Translation from Norwegian

CONSEQUENCE ANALYSIS

FOR

HOD FIELD

APPENDIX TO HOD FIELD DEVELOPMENT AND OPERATING PLAN

PL 033, Block 2/11
Amoco/NOCO Group
Stavanger, February 1988

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PREFACE

The Petroleum Act requires licensees to submit a comprehensive Field Development and Operating Plan (FD&OP) for a petroleum accumulation to the Ministry of Petroleum and Energy (MPE) for approval before a field development project is initiated.

The present Consequence Analysis has been prepared by Amoco Norway Oil Company (Amoco) as a stand-alone appendix to the Hod Field Development and Operating Plan as required by § 23 of the Petroleum Act, and § 15 of the Petroleum Regulations in pursuance thereof.

The MPE´s guidelines for preparation of the Consequence Analysis ask the licensee to address the questions upon which the authorities´ consideration of the development application hinges. It is further noted that the brief is not to examine every conceivable consequence of the project, but only its significant and foreseeable effects.

This document has been prepared by Amoco in consultation with the Ministry of Petroleum and Energy. Data have been obtained from the Fishery Directorate´s Ocean Research Institute, Chief Fishery Officers, Central Bureau of Statistics, the Institute for Continental Shelf Studies (IKU) of the SINTEF group, and Rogaland County Council. We have also been in contact with the Federation of Norwegian Engineering Industries (MVL) and the Norwegian Industry Association (NIF) to establish the predicted activity level for involved businesses.

A similar analysis was presented by BP Petroleum Development (Norway) Limited on 18 February 1987 for the Gyda field. The location of Gyda, as well as its onshore operating organization and supply base, are in many respects very similar to the Hod field. Parts of this analysis are therefore based on studies done for the Gyda field.

The analysis of consequences presented here provides a summary of the studies implemented. Further documentation is available in Amoco.

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SUMMARY

This report considers the consequences of developing the Hod field. It is an appendix to the Hod Field Development and Operating Plan.

Hod is an economically marginal field for which cost-efficient development and operation is critical. Development is made economic by the Valhall infrastructure already in place. The plans call for the installation of a single wellhead platform above the existing template with one well drilled. Only the absolutely essential equipment will be included. The platform's equipment will be simple, straightforward and reliable. Produced oil and gas will be transported through a 13 kilometer pipeline to Valhall for processing. Development of Hod was originally considered and approved in connection with Valhall in 1977, so sufficient processing capacity was provided for on the latter. The Hod platform will normally be unmanned, being monitored and controlled from Valhall.

Investment in field installations, including wells, is estimated to cost about NOK 600 million. Development of Hod in 1988-89 may help utilize idle capacity in the offshore oriented industry during a period when investments on the Norwegian shelf are relatively low.

The operating organization for Hod and support functions will be coordinated with those existing for Valhall in all respects. This will keep operating costs to a minimum. Activities will therefore have to be located in existing facilities in Stavanger. The total operating costs for Hod are estimated to be about NOK 80 million a year.

A mobile jack-up drilling rig is envisioned for drilling of up to five wells, in the base case. This will take about one year and will result in discharge of oily drill cuttings. The concentrations of oil will not exceed the State Pollution Control Authority (SFT)'s pollution limits. The negative effects will largely be confined to organisms on the seabed in the immediate vicinity of the platform. There will be no continuous discharges of gas or liquid from the Hod platform.

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Summary

Produced water, if any, will be transported with the oil and gas to Valhall for separation and treatment together with Valhall products. The increase in discharge rate of cleaned water at Valhall is not expected to disturb marine life.

Amoco will continue to record hydrocarbon levels and conduct biological studies on the Hod and Valhall fields in order to monitor the biological and chemical environment around the platforms.

Any drilling or production operation involves some risk of a major oil spill. If such an event should occur, the death of seabirds is likely, though the numbers and species will depend on the weather and season. In periods of low mackerel numbers, a major spill may have long-term consequences for the population, specially if a blowout lasts for a major part of the spawning period. Residual oil quantities reaching shore may have negative effects for shorter periods on fish farming in the affected coastal districts. However, the probability of a large spill is considered very small, and it is unlikely that the oil would in any case drift ashore.

During normal operations on the continental shelf, the main impact on the fishing industry will arise from loss of fishing areas. As the Hod field is located in an already developed area, this area loss will be minimal to the fisheries. A template marked with a buoy has already been sitting on the seabed at the planned Hod platform location for more than six years.

Development of Hod is expected to have positive socio-economic effects. At a time when other operating organizations are expected to have to cut back, the Hod development will provide an opportunity to make use of existing operating capacities and expertise.

No potentially negative socio-economic consequences of the Hod development have been identified.

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1. SUMMARY OF FIELD DEVELOPMENT AND OPERATING PLAN

This chapter provides a brief summary of central aspects of the Hod Field Development and Operating Plan. Particular emphasis has been given to the factors which are of significance for the Consequence Analysis.

1.1 Brief historical outline

Licensees

The Hod field lies in Block 2/11 which is a part of Production Licence (PL) 033 allocated in 1969.

The Hod licensees and their interests are:

* Amoco Norway Oil Company	25 %
* Amerada Hess Norge A.S	25 %
* Norwegian Oil Consortium A/S & Co	25 %
* Texas Eastern Norwegian Inc	25 %

By virtue of the State´s participation in PL 033, the licensees are obliged to pay Statoil 10 per cent of the net profits.

Amoco Norway Oil Company (Amoco) is the operator of the licence.

Location

The Hod field lies in the southern part of the Norwegian Sector of the North Sea, 270 kilometers southwest of Stavanger and 45 kilometers southeast of the Ekofisk center. The field is only 13 kilometers southeast of Valhall, which is also operated by Amoco. The location of Block 2/11 and the Hod field is shown in Figure 1.1.1.

The water depth on the field is 72 meters.

Exploration and appraisal history

Hod was discovered in 1974 by the drilling of Well 2/11-2. The field was discussed in Storting Report no. 92 (1976-77) which dealt with the development of the Valhall and Hod fields. A phased development of Valhall and Hod was planned on certain conditions (including proving of reserves). Permission to export petroleum was granted in 1977. Later appraisal wells indicated smaller reserves, and other conditions for development also changed. Development of Hod was therefore not implemented. Various development concepts were studied more closely in the period up to 1982 when the last of five wells on Hod, 2/11-6(ST1), was drilled.

Geology

The Hod field consists of two small hydrocarbon accumulations, called East and West Hod. The reservoir lies in chalk formations dating from the Upper Cretaceous period. The East and West Hod reservoirs are 2700 and 2600 meters below the sea surface and each structure consists of three zones.

Reserves

The field is considered to contain the following recoverable oil, gas and condensate (NGL) reserves:

TABLE 1.1.1. Recoverable reserves

Oil	4.04 million cubic meters (25.4 million barrels)
Gas	0.88 billion cubic meters (31.2 billion cubic feet)
Condensate (NGL)	0.52 million cubic meters (3.3 million barrels)

The production phase is expected to last roughly 15 years, from 1990 to 2004.

1.2 Technical solutions

In 1977 the development of Valhall/ Hod was approved by the authorities. The first phase consisted of building the Valhall A platforms, while other platforms were expected to be phased in as conditions were fulfilled. The equipment on Valhall was designed to accommodate production from these other platforms.

Alternatives

Development of Hod has been considered on several occasions during the previous ten years. Several alternative field development concepts have been studied, ranging from a stand-alone platform with drilling and production equipment and living quarters, to a simple subsea production system. Many intermediate concepts were also evaluated. Common to all alternatives was the connection to the adjacent Valhall field, and the utilization of the existing idle capacity provided there. Since Hod is a small field, development did not become economically attractive until the tax conditions were changed in 1986-87 and an acceptable development concept was established. Another precondition has been that the problems connected with production of formation particles would have to be overcome before Hod development could be started. Chalk formations in the Valhall/ Hod area are very porous, mechanically weak and sensitive to pore pressure changes, requiring special treatment to maintain stable production. A subsea production system would therefore not be attractive during the operating phase. When the need for well maintainance and workover (logging, cleaning, stimulation etc) arises, this can be done more easily and cost effectively from a fixed platform. Subsequent studies have therefore concentrated on reducing the costs of a fixed platform. The concept chosen is discussed in more detail below.

Field installations

In 1981 a well template was installed on the seabed between the hydrocarbon accumulations called East and West Hod and an appraisal well was drilled through the template to appraise the East Hod structure. There are plans to install a small wellhead platform above this template. The steel jacket will have four legs and be of standard lattice construction, piled to the seabed. The appearance of the platform, with two decks, can be seen very roughly from Figure 1.2.1. Facilities have been kept to a minimum and hence include only essential items. The tentative weights of the installations are given in Table 1.2.1.

TABLE 1.2.1. Weights of installations

Deck	700 tonnes
Steel jacket	1700 tonnes
Piles	1700 tonnes
Total	4100 tonnes

Platform operation will normally be unmanned. A mobile jack-up rig is being considered for drilling of production wells and tying these back to the platform deck. The existing well, 2/11-6(ST-1), will be prepared for production and a further 4-5 production wells are planned. To allow for future expansion the Hod platform will be constructed to accommodate eight wells. The facilities will have a capacity of roughly 4300 cubic meters (27,000 barrels) of oil per day at standard conditions. The platform equipment will be simple, straightforward and reliable.

A separator on the platform will be able to separate produced gas from liquids, thus enabling the flow rate and total production from individual wells to be metered. The two phases will be recombined and transported by pipeline to Valhall. This pipeline will be about 0.3

meters (12 inches) in diameter and 13 kilometers long.

At Valhall the oil, gas and water from Hod will be separated and treated in conjunction with Valhall's production in the existing facilities. Finally treated oil and gas will be transported, respectively, to Teesside in England and Emden in Germany via Ekofisk. For locations, see Figure 1.1.1.

Development schedule

The Hod development schedule has been prepared assuming that the Field Development and Operating Plan will be submitted and approved by the Ministry of Petroleum and Energy during the first half of 1988, as illustrated in Figure 1.2.2.

Detailed engineering, however, can begin as soon as the Ministry of Petroleum and Energy has approved the Field Development and Operating Plan and consent has been given. This is expected to occur in May 1988. Orders for materials with long lead times and fabrication contracts are expected to be placed in autumn 1988. Fabrication of the jacket and decks should start before the end of 1988. The pipeline will be laid during summer 1989. The steel jacket and deck unit are expected to be lifted into place in spring 1990. No final decision has been taken whether to drill the wells before or after installation of the platform, but below it has been assumed that the platform is installed before the wells are drilled.

1.3 Economic aspects

Hod is basically an economically marginal field where cost-efficient development and operation is critical. It has therefore been crucial to total project economy that technological concepts be found which can cut costs to below a conventional development, and which the project can carry. Organizational concepts which minimize costs are also essential.

A key point in this philosophy has been to integrate the development and operation of Hod into the Valhall organization. Coordination is the preferred approach to organizational development, involving joint use of personnel, supply and helicopter services etc. The objective is to create an economically efficient organization with optimal utilization of skills and expert staff resources. This integration of Hod and Valhall means that the activities will have to be located in the existing facilities in and near Stavanger.

Development costs

The total development costs for Hod are estimated to be NOK 600 million (1987 kroner). The investment timetable is shown in Table 1.3.1.

TABLE 1.3.1. Investment in NOK millions (based on exchange rate of NOK 7 per USD and unescalated 1987 costs).

	1988	1989	1990	Total
Platform	39.2	107.8	9.8	156.8
Equipment	21.7	28.0	—	49.7
Pipeline	12.6	56.0	9.8	78.4
Modification of Valhall	1.4	5.6	3.5	10.5
Installation	—	—	71.4	71.4
Drilling	—	—	233.8	233.8
Sum	74.9	197.4	328.3	600.6

Economics

The Amoco/ NOCO group's economic evaluation of the Hod project, assuming production startup in 1990, indicates that the field is marginally commercial. Project economics depends on the assumed oil price for the recoverable reserves of 4.04 million cubic meters oil, as well as final transport costs. At an oil price in real terms of USD 17.50 a barrel, the project economy assuming 10 per cent annual discount rate produces a net present value before tax of NOK 490 million (1987 kroner) and internal rate of return (IRR) of 35 per cent for the group.

Under the same assumptions, the net present value after tax will fall to NOK 150 million and the State's share will approach NOK 340 million. The IRR for the Amoco/ NOCO group will then be roughly 20 per cent. But taxes and royalties will probably be less due to deductions deriving from the unit owners' other Norwegian activities. On the other hand, the State will also receive income from Hod through Statoil's 10 per cent share in the field's net profit, plus taxes from companies and persons involved in the Hod development.

Manpower requirements in development phase

Special emphasis will be put on utilizing the established organization, staff resources and experience of the Valhall development.

It is assumed that contracts for detailed design engineering will be signed in summer 1988.

Amoco's project organization in Stavanger will be expanded relatively steadily toward a peak of 15-20 persons in 1989, with another 15-25 at the fabrication sites. Thereafter the project organization will be wound down until dissolution at the end of 1990. The total manpower requirement for the entire project period is estimated to be roughly 80-90 man-years.

Engineering services are planned to be handled by a multi-disciplinary contractor. Roughly, there will be a need for around 150 persons during the 10 month long engineering phase. Procurement activities are expected to last about one year and require approximately 30 persons.

The volume of fabrication tasks is very difficult to assess at this early phase of planning. Important factors such as contract strategy, yard location, design criteria, degree of module completion before tow-out etc will materially affect the prediction. At present the total volume may be estimated at from 400 to 500 man-years. The fabrication phase is expected to last about 15 months.

Installation, hookup and commissioning will be relatively modest since there are relatively few, straightforward modules. Under normal weather conditions, the installations should be in place and completed in less than half a year and require about 60-70 man-years.

The estimated labour requirement in the development phase is given in Figure 1.3.1. The full project is estimated to amount to approximately 700-800 man-years in total.

Onshore operating organization

The Hod operating organization onshore will be fully integrated with Valhall, and will act as the joint operating organization for both fields. This way existing expertise will be effectively utilized, as will the capacities of the Valhall organization. The need for supplementary personnel is expected to be minimal. Common staff functions will also be involved in these operations, and staffing levels will be adjusted accordingly. The operator, Amoco, has a total of about 150 employees at its Stavanger office and Tananger supply base. In addition there are about 35 contractors connected to these organizations.

Offshore operating organization

The Hod platform will normally be unmanned. Personnel will be transported from the Valhall field when required for operations or maintenance. Under the present working hours and shift arrangements, continuous operation of a platform requires about 2.75 times the necessary stationary complement. Accordingly, 145 Amoco employees are needed to fill 56 positions on Valhall. The drilling contractor employs about 125 persons when development wells are being drilled in the Valhall field. A further 100 persons are at present engaged by other contractors to fill 37 positions. These personnel are Norwegian. Operation of the Hod field in addition to Valhall may result in minor adjustments to these numbers.

During Hod drilling operations, which are estimated to last less than one year, the mobile drilling rig on hire will have a crew of 60-100.

Division of labour in operating company

The total number of employees in Amoco required to operate Valhall and Hod is expected to be about 300. This includes both onshore and offshore personnel. The distribution of employees by department is given in Table 1.3.2.

TABLE 1.3.2. Distribution of employees by department in operating company

Management	1
Legal	3
Safety and internal control	5
Personnel	8
Exploration	4
Administration and financial	64
Construction	7
Production	205
Total number of employees	297

Supply services

Valhall is operated with its base functions located at the Tananger base outside Stavanger. Amoco's base staff serving Valhall consists of seven persons. This staff is also assumed to be able to service Hod. The other base support functions will also be utilized.

Supply services to Hod and Valhall will be coordinated as a joint service. There will not be any need for further personnel beyond those presently engaged with Valhall for administration and coordination of supply services to Hod. Hod, however, will require a standby boat in periods when particular operations are carried out.

Helicopter transportation

Helicopter transport to and from Hod and Valhall will be coordinated, with Sola/ Stavanger as base. There will not be any requirement for further shore-based staff for this service.

Operating costs

Figure 1.3.2 shows the assumed composition of annual operating costs over the life of the field. The total operating costs for Hod will be about NOK 80 million a year. Table 1.3.3 shows the breakdown of operating costs for a normal year during the production phase.

These costs cover all cost elements, including onshore activities. The costs of transportation of hydrocarbon products to shore (tariffs) are not included.

The total costs are made up of the following elements:

TABLE 1.3.3. Operating costs in an average year

Offshore labour	NOK	9.0 million
Transport by sea and air	NOK	2.5 million
Materials and contracts	NOK	5.3 million
Total, direct operating costs	NOK	16.8 million
Well workover	NOK	38.5 million
Onshore support	NOK	18.2 million
Insurance	NOK	3.5 million
Total, direct and indirect operating costs	NOK	77.0 million

Production

At startup in 1990 the daily production volume from Hod will be approximately as given in Table 1.3.4.

TABLE 1.3.4. Production rates at startup

Oil	3800 cubic meters a day (24,000 barrels a day)
Gas	0.8 million cubic meters a day (27.5 million cubic feet a day)
NGL	450 cubic meters a day (2800 barrels a day)

Production rates will fall off steadily toward expected production shutdown in 2004.

Industry and commerce

The development and operation of Valhall has provided Amoco with extensive knowledge of and daily contact with Norwegian contractors and vendors of goods and services. Of development contracts totalling over NOK 6 billion, over 70 per cent were placed in Norway. Of Valhall´s direct operating costs of at least NOK 250 million a year, almost all was for goods and services from Norwegian firms. The Norwegian content of the supplies has been about 70 per cent.

Amoco will continue to emphasize that competitive Norwegian vendors should be given genuine opportunity to land contracts for delivery of goods and services.

1.4 Other conditions

Safety and preparedness

One of Amoco's main objectives in conducting its activity is to ensure that safety and emergency preparedness considerations for personnel, the environment and equipment receive highest priority. Amoco's quality assurance and quality control system, and the company's safety review system, will be applied in all phases of the project to avoid accidents. However, Amoco realizes that emergencies may nevertheless arise. Emergency preparedness measures for each phase of the Hod project will therefore be developed. The procedures will be prepared and implemented in collaboration with the Valhall field close by. The emergency measures will cover the organization and procedures to be used in emergency situations. The Valhall platform manager's area of responsibility will be expanded to include Hod.

Links with other activities in area

The development and operation of Hod will be closely tied to and coordinated with activities already existing in the area, particularly in connection with Valhall, which was designed and built with capability for such tasks. The plans call for connection of Hod to existing transport systems for oil and gas via Valhall and Ekofisk.

2. PHYSICAL AND BIOLOGICAL CONDITIONS

The Hod field lies in Block 2/11 in the middle of the North Sea, 45 kilometers southeast of the Ekofisk center and 13 kilometers southeast of the Valhall field. The water depth on Hod is 72 meters. The area where the platform is planned to be located has a 15-18 meter thick layer of sand overlying an 8-12 meter thick layer of clay. Under the clay are generally layers of firm sand and hard clay.

The field will produce light, low-sulphur crude oil similar to oil from other fields in this area of the North Sea. The crude will be fluid even at the winter temperatures likely on the field, and any spills can be collected with traditional oil skimming methods irrespective of season.

2.1 Oceanography and meteorology

The best source of meteorological data for the Hod area is the systematic measurements taken on Ekofisk since 1980 and Valhall since 1982. Due to the short distance between these fields, the conditions on Hod are expected to be similar.

Wind conditions

The prevailing wind in the area comes from the west-southwest. Generally wind strength is Force 3-5 on the Beaufort scale (4-11 meters per second). In the period from November to February, stronger winds occur frequently, with strengths up to Force 8-12 (17-33 meters per second or above).

Weather conditions, air temperature etc

The mean air temperature varies with the month, between 2-14 degrees C. The extreme maximum and minimum temperatures recorded were 20 and minus seven degrees C. The relative humidity is generally 70-80 per cent, with extremes of 20 and 100 per cent. Fog can occur (less than 1000 meters visibility) in the area. Fog is particularly likely in April and May.

Water temperature

The temperature in the upper water layers varies from 3-18 degrees (March-August), the monthly mean being 5-15. Temperature on the seabed is more stable, lying generally between 6-7 degrees C.

Tides

The normal tidal variation is about 1.0 meter. Special combinations of atmospheric pressure and strong winds can cause variations of the order of plus or minus 0.4 meters.

Wave data

The maximum wave height during a 100 year period has been estimated by Amoco at 22.6 meters, with a period of 13 seconds.

Currents

Three major current systems dominate the North Sea. These are the coastal current which flows northward along the Norwegian coast, the Egga current which follows the western edge of the Norwegian Trench southward in the North Sea, and water flowing from the English Channel into the North Sea basin. Figure 2.1.1 provides an indication of the resultant current flow in the North Sea.

The Hod area lies in a part of the North Sea which is little affected by these current systems. The current in the area will be determined primarily by tide and wind. Tidal current velocities vary between 0.1 and 0.3 meters per second. Other currents lie in the 0.04 to 0.07 meters per second range. Special wind directions and atmospheric pressures may nevertheless generate substantially stronger currents.

2.2 Description of technical systems that may affect the biological environment

Drilling

Drilling of four wells in addition to the one already drilled is planned initially. Later more wells may be called for. In either case, a stand-alone, mobile, jack-up drilling rig is envisioned.

Due to the local geology and for technical and safety reasons, oil-based mud will be used for drilling these wells. Use of oil-based mud will comply with the provisions laid down by the State Pollution Control Authority (SFT). Drilling mud will therefore not contain diesel oil.

The drilling rig will be fitted with equipment for cleaning the cuttings before discharge into the sea. Though with the technology available removal of all oil from the mud will be impossible, the discharges will be within the limits imposed by the authorities.

Unused drilling mud will be returned to shore. Several measures will be implemented to ensure that any drilling mud leaks on board the platform never reach the sea. Any spill of drilling mud will therefore be very limited.

Other chemicals may be required to clean out or stimulate wells. The majority of such chemicals will stay in the formations, while the remainder will flow with the produced fluids to the platform.

Platform and pipelines

The Hod platform decks will primarily consist of gratings. In connection with particular equipment components containing hydrocarbons, overflow, drip pans and collection systems will be installed. Any hydrocarbon spills resulting from leaks or maintenance will drain to the sea sump in which oil, gas and water separate. The oil will be pumped into the pipeline to Valhall, the gas vented to the atmosphere and the water discharged into the sea. Chemicals may be injected into the wellstream (wax dispersant, corrosion inhibitor, biocides etc) in order to reduce potential pipeline transporation problems.

A 13 kilometer long pipeline 30 centimeters in diameter will tie the Hod platform to Valhall for transportation of produced liquids, where the liquid will be separated into commercial oil and gas. These products will be transported onward in the existing oil and gas pipelines to Ekofisk.

The pipeline is a closed system and will therefore provide no contact surface between hydrocarbons and the surroundings. Following pressure tests of the pipeline, about 1000 cubic meters of seawater containing chemical additives will be dumped in the sea. The types and quantities of additives will comply with the State Pollution Control Authority (SFT)´s directives. An evaluation will be made of whether the pipeline should be buried to avoid contact damage from anchors or fishing implements.

Produced formation water

Formation water from Hod which is produced in association with oil and gas will be separated out and treated on Valhall together with water produced from Valhall itself. The Valhall equipment was originally intended for this task and has adequate capacity built in to handle Hod production as well.

All oily water on the platform will be cleaned to comply with the State Pollution Control Authority (SFT)´s requirements. After cleaning, the water will be dumped in the sea. The increase in discharge rates due to Hod development is expected to be proportional to the number of additional wells. According to existing plans, this means an addition of less than 25 per cent in the Valhall/ Hod area compared with today´s level, while remaining within rates predicted when Valhall was installed.

Other conditions

The biological environment may also be affected by exhaust gases, gas vent systems etc, spills of refuse, and boat and helicopter traffic to and from the platform. But, since produced liquids and gases will be transported by pipeline away from the area, there will be little risk of spills from the platform. Any dirty water or sewage will be discharged into the sea. This will be a relatively infrequent occurrence on Hod since the platform will normally be unmanned. All solid waste will be transported ashore.

Personnel ordinarily on the Valhall installations will be flown to Hod to carry out maintenance work and otherwise as needed. These flights will be coordinated with other transport assignments in the Valhall and Ekofisk area. Helicopter traffic will follow the same routes as other flights in the area where practicable.

2.3 Biological conditions

Fish

The North Sea has been one of the most productive fishery areas in the world. According to the "Bulletin Statistique" of the International Council for the Exploration of the Sea (ICES), the total pre-1970 catch from the North Sea was as large, and sometimes larger, than from the entire area from 62 degrees N to Svalbard and eastward into the Barents Sea. Catches in the 1980s were sometimes substantially smaller

than earlier, not least due to a diminishing resources base and stricter regulation.

In the area from 56-57 degrees N and from 3-4 degrees E (Figure 1.1.1), sprat (brisling) spawn from April til mid-June, Norway pout (øyepål) from March to the end of April, plaice (rødspette) from January to mid-April, cod (torsk) from February to mid-April and mackerel (makrell) from mid-May to the end of July. In other words, spawning of economically important fish is taking place from January to mid-July.

Mackerel stays more or less within the spawning area until 3-4 years old. Adult, sexually mature mackerel spend the winter in the Norwegian Trench, returning to the central parts of the North Sea in the summer.

Seabirds

There are several important seabird roosting colonies along the southern Norwegian coast. Between East Agder and Sogn og Fjordane the number of roosting seabirds is in the region of 125,000. The most numerous species are fulmar (havhest), cormorant (småskarv), grey goose (grågås), eider (ærfugl), herring gull (sildemåke), grey gull (gråmåke), great black-backed gull (havmåke), mew gull (fiskemåke), kittiwake (krykkje), common tern (makrell-terne), Arctic tern (rødnebbterne), razor-billed auk (alke), guillemot (lomvi), black guillemot (teist) and puffin (lundefugl). At Einevarden in Sogn og Fjordane is the largest roosting area for puffin in South Norway. In South Norway most seabirds arrive at their roosting areas in April-May and leave again in July-August. Outside roosting periods the populations are more spread out. For many species of seabird the Skagerak and West Norway coast are important wintering areas. One general feature of the winter stay areas is the rich populations of plankton and fish. There are relatively few statistics available about the various winter stay areas, though for some bird species relatively good figures exist. The whole of the North Sea possesses a biotope which is suitable for seabirds who live off fish and plankton.

Sea mammals

The common seal (steinkobbe) (Phoca citulina) is the only species of seal found in appreciable quantities in South Norway. The cubs are born at the end of June. At Kjør in Rogaland is the only known grey seal (havert) colony in South Norway. Cubs are born from September to November. Both species live on fish and remain more or less in the same area.

Otters, too, occur along the coast and in the fjords. Otters are generally on the retreat in Europe and the Norwegian population is considered important, also in an international context. Some types of whale occur more or less regularly in the coastal areas off Western Norway.

2.4 Assessment of consequences

Below is an outline of the continuous discharges that will result from operation of the platform. In addition, there will always be some risk of spills due to accident or incident, for example blowout, leakage from the pipeline, or structural failure of the platform. The quantities and consequences of such spills are also discussed below. Any commercial consequences of such spills to the fishing industry will be discussed more fully in Chapter 3.

Oil pollution preparedness on and around the platform will be coordinated with Valhall and the associated service tenders. Expansion of the existing cooperation agreement with the operator of Ekofisk, Phillips, is planned in order to also cover contingency preparedness on Hod. Amoco, being a member of the Norwegian Oil Pollution Protection Association for Operating Companies (NOFO), will relatively easily be able to requisition assistance and equipment from NOFO should a major oil spill occur. In such cases, assistance and equipment will also be available from Amoco (UK) Exploration Company in Great Yarmouth and Aberdeen.

Spills in connection with installation and normal operations

As mentioned in Section 2.2, discharge of water containing some chemicals will occur during commissioning of the pipeline. The total quantities of contaminated water will be about 1000 cubic meters. This discharge will be within the limits set by the State Pollution Control Authority (SFT).

During well drilling, washed cuttings will be spread on the seabottom around the Hod platform. These cuttings will contain some oil which could not be washed out. An exploration well was drilled in 1981-82 at the planned location of the Hod platform. Since then, annual seabottom surveys have been carried out in the area. Similar measurements and biological studies have been performed on the Valhall field since 1980 when the pre-drilling baseline was established. Since then 20 wells have been drilled. Considerable concentrations of hydrocarbons were measured within a radius of 500 meters around the Hod template. The quantities of barium and strontium, and metallic compounds of iron, magnesium, lead and zinc measured near to the wellheads were also above normal. But these compounds were not found in the liver of cod caught nearby. The liver analysis results did, however, indicate a higher level of hydrocarbons than in the reference fish. These analysis results can be used for comparison with similar surveys in the future. In this connection it must be noted, however, that the results from Valhall, with its 21 wells, cannot be directly compared with the Hod case, since plans call for only four wells to be drilled on Hod.

The volume of drill cuttings from these four wells will be less than 1800 cubic meters, or about 4000 tons. The planned drilling fluid will contain mineral oil of low toxicity instead of the diesel oil used up to 1983. With existing technology and the experience Amoco has gained on Valhall, it is possible to limit the quantities of oil released with the cuttings to less than 10 per cent of the dry cuttings weight, which is the limit set by the authorities. Only a portion of this oil will be released to the sea over time.

- Translation from Norwegian -

Water produced on Hod will flow to Valhall together with the oil and gas for separation and treatment in the existing plant. Most chemicals which may possibly be added to Hod production will flow onwards into the oil pipeline from Valhall. Any biocide injected at Hod will, however, have a tendency to stay in the water phase. Water discharge at Valhall is quantified below. After treatment the produced water will have an oil content which complies with the State Pollution Control Authority (SFT)'s requirements. While the oil production rate will decline during the life of the project, the produced water ratio will increase. The quantity of produced water will therefore remain essentially constant. On Valhall the 12 month average discharge volume is equivalent to about 100 cubic meters of water per day. This discharge rate represents about 1.5 tons of oil per year. The increase in discharge rate resulting from the Hod development is expected to reflect the increase in the number of wells on the two fields. According to present plans this means an increase of less than 25 per cent. The sea around Valhall and Hod has good dilution and spreading properties. The effects of these discharges will therefore be very local.

Transportation of gas by pipeline from Hod means that very little gas, if any, will be released from the Hod platform.

Diesel generator sets will provide electric power for the platform. The diesel oil used as fuel releases sulphur dioxide (SO_2) gas, though only in small amounts. In normal service the diesel engine consumes less than one cubic meter of diesel oil per day. Though air in the immediate vicinity will be heated, the area concerned will be very limited.

Spills due to accident or incident

Development of the Hod field will be based on technology already known from development of other North Sea fields. The risk of major pollution is therefore considered very small, both during drilling and production. The same is true for the probability of uncontrolled blowout, which has been estimated to be less than 0.4 x 10 exp(-4) per year.

Simulations have been run at the Institute for Continental Shelf Studies and Petroleum Technology (IKU) which show the drift pattern of large spills from around Ekofisk (an area which also includes Hod and Valhall). These calculations show large variations in drift direction, though there is some tendency to move east. The coastal areas which may be affected by the oil are western Denmark and southwest Norway from Lindesnes to Sognefjorden. The amounts beaching will be relatively small, in part due to the low spill rate, and in part due to the long drift times before reaching shore. The probability of oil reaching the beaches during a spill is also relatively low, from 15 per cent in summer to 30 per cent in autumn. The shortest drift time to the Norwegian coast has been estimated at 9-15 days. During this period, large parts of the spill will normally be collected, and the remainder will generally evaporate and get diluted.

Large pipeline leaks will be discovered immediately due to the pressure drop at the platforms. The pipeline will then be closed off immediately at both ends. The oil quantity that can escape from a broken oil line is about 250 cubic meters. Spills in the case of gas leaks can vary somewhat depending on the type of leak. The quantities discussed here will not cause large hydrocarbon concentrations in the water, since most of it will evaporate or be broken down in a short time. Such spills will therefore present only an insignificant threat to seabirds, sea mammals and beaches.

Consequences of spills

Installation of the platform and pipelines may have a negative effect on seabottom organisms in the sea area affected. Drilling and production may additionally affect plankton, fish eggs and fish larvae. Grown fish, however, will be able to swim away from polluted areas.

Generally, the immobile inhabitants of the seabottom will be those that suffer the most. Through the food chain this may ultimately affect the size of fish populations, and therefore also the catch quantities. Experience from the North Sea so far indicates no severe effects of this type on fish populations. The disturbance to fisheries primarily relates to loss of fishing areas. Fish resources further away from the field, for example along the coast, will not be affected by spills during installation or normal operation.

The environmental consequences resulting from installation of the platform and the laying and testing of the pipeline will affect a limited area. No long-term effects are expected. Experience on Valhall indicates that seabottom dwellers will be disturbed, sometimes severely, within an area of about one square kilometer around the platform, primarily due to drill cuttings. Outside a surrounding area of about 30 square kilometers there are no marked biological effects. One must remember that these are the results after drilling 20 wells, while on Hod only four wells in addition to the one existing are planned.

Effects of gas venting are also considered quite insignificant. Normally the biggest effects are likely to be caused by the various liquid discharges from the Valhall platforms. These discharges, however, are strongly diluted, and are further diluted the moment they enter the sea. Their effects on fish eggs and fish larvae will be very small, and limited to the area immediately around the platform. Nor will the emission of exhaust, cooling air or discharge of sewage or similar have any significant impact on the Hod platform area.

During production small spills of crude and waste oil may occur. Such spills will be quickly diluted and broken down. In some cases the spills will have negative consequences for seabirds, but are expected in other respects to have only marginal effects. If a major oil spill occurs, it is likely that some seabirds will be killed. The number and species will depend on the season and weather. Under unfavourable conditions, a residual quantity of oil may drift ashore along the Norwegian coast. In such cases, some seal and otter may succumb. The effects of such spills on fisheries and fish farming are discussed in more detail in Chapter 3.

In conclusion, development of the Hod field is expected under normal operation to have only insignificant effects on fish, seabirds, sea mammals or similar.

3. EFFECTS ON FISHERIES

3.1 Effects on saltwater fisheries

Development of Hod may disturb fisheries by reducing the area available for fishing. If an accident or incident occurs, the numbers of fish eggs and larvae may be reduced, fish caught near the platform may be unpalatable (tainted), and fishing gear may become contaminated etc.

Area reduction

The new 13 kilometer long pipeline will lie close to the already-existing line from Ekofisk to Emden in Germany, and constitute an extension of the line from Valhall to Ekofisk (Figure 1.1.1).

The Hod field lies within the area 56-57 degrees N and 3-4 degrees E. The most extensive Norwegian fishing in the area is for mackerel and herring with ring nets. The area also contains good fishing grounds for cod, haddock (hyse) and plaice. Fishing vessels from the European Economic Community (EEC) use trawls and Danish seine in the area.

Herring catches in the North Sea declined from 313,000 tons in 1975 to 11,000 tons in 1978. Since then catches have increased. The total catch of almost 530,000 tons in 1985 represents an increase of 67 per cent in relation to 1984, and an over-catch of 132 per cent in relation to the total quota recommended by the International Council for the Exploration of the Sea (ICES). Norway's share was approximately 160,000 tons. The Norwegian quota for 1986 was set at 200,000 tons by Norway and the EEC. The Norwegian quota was filled, and fishing was stopped on 17 October. The most important catch periods were May-June and October. Catch statistics from other countries are not yet available.

The population has been growing healthily since 1983 due to a series of good age groups after 1980. The growth in population, however, has been retarded somewhat by heavy exploitation. Since fishing in the

northern and central North Sea was reopened in 1983, the annual catch has been 2-3 times the size of the quotas recommended by the ICES.

The conclusion from the international young fish surveys in February 1986 is that the 1984 age group was good, and that the 1985 group will probably also be good. The results of acoustic surveys in November 1986 confirmed this. This means that recruitment to the spawning population will be good in 1987 and 1988. The ICES has recommended that the total quota for 1987 should not exceed 600,000 tons. For the first time since reopening of fishing, Norway and the EEC agreed to a quota not in excess of the ICES recommendation. The Norwegian quota was 224,000 tons. The agreement with the EEC for 1988 assures Norway a North Sea herring quota of about the same size.

Catches using nets, however, will only suffer a loss of area equal to the size of the safety zone around the platform. This area is so tiny (0.8 square kilometers) that no catch reduction is anticipated. Fishing has already been restricted by the drilling template which has been sitting on the seabed where the Hod platform is planned to be installed for more than six years. The template is marked with a buoy.

We can therefore conclude that the loss of area through development of the Hod field will - seen in isolation - be of little consequence to Norwegian fishing industry, and will not cause any loss of jobs in the fishing fleet.

Other conditions

Mackerel is traditionally an important resource in the North Sea. In the years 1975-77 the catch was around 250,000 to 300,000 tons in the North Sea and Skagerak, with a peak in 1976 of around 306,000 tons. Of this, Norwegian vessels caught 197,000 tons. The mackerel population has later been severely reduced. The total catch in 1985 was 49,000 tons, or an increase of about 10,000 tons in relation to the two previous years. The Norwegian ring net fisheries in the North Sea brought in 11,200 tons.

Population trends in the years ahead will essentially hinge on the strength of the recruiting age groups. All age groups in the 1970s were weak, and except in 1974, so weak that the newcomers did not even balance the loss due to natural mortality. The 1980 and 1981 groups were again weak. Observations from research trips and fishing in 1985 indicate that the 1984 age group is much stronger than earlier crops, presumably the most populous since 1974. New studies in 1986 have confirmed this, though tests from the spawning area in the North Sea showed that only a very small part of the 1984 age group spawned in 1986. Since the age group provided no addition to the spawning population and fishing continued, it was no surprise that the population further declined in 1986.

The situation may change in 1987. Usually all three year old mackerel spawn, and the 1984 age group will presumably contribute to an increase in the spawning population in 1987. This age group is strong, but has been biased westward; and as yet it has been impossible to estimate how much will be recruited to the spawning population in the North Sea in 1987.

The International Council for the Exploration of the Sea (ICES) recommended that mackerel fishing should not be opened in the North Sea and Skagerak in 1986. Despite this, Norway and the EEC agreed to fix a total quota of 55,000 tons. A similar quota was fixed for 1987. According to provisional catch statistics, the total catch was 44,000 tons in 1986. It is reasonable to assume that fish mortality was very high in 1986. Fish mortality will regress again in 1987 if the 1984 group recruits as expected. The spawning population will then increase strongly, though even with good recruitment also from the 1985 age group and moderate fish mortality in the years ahead, it will be several years before the North Sea population again reaches the level it had in the early 1970s. The Norwegian mackerel quota in 1988 will not be much bigger than in 1987, though agreement has been reached that the large mackerel resources must be managed through close, active cooperation between Norway and the EEC.

- Translation from Norwegian -

Mackerel generally spawn in June and July. Studies have shown that the fish is most vulnerable to oil pollution during the very early stages of its live, the egg and larvae stages. According to Norwegian Public Report NOU 1980:25, "Petroleum Activity North of 62 Degrees North Latitude", studies by the Fishery Directorate's Ocean Research Institute have shown that oil more than 15 days old is no longer considered harmful to fish eggs or larvae. If fresher oil overlaps fish eggs or larvae, the Institute assumes the eggs and larvae will succumb.

It follows from the above that during a period of low mackerel population, a major oil spill in the spawning period may have long-term consequences for the population, particularly if the spill lasts through most of the spawning period. The probability of this happening seems nevertheless to be small, and development of Hod is therefore not considered to have long-term negative effects from a marine biology viewpoint.

Spills and natural drift are not expected to have marked effects on the mackerel population or other populations in the area. Nor are such spills expected to have appreciable effects on the taste of fish caught by Norwegian fishermen, or contaminate fishing implements.

3.2 Effects on fish farming

In recent years there has been a strong increase in fish farming (aquaculture). Production according to the Central Bureau of Statistics of salmon and trout in 1985 was roughly 45,000 and 4,400 tons from a total of 538 farms for "consumer (table) fish". Hordaland is the county with most consumer fish licences, having a total of 170 in 1986. Møre og Romsdal has 113 licences, Sogn og Fjordane 89 and Rogaland 58. East and West Agder totalled 24 licences in autumn 1987. Most licences apply to fish farms already in operation or shortly due to start.

The distribution of stock fish installations shows a similar pattern. In 1986 Hordaland had 40 licences, Møre og Romsdal 27, Sogn og Fjordane 21 and Rogaland five. The number of stock fish installations in the Agders was 18 in autumn 1987.

The statistics also show that 3500 people were engaged in fish farming in 1986, comprising 2500 in consumer fish farms and 1000 in hatcheries and stock fish installations.

In summer 1986 a total of 197 licences had been awarded for shell fish cultivation in Møre og Romsdal, 88 in Sogn og Fjordane, 130 in Hordaland, 53 in Rogaland and 25 in the Agders. Interest in shell fish cultivation is increasing and the industry is expected to expand strongly in the years ahead. The best growth conditions for shell fish are found in fjord areas. Existing and future installations will therefore not be as exposed as consumer fish farms to oil pollution arising offshore. Interest in farming of sea fish and "sea char" (sjørøye) is also increasing.

Any residual oil quantities from a major spill on the Hod area which drift ashore will, however, generally hit the coast between East Agder and Sogn og Fjordane. The coasts of Hordaland, Rogaland and West Agder will be particularly exposed in such cases. Beached oil may cause contamination of fish farming installations and render the product unpalatable, and, as a consequence, unmarketable. In special cases therefore, considerable damage may be done.

In connection with the spill of 2000 tons of crude oil from the UK sector of the North Sea at the end of November and beginning of December 1986, an assessment was made of the consequences that might be expected if the slick drifted ashore in Hordaland. It is always difficult to predict the damage in such cases. At the most critical stage, potential damage to fish farming installations in Hordaland was estimated at a tentative NOK 40-200 million. In retrospect, it seems that such damage was avoided because the oil was broken down before reaching shore.

Ch.3. Effects on fisheries

Given normal operating conditions, the Hod field development will have no deleterious effects on fish farms. The probability of a major spill resulting from the development proposed is considered negligible.

4. SOCIO-ECONOMIC EFFECTS

This chapter deals with the social consequences and effects on the community of the Hod development. A similar report was prepared by BP Petroleum Development (Norway) Limited about one year ago for the Gyda field, which also lies near Ekofisk. The locations of the existing operating organization and supply base are identical for BP and Amoco, being in both cases Stavanger and Tananger Base. Parts of this report have been revised and updated as required to cover Hod and the present situation. The analysis carried out was based on systematic consideration of the essential questions raised by the setting up of such a project. A field development may, in general, affect the surroundings as exampled by the following series of events:

- commercial effects through suppliers and the direct creation of jobs at the national, regional and local levels, producing

- employment effects at the national, regional and local levels

- adaption of the job market, with attendant effects on settlement patterns, causing

- different housing requirements by the population

- new requirements for technical utilities and municipal services (water, sewage, schooling) due to the changes in population and housing demand.

4.1 National perspectives

Investment level

The history of oil in Norway is brief. Only 16 years ago test production was initiated on Ekofisk. As time went on more commercially viable fields were discovered and the investment rate in offshore development rapidly escalated. In the late 1970s and early 1980s investment ran to roughly NOK 10 billion a year. From 1982 another

increase took place, reaching a level of almost NOK 30 billion in 1986.

Future prospects are more uncertain as a result of the unsettled oil market and low oil price, and uncertain gas market opportunities.

Investments in fields at the development stage will decline toward 1991. Among the new major projects, Troll and Sleipner have already been approved for development, though investments will not be made before 1989-90. A definite drop in investments is therefore anticipated in the intervening years (1988-89), as shown in Figure 4.1.1. Veslefrikk and Gyda will tend to offset these low investment levels, but further development decisions are essential if activity levels are to remain buoyant.

One central policy goal of the authorities has been to sustain as uniform activity levels in the sector as possible.

Seen from this viewpoint the Hod project provides very well timed investments of about NOK 600 million. As the main thrust of the investments will occur in 1988-89, the Hod project will help secure Norwegian continuity offshore, even though the activity level will unavoidably drop below the level of the last 2-3 years.

Effects for Norwegian industry

Oil activity has become of steadily increasing importance to Norwegian industry. The results are seen directly in the job market, and indirectly in connection with supplies of goods and services. Though in 1973 less than 10,000 people had links with the oil industry in Norway, in 1986 the figure is over six times greater.

The declining investment commitment will represent an employment problem, in addition to many firms' concern about how to retain their expertise and capacity in the future. The shipyard industry and engineering design contractors, particularly, are facing short-term recession.

- Translation from Norwegian -

Without new offshore development the yards themselves reckon on a decline from about 23,000 man-years in 1985 to 7,500 at the end of 1987, to only 3,700 in the first six months of 1988. Several factors combine to brighten this dismal outlook; Oseberg North, Veslefrikk and Gyda in 1988-89 and Sleipner-Troll are expected to have a positive effect in 1989. Nevertheless, a capacity utilization of only about 30 per cent is likely in 1988, followed by 50 per cent in 1989. These statistics assume that all contracts are placed with Norwegian vendors, which hardly seems a realistic view. Hod, with its 700-800 man-years is one of the projects than might offset the decline and tend to improve the situation.

Engineering design and fabrication will take place during a period (1988-89) when activity in Norwegian yards and associated industry is in the pit of a recession. Idle capacity could then be utilized, thus removing undue pressure on the industry. This might help provide Norwegian enterprises dependent on offshore projects with an opportunity to retain their level of experience and capacity until the new, major contracts arrive on the Norwegian shelf in the 1990s. The development concept proposed for Hod may also suit other marginal fields close to existing infrastructure. During the development phase, Norwegian supplies can come from all over the country. During the operating phase, proximity to the operating organization and base will be more crucial. This situation ideally suits Stavanger and the Jæren hinterland.

4.2 Consequences for Rogaland County

Population and settlement patterns

Rogaland County at the start of 1987 had slightly over 325,000 inhabitants. The county experienced strong population growth from 260,000 in 1970 to 305,000 in 1980. Growth has continued, but the rate has fallen. Growth during this entire period was two or three times as large as in the country at large.

Rogaland's population is markedly younger than the national average, includes a smaller proportion of elderly and has higher birth rate.

Three out of four Rogalanders live in a built-up area. The natural regional centers are Sandnes, Haugesund, Egersund and Sauda, though Stavanger is the major focal point with roughly 100,000 inhabitants in 1987.

Industrial development

Historically speaking agriculture and fisheries were the main industries, in addition to canning and foodstuffs. Gradually, manufacturing and other service industries have attained greater importance. During the last 15-20 years, the oil activity has attained the status of a prime-mover in the county's industrial development.

In 1986 there were 148,000 employed persons in the county as a whole. This represents a growth in the working population of about 17,000 from 1980, or on average roughly 2.5 per cent per annum. This rapid expansion appears now to have levelled off.

The growth in the working population derives primarily from the oil industry and social and private service activities: more traditional industries have been on the decline. Shipyards and heavy engineering have tended to stagnate.

Oil activity has brought about a restructuring of Rogaland's industry, which has become increasingly petroleum-oriented. In addition the oil activity has provided the basis for heavy population influx, escalating population growth, and consequent strong expansion in service industries.

Rogaland is Norway's "oil county". Over 26,000 of the county's jobs are oil-related. One third of the oil workers in Norway live in Rogaland, and around 40 per cent of Norwegian jobs are found here. Rogaland is a power player in almost all fields, except in engineering services (centered around Oslo and Akershus) and research and

education (with centers at Trondheim and Bergen).

Rogaland's employment outlook

The county administration points out that we are facing a considerable challenge if full employment is to be maintained. The challenge stems from the large annual recruitment into the labour force, combined with signs of stagnating industrial development.

One important aspect is the declining exploration and development activity on the southern part of the Norwegian continental shelf. The center of gravity of oil expansion is in the process of moving northward, at the same time as direct cuts in the operating organizations for Frigg and other fields will soon be facing us.

In consequence analyses it has become usual to estimate the employment effects to between 0.5 and 1.5 jobs in other activity for each directly project-related position. Model simulations for Rogaland indicate that here the effect is in fact rather larger (close to 2.5). The explanation may lie in the fact that Rogaland's industry is well adjusted to the oil world and therefore in a position to supply the necessary goods and services locally.

Employment in development phase

During the development phase, Amoco's project organization will be integrated with the company's existing organization in Stavanger. The project organization is expected to reach a peak of 15-20 persons in 1989, with another 15-25 at the fabrication sites. Amoco personnel in the US will also be on call should assistance be necessary.

Engineering services will generally be procured from a multi-discipline contractor. With the simple development concept planned for Hod, a medium-size Norwegian engineering contractor should be capable of handling this. A few such firms are found in Rogaland.

Estimation of the size of the fabrication assignments is not easy in the early planning stage. The total volume is likely to lie between 400-500 man-years. Most of this requirement will surface in 1989. To what extent Rogaland will be involved is not known, but will depend on the various contractors' competitive rating with respect to quality, price, delivery times and so forth. Platform units and associated equipment will be as far completed as possible before installation. Considering the very limited number of units and modules, the installation and hook-up work offshore is expected to take less than one month. The plan is therefore to employ the crew of the crane-barge which lifts the units into place to also hook up and complete the platform.

Employment in operating phase

Naturally the plans call for integration of the Hod operating organization with that of Valhall as mentioned above. Valhall will be able to support production on Hod with only a minor increase in staff.

No consent is required under the Establishment (New Businesses) Act for establishment of the onshore operating organization for Hod.

The direct operating costs including well workover on Hod will be about NOK 60 million a year. Indirect operating costs are expected to run to roughly NOK 20 million a year. This means considerable contracts to or through Rogaland firms. The costs of pipeline transport and tariff charges in this connection will be additional.

The operation will have spinoff effects on jobs in other areas of activity. Due to the expectation of unused capacity and the tendency even today for capacity to be idle, it seems probable that this will not represent a supplement to the present job level; it will primarily just lessen the anticipated decline.

This leaves us with the following set of development predictions up to the end of the century:

There is reason to assume that productivity will continue to rise in primary industry. As long as a major part of jobs in this sector are in agriculture, new unemployment can nevertheless be expected to remain modest. Both fish farming and traditional fishing are relatively non-labour-intensive (see Chapter 3 on the Effects on Fisheries). All in all a slight decline in employment is expected in the primary industries.

In the industry sector the following assumptions apply:

- the food industry will experience slow growth in jobs, the main reason being the increasing consumption by the predicted increasing population, and ripple effects of the growing sea farming industry

- textiles will experience a gradual decline in jobs during the entire period

- the large ready-designed housing contractors in Rogaland will probably decline in importance as job providers

- timber processing and graphics are likely to experience slight job recession up to year 2000

- during the 1990s an ammonia and methanol plant will be erected in North Rogaland, plus a nitrogen plant in Dalane. This gives reason to expect considerable growth in chemicals.

- stable job development is predicted throughout the period in minerals and metals

- shipyards and heavy engineering will experience a heavy decline in jobs up to 1988 in their offshore-oriented activities. In 1988 jobs may fall to about 12,500 as a result of reduced investment in the North Sea, followed by moderate growth.

Another prediction is that building and construction will experience some recession following their very high activity level in recent years. Communications, tourism, hotels and restaurants on the other

hand are considered growth industries, as also are consumer goods, banking and insurance. Services have been expanding, though in recent years there has been a tendency to level off. Some continuing growth is nevertheless anticipated.

In all the number of jobs is expected to rise from 148,000 to about 170,000 in year 2000. This represents an average growth rate of roughly one percent a year, which though less than half the figure for 1980-86, is still strong compared with other regions of Norway.

4.3 Industrial consequences in employment region

The Stavanger hinterland will be the area most directly affected by the development and operation of the Hod field. Most of the oil-related activity in Rogaland is located nearby, and Hod's operating organization will be integrated with Valhall's, already in Stavanger.

Stavanger area

With its 100,000 inhabitants and 15,000 oil-related jobs, Stavanger qualifies as Norway's "oil capital". The city has experienced a difficult process of restructuring and rebuilding. Today's problem is the clearly-perceived decline in oil activity. Existing operating organizations will soon be subject to cuts, and there are few major development tasks in sight for which Stavanger would be the natural nerve center.

Stavanger is one part of the larger "employment region" comprising several local government districts on the Jæren peninsula. These include Hå, Klepp, Time and Gjesdal (South Jæren); and Sola, Randaberg, Sandnes and Stavanger (North Jæren). Collectively the region had a population of about 200,000 in 1986 of whom about 160,000 live in the northern part.

The region has a broadly based job market. The demand for labour is expected to be about 97,000 in 1988. Unemployment is less than 1000, commuting is extensive and mobility has been very high.

The regional outlook predicts pronounced growth in available labour, while demand will stagnate. Population influx will decline slightly. Net commuter inflow will approach zero and unemployment will rise until the early 1990s, then decline.

The regional labour market is no longer as rigid as at one time. Pressures on the region in the early 1980s have been replaced by the desire to generate new growth in order to satisfy the steadily expanding working population.

Given the predicted outlook for the region, there would seem to be no difficulty recruiting personnel with the various qualifications required (see Section 1.3). Indeed, the project would be a positive step toward retaining the expertise available in the area, and utilizing already-existing capacity.

4.4 Population and settlement patterns in Jæren

As mentioned earlier, at present about 200,000 people live in Jæren. Table 4.1 shows how they are distributed by municipal area in North Jæren and in South Jæren as a whole.

TABLE 4.1. Population trends in Sola, Randaberg, Sandnes and Stavanger in North Jæren, and in South Jæren.

	Change 82-86				Change 1986				1987
	Population 1.1.82	Natural growth	Net inflow	Increase p.a.	Population 1.1.86	Natural growth	Net inflow	Increase p.a.	Population 1.1.87
South Jæren	39630	1723	175	1.2%	41493	471	375	2.04%	42339
Sola	13006	667	1143	3.48%	14832	167	-31	0.92%	14968
Randaberg	6345	303	304	2.4%	6967	78	77	2.22%	7122
Sandnes	37413	1529	1855	2.26%	40856	505	579	2.65%	41940
Stavanger	91021	1874	2286	1.14%	95084	587	-20	0.60%	95651
Total North	147785	4373	5588	1.69%	157739	1337	605	1.23%	159681
Total Jæren	187415	6096	5763	1.58%	199232	1808	980	1.40%	202020

Note: p.a. is per annum.

As the table shows, population growth in North Jæren has been declining in recent years. This is particularly true of Stavanger, where Amoco's operating organization is situated. In this local government area, the population growth in the first half of 1987 was still less than 0.6 per cent.

Though the outlook for the region as a whole predicts growth, the rate of growth will be less. Net population influx in the years ahead is expected to be less than one fourth of the 1981-85 level. The

population will grow from about 200,000 in 1986 to about 230,000 in 2000, or about one per cent per annum.

The strong growth which took place in the area sometimes gave rise to severe pressures, for example on housing. The massive construction of technical infrastructure and housing has done much to relieve this pressure.

It seems therefore unlikely that the retention - or possible restructuring - of the Valhall organization and base functions in order also to operate Hod will cause any particular difficulties in the region.

4.5 Other local consequences

Social and cultural factors

A project the size of Hod is not expected to cause social or cultural conflict or other problems by virtue of its location.

The Stavanger region is already well developed with mature centers of professional, social and cultural life.

An international community already exists with roots in the oil activity; schooling is well developed at most levels and caters to many nationalities and cultures.

Public services

Considerable financial commitments have been made to public services and technical utilities. The area enjoys good communications systems.

Area conflicts

The Hod operating organization will make use of existing buildings and facilities and therefore requires no new site. For this reason there seems no reason why the operating or base functions should trigger any conflicts concerning area utilization.

5. FOLLOW-UP STUDIES

In accordance with the requirements of the State Pollution Control Authority (SFT) and Amoco practices, monitoring and control of hydrocarbon discharge and spills will continue, as will monitoring of the biological and chemical environment in the area around the Hod platform.

In addition the discharge of drain water and oily cuttings will be recorded in compliance with State Pollution Control Authority provisions. Similarly, inspection of oil-based drilling mud and its oil component will be carried out in accordance with State Pollution Control Authority codes and Amoco´s practice.

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7. FIGURES

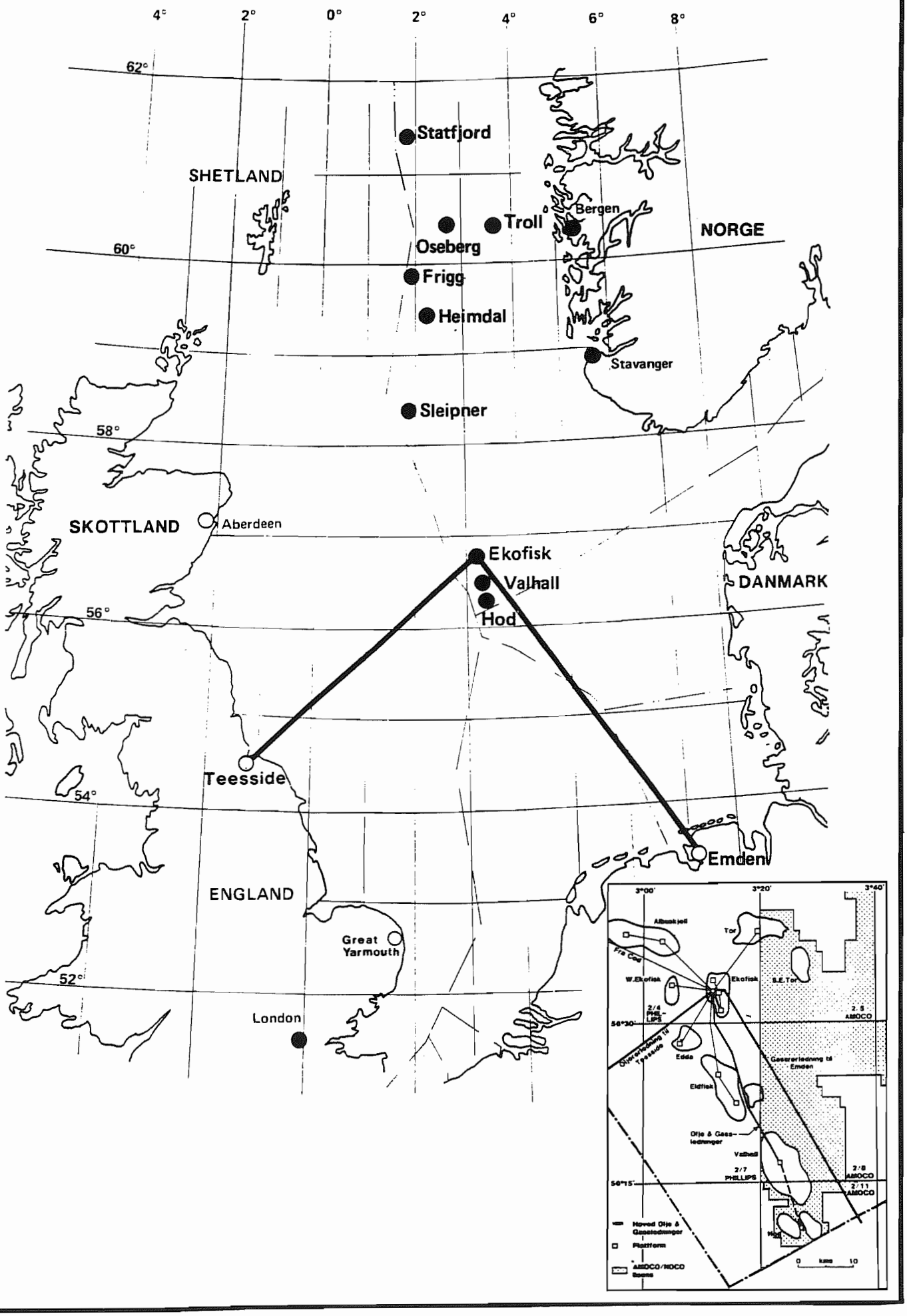

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FIG. 1.1.1 HODFELTETS BELIGGENHET

PLATTFORM SKISSE

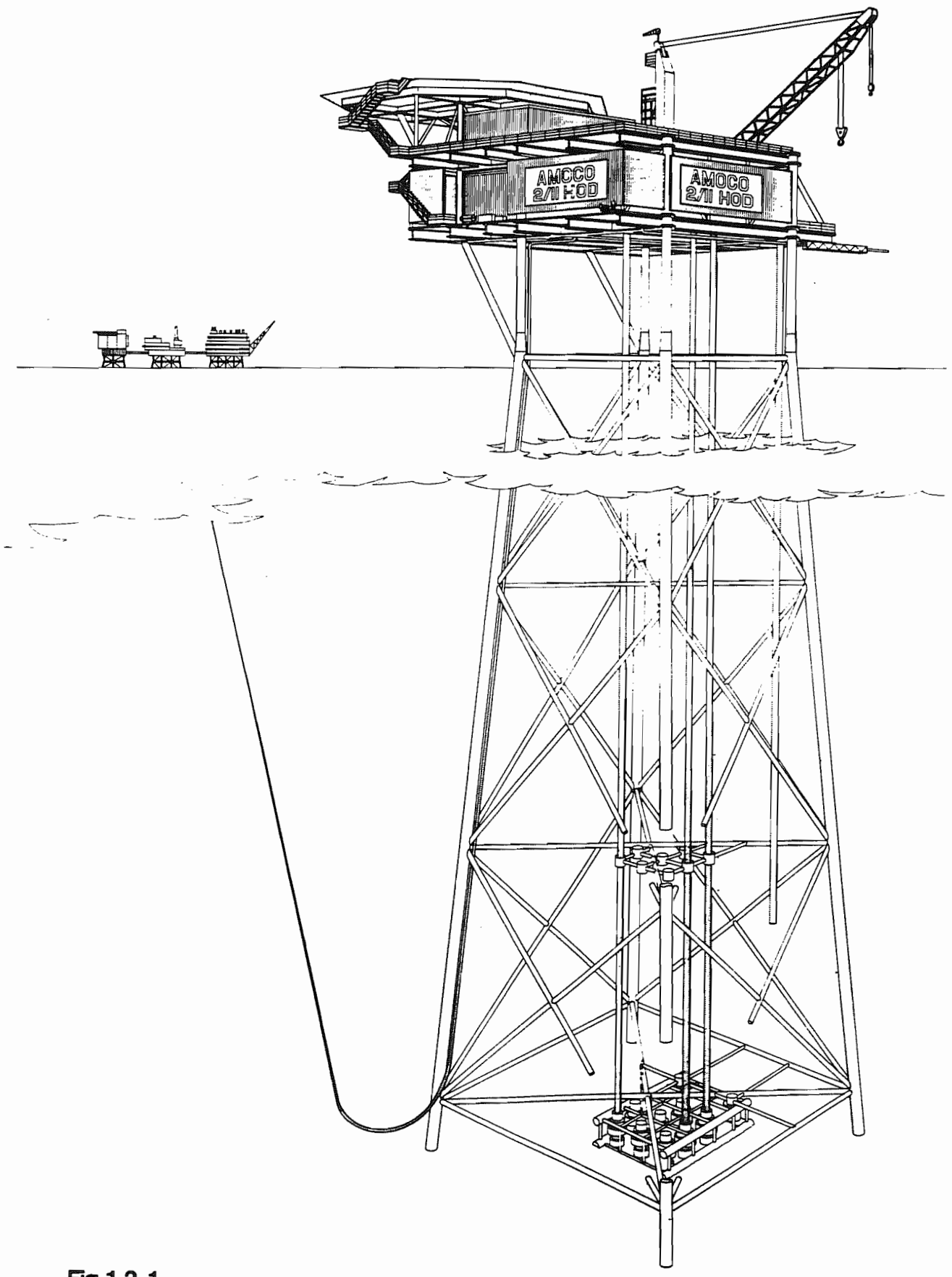

Fig. 1.2.1

FRAMDRIFTSPLAN FOR UTBYGGING AV HOD FELTET

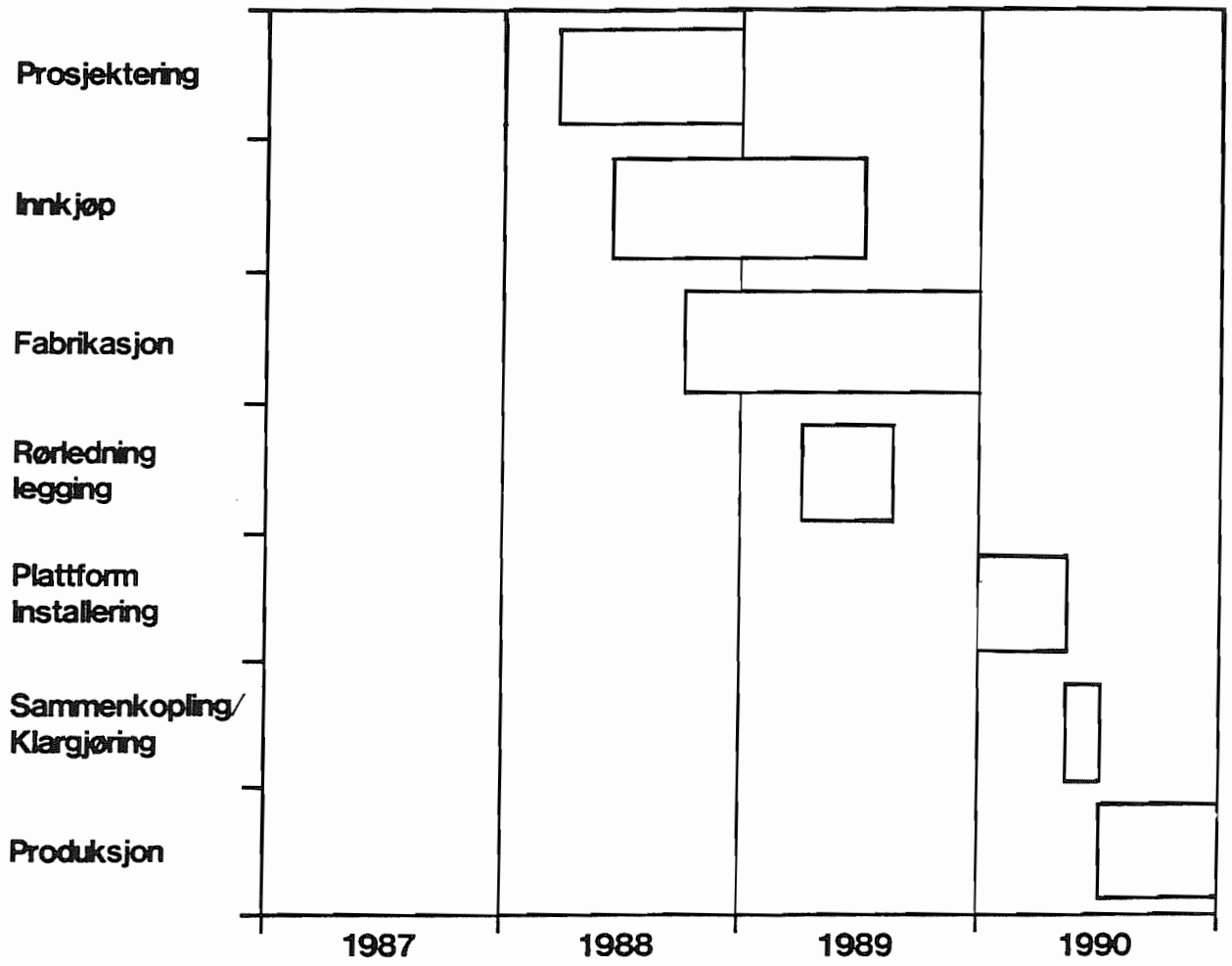

Fig. 1.2.2

ARBEIDSKRAFTBEHOV I UTBYGGINGSPERIODE

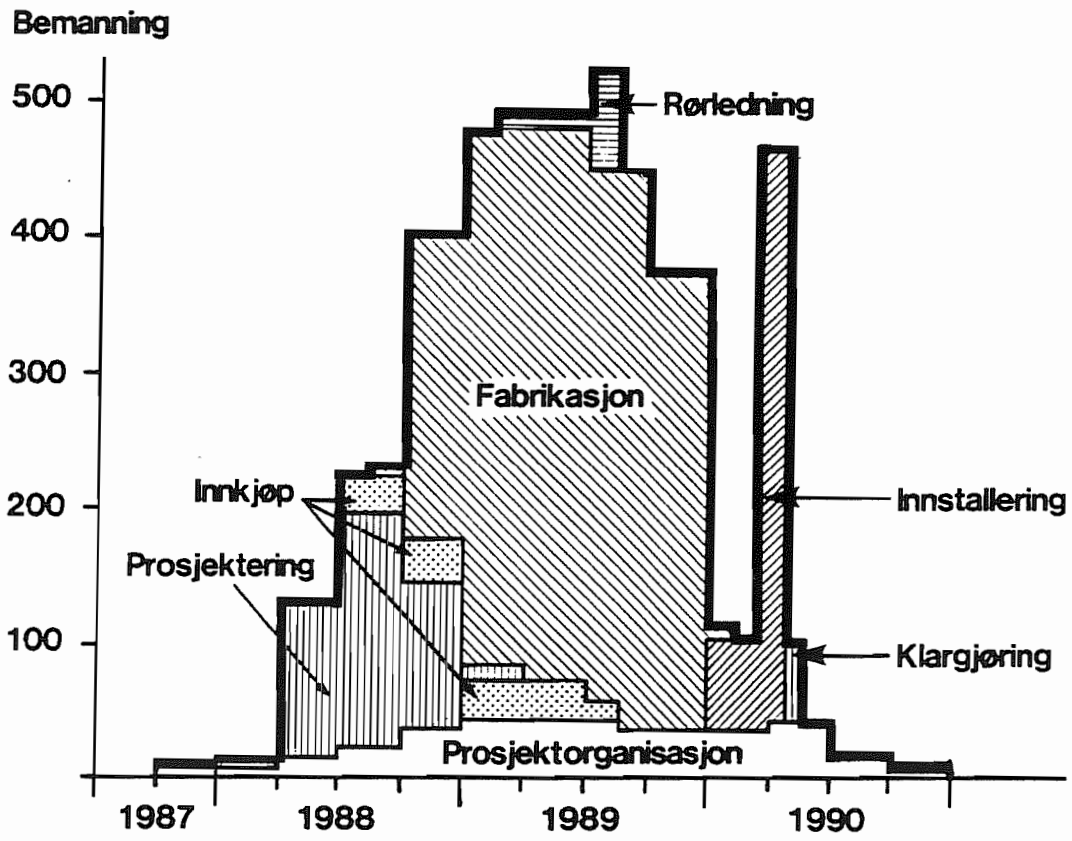

Fig. 1.3.1

ÅRLIGE DRIFTSKOSTNADER

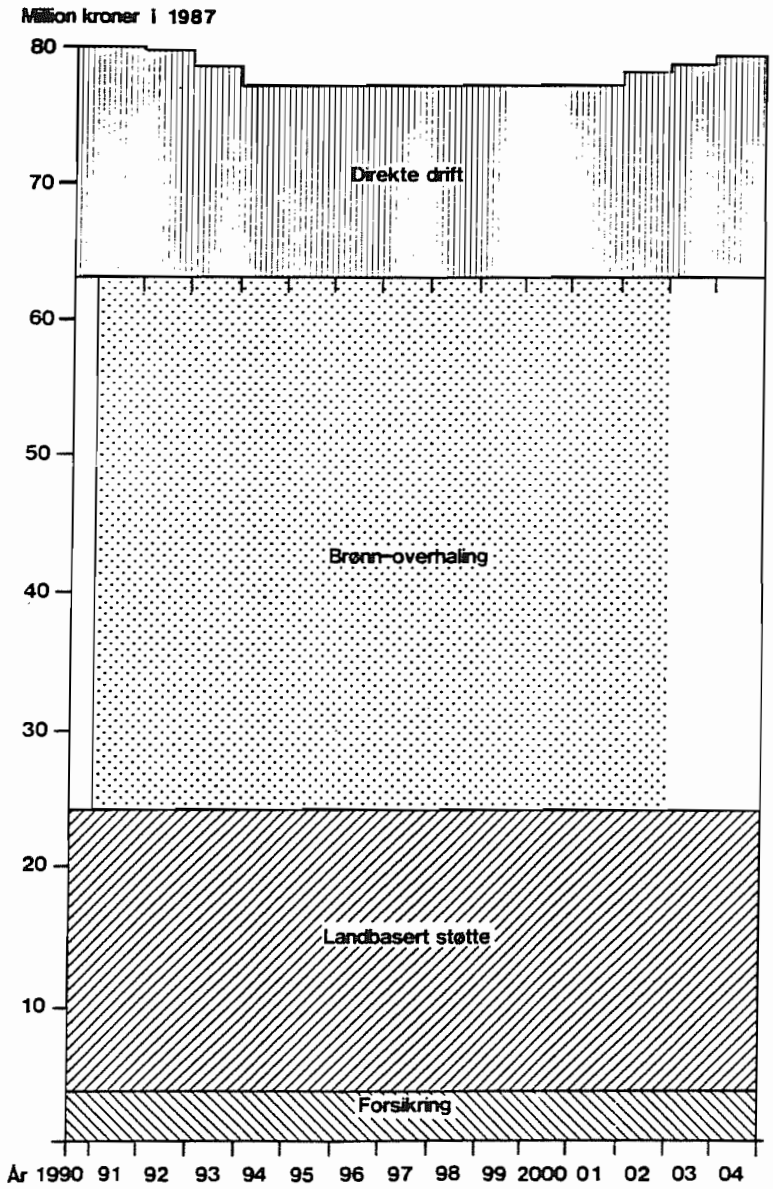

Fig.1.3.2

VIND OG TIDEVANNS-STRØMMER

Atlantisk-eller Nordsjøvann

Kyststrømmer

Hvirvelstrømmer

HOD-området

Fig. 2.1.1

INVESTERINGSPROFIL FOR VEDTATTE OG EN NY FELTUTBYGGING (SNORRE)

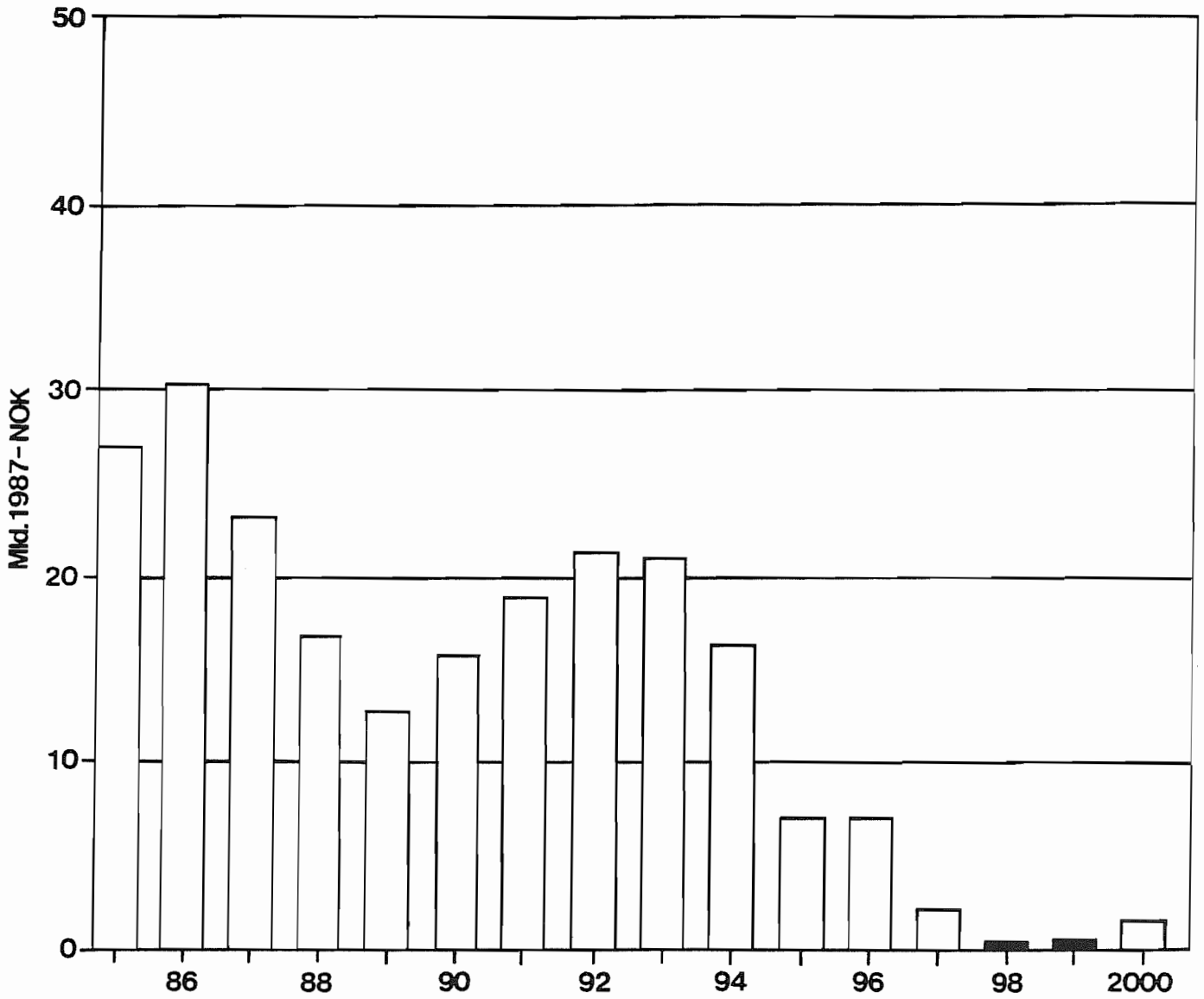

Fig.4.1.1