **reduce the spread of hazardous substances harmful to health and the environment**
- **achieve integrated and ecosystem-based management of the marine and freshwater environment**
- **increase waste recovery and reduce emissions from waste**
- **reduce the harmful effects of air pollution and noise**

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