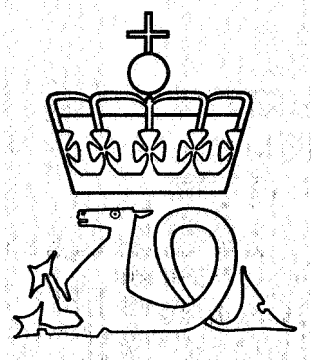

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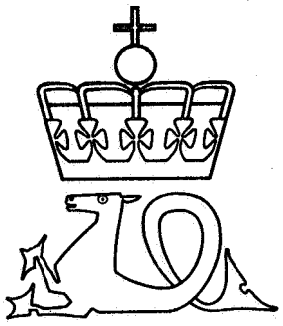

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June 1984

"The Norwegian Petroleum Directorate`s purpose is to actively contribute to a sound administration of the Norwegian petroleum resources though a balanced weighing of the natural, safety and economic aspects of the activity."

C O N T E N T S

PREFACE

In pursuance of § 4, Section f, of the Instructions for the Norwegian Petroleum Directorate, the Board of Directors shall each year prepare a report on the activities of the Directorate. The Board of Directors hereby presents the Annual Report for 1983.

Stavanger, 29 February 1984

Members of the Board of Directors of the Norwegian Petroleum Directorate

Martin Buvik

Andreas Lønning

Bjørg Simonsen

Liv Hatland

Kåre D. Nielsen

Ole Knapp

Øystein Kristiansen

Odd Erik Hansgaard

Fredrik Hagemann
Director General

Bjørn Bratbak
Department Director
Secretary to the Board

Report by the Board of Directors

During the report period the Norwegian Petroleum Directorate passed its first decade as a separate agency. During these 10 years, the Directorate has grown from 40 members of staff at year-end 1973, to 296 at the year's end 1983.

Experience has shown that the resolution by the Storting to locate the Directorate in Stavanger was a fortunate choice. The Directorate is well established, and cooperation with the representatives of the petroleum industry and local authorities has taken on its natural form.

It has been particularly pleasant to note that Stavanger City has contributed substantially in making conditions right for a satisfactory solution of the housing and office space questions.

The Norwegian Petroleum Directorate is evaluating now whether to expand its office in Harstad. The Ministry of Petroleum and Energy has asked the Directorate to initiate the necessary planning and budget preparations, so that the question of development of the Harstad office can be presented to the Storting in connection with the state budget for 1985. This work was in full swing at the end of the report period.

Crucial matters dealt with by the Board during the report period include the Directorate's comments on the (Mellbye Committee's) report on the "Organization of the State's Participation in the Petroleum Activity". The Board is concerned that possible changes in comparison with the present organization should be clarified soon. Among other things, it is important that the Norwegian Petroleum Directorate receives clarification regarding the administrative tasks it will be assigned in the future. The Board emphasized in its comments that the Norwegian Petroleum Directorate's professional and independent standing must not be compromized by any changes in the organization of state participation in the petroleum activity.

Furthermore, the Board dealt with comments on the report entitled "The future of the Petroleum Activities" (Skånland Committee). In this connection the need for stability in shelf activities was highlighted, as was the importance of setting up targets for future progress. It was also noted that the Committee's proposal for the main criterium for management of the shelf activities, the state's income from the petroleum activities in proportion to the land-based economy, might lead to developmental instability. Irrespective of what targets are chosen for management of future activity, it is crucial that the necessary management means are made available to the authorities to achieve these targets. The Norwegian Petroleum Directorate will have a central role here with its multidisciplinary insight into the petroleum activities.

The Board has previously noted with satisfaction that the government, in its declaration upon assuming power in the autumn of 1981, expressed the need to strengthen the Directorate's position, and that this view has received the full support of the Storting. The Board finds reason to point out that this has not brought about results in budgeting or personnel resourses that have so far been made available to the Directorate. In order for the Directorate to be able to further develop as a professionally strong and independent administrative body which can provide central government with the necessary background

material upon which to take decisions, the Board feels that the Directorate must receive priority for the necessary resources, and be secured sufficient flexibility in their application.

In previous annual reports, the Board was concerned about the personnel situation within the Directorate. In last year's report, the Board stated that the improvements in salary conditions and the general employment situation had lead to an increase in the number of applicants to vacant posts. Although total retirement has fallen off uniformly the last three years, departure from the most exposed professional categories has continued. The economist category has also joined the groups of personnel which it seems difficult to hold on to.

The Board has noted that the Petroleum Act with associated regulations has now been presented to the Storting for treatment. In this connection, there have come forth clear statements that the Coast State has unmitigated jurisdiction over installations which are employed in connection with exploration for and exploitation of natural resources. The three ministries involved: the Ministry of Petroleum and Energy, the Ministry of Local Government and Labour and the Ministry of Trade, have arrived at the principles for subdivision of jurisdiction on the Norwegian continental shelf, giving the Ministry of Local Government and Labour the main responsibility for the safety-related aspects of the activity. The Norwegian Petroleum Directorate in this context is prepared to undertake the responsibility and additional work which may result. The Norwegian Petroleum Directorate assumes that the necessary resources for this will be forthcoming to the Directorate.

The Norwegian Petroleum Directorate has as its aim and is responsible for coverage of the unopened areas on the continental shelf north of Stad by seismic survey on a grid equivalent to 4 x 4 km.

On the basis of Storting Report no. 58 and Storting Recommendation no. 278 from the Energy and Industry Committee on expansion of the exploration areas on the continental shelf etc, the Norwegian Petroleum Directorate, in collaboration with the Ministry of Petroleum and Energy, has prepared a 5-year plan for the Directorate's seismic surveys. The plan involves a gradual escalation from 10,500 km in 1984 to 20,000 km in 1987 and onward. The Board considers this to be an important step in the direction of a more long-term planning of the activities on the shelf.

The Norwegian Petroleum Directorate's reserves estimates have been modified during 1983, in part due to new finds, in part due to up-dating of previous computations. The total change in reserves estimates represents an increase in oil reserves of 44 million Sm3, and an increase in gas reserves of 934 billion Sm3. The Norwegian Petroleum Directorate's present estimate for proven, recoverable reserves is 3.74 tons oil equivalents (toe).

As a step in the work of conserving marginal resources, the Norwegian Petroleum Directorate has for several years been pointing to the necessity of assisted recovery on Ekofisk. The positive effect of gas injection has previously been noted, and the results of the pilot project using water flooding were encouraging. The authorities' basis for getting involved in the waterflood project were, for one thing, the Directorate's own geological, reservoir-related and economic evaluations of the field.

The Norwegian Petroleum Directorate is particularly concerned that marginal resources should be conserved. This applies specially to fields which are highly time-critical or time-marginal. As an example can be mentioned the water flooding of Ekofisk, where the incomes to the state will probably drop heavily if the project is not implemented immediately.

It is the Norwegian Petroleum Directorate's task to see that optimal exploitation of resources takes place. A precondition for this is that the incentives facing the licensees promote the correct decisions. The Norwegian Petroleum Directorate is therefore concerned that all regulations and official resolutions lead to decisions by the licensees which provide more or less optimal resource recovery of a find. The solution arrived at for Ekofisk water flooding is an example of an arrangement which can cause such aims to be achieved.

The plans for development of Oseberg are another example where the authorities have interfered actively with the decision-making process as far as the choice of development solution goes. The Directorate's advice to the Ministry was founded on geological, reservoir and technical development expertise which could be placed in an economic context. It is the Board's considered belief that we can expect similar situations in the future. We will therefore emphasize the importance of a wide professional insight within the Directorate, so that the companies' plans for development and operation can be given a sound, expert evaluation in connection with official approval of such plans.

The Petroleum Outlook for 1983 is based on the same arrangement as last year's analysis. A new aspect of the outlook prepared in the report period is that it now also analyses central questions which were discussed in the previously mentioned report on the future of the petroleum activity. One result, among others, is an acknowledgement that the amounts of reserves are highly dependent on future prices and yield requirements.

Each year the Norwegian Petroleum Directorate will prepare a petroleum outlook. The Board will discuss with the Ministry the question of publication of the analysis at the same time as it is handed to the Ministry.

The eighth round of concessions was announced in June 1983. In all 40 blocks were announced. Of these, 11 are in the North Sea, 9 on the Halten Bank, and 20 on or near the Troms I area. The eighth round was thus the first occasion upon which blocks in the North Sea and blocks north of Stad were announced simultaneously. As the deadline closed, 25 applications had been received for 21 blocks. Negotiations with the companies were held during November. Block allocations are expected to take place in early 1984.

During the report period the Valhall field was officially opened. Because of the peculiar reservoir-related properties of the field, production at the end of the year was lower in total than predicted. Intensive studies and testing of new methods have, however, managed to improve the production results. Nevertheless, it is still too early to say whether the best solution to the production-related problems has been found.

the Norwegian continental shelf under the direction of a Norwegian operating company. Statoil is operator for both projects.

In all, the Gullfaks development and the Statpipe project are the largest development projects initiated on the Norwegian continental shelf as regards human, technical and economic resources alike.

It is therefore with great satisfaction that we can record that these projects are moving forward in accordance with the established economic and time-schedule frameworks, and moreover that no serious technical difficulties seem to have arisen.

During the report period, four accidents occurred in connection with activities related to mobile facilities (excluding ships) in which human lives were lost. On fixed installations, there have been no accidents resulting in death since 1978.

The Board is very concerned about the work and efforts made within safety and the working environment, and particularly as regards preventative measures. In addition to continued research in this area, the Board will particularly emphasize direct influence of and close collaboration with organizations on both sides of industry.

1. THE DIRECTORATE'S TASKS, BOARD OF DIRECTORS AND ADMINISTRATION

1.1. The Norwegian Petroleum Directorate's terms of reference

The objectives and tasks of the Norwegian Petroleum Directorate are provided for in special instructions. These were most recently amended by resolution of the Ministry of Petroleum and Energy on 29 March 1979. The instructions' § 1 relating to its objectives and § 2 relating to its tasks are worded as follows:

§ 1 Objectives

The Norwegian Petroleum Directorate is located in Stavanger and reports to the Royal Norwegian Ministry of Petroleum and Energy. In matters relating to the working environment, safety and preparedness, it reports to the Royal Norwegian Ministry of Local Government and Labour. The Norwegian Petroleum Directorate is authorized to determine matters relating to exploration for and exploitation of petroleum resources on the sea floor and its substrata, to the extent that these matters are not to be determined by the King, relevant Ministry or other public authority. The Norwegian Petroleum Directorate exercises this authority in Norwegian coastal waters, Norwegian sea territory, on that part of the continental shelf which is subject to Norwegian sovereignty, and in other areas where Norwegian jurisdiction follows from agreements with foreign states or from international law in general. In addition, the Norwegian Petroleum Directorate shall enforce safety regulations, etc., in the areas defined by Article 1 of the Svalbard Treaty of 9 February 1920 and Section 1 of the Svalbard Act of 27 July 1925, and in the territorial waters of these areas.

§ 2 Tasks

The tasks of the Norwegian Petroleum Directorate within its area of authority are:

a. To undertake regulatory and economic control to ensure compliance with applicable legislation, regulations, decisions, concession terms, agreements, etc. in the exploration for and exploitation of petroleum, cf. § 1.

b. To ensure that applicable safety regulations are complied with.

c. To ensure that the exploration for and exploitation of petroleum resources does not lead to unnecessary damage or cause inconvenience to other activities.

d. To ensure that the exploration for and exploitation of petroleum resources at all times takes place in compliance with the guidelines stipulated by the relevant Ministry.

e. To collect and process geological, geophysical and technical material relating to subsea natural resources, including their evaluation and the possibilities thereby available for the formulation of national petroleum policy and negotiation plans, as well as to plan and have executed geological and geophysical petroleum surveys.

f. To undertake current financial control of exploration for and exploitation of petroleum resources.

g. To issue exploration licences and assist the relevant Ministry, upon request, in the processing of applications for other licences, the formulation of regulations, etc.

h. To maintain links with scientific institutions and ensure that material is made available to interested companies, scientific institutions, etc., to the extent that this is possible in view of the rules which apply concerning confidential treatment of material submitted by licencees and in general pursuant to the decision of the relevant Ministry.

i. To keep the Ministries informed at all times about the activity given in § 1, and to present the issues dealt with by the Directorate which do not come under § 2 a-h, to the Ministry in question.

j. To prepare and present for decision to the relevant Ministry matters of significance to plant and animal life or matters which may otherwise affect important environmental preservation interests in the areas mentioned in § 1, final sentence.

k. To present to the relevant Ministry regulations and individual decisions made concerning proper and sound exploitation of petroleum resources (conservation).

l. To act as advisory body to the Ministries in matters relating to exploration for and exploitation of subsea natural resources.

Even if a matter is subject to the authority of the Directorate pursuant to § 2 a-h, it shall be presented to the appropriate Ministry if it is of special importance or fundamental interest.

1.2 The purpose of the Norwegian Petroleum Directorate

On the basis of one of the above terms of reference, the following purpose for the Directorate has been laid down:

"The purpose of the Norwegian Petroleum Directorate is to actively contribute to a sound administration of the Norwegian petroleum resources through a balanced weighing of the natural, safety and economic aspects of the activity."

1.3 The Board of Directors and the Administration

1.3.1 The Board of Directors

At the start of the the report period, the Board consisted of:

1 Martin Buvik, County Governor, Tromsø (Chairperson)
2 Andreas Lønning, Director, Oslo
3 Bjørg Simonsen, Mayor, Mo i Rana
4 Liv Hatland, Municipal Director, Trondheim
5 Kåre D. Nielsen, Director, Oslo
6 Ole Knapp, Secretary, Oslo
7 Øystein Kristiansen, Section Manager, Stavanger

8 Inge Døskeland, Section Manager, Stavanger

Deputies:

For 1-4: Olav Marås, Farmer, Sæbøvåg
Astrid Nistad, Executive Committee Secretary, Gaular
Marit Greve, Editor, Bærum

For 5: Odd Henrik Robberstad, Director, Oslo

For 6: Bjørn Kolby, Attorney-at-Law, Oslo

For 7-8: Aase Moe, Senior Engineer, Stavanger

The period of office of this Board of Directors expired on 31 March 1983. By King´s Resolution of 25 March 1983, a new Board was appointed for the subsequent 2-year period. Board members 1-6 above were all reappointed.

Regarding the two representatives of the employees on the Board, Mr. Øystein Kristiansen, no. 7, was reappointed by election.

Mr. Odd Erik Hansgaard, First Consultant, Stavanger, was appointed as the new member replacing Inge Døskeland.

As deputies for 1-4 were appointed:

Professor Arild Rødland, Trondheim
Astrid Nistad, Executive Committee Secretary, Gaular
Marit Greve, Editor, Bærum

The deputies for 5 and 6 were reappointed, while deputies for 7 and 8 were:

Kjell Dørum, Senior Engineer, Stavanger
Angela Ebbesen, First Consultant, Stavanger.

By King´s Resolution of 27 June 1983, Professor Arild Rødland was appointed as secretary general to the Ministry of Petroleum and Energy, and was therefore by letter of 10 August 1983 from the Ministry of Petroleum and Energy relieved of his office as deputy on the Board for the period he holds down his post as secretary general in the Ministry of Petroleum and Energy. By King´s Resolution of 28 September 1983, Inge Johansen, Dean, Trondheim, was appointed as principle deputy for board members 1-4.

During the report period the Board held 11 board meetings. In May, the Board visited Det norske Veritas and in connection with the board meeting in August, the Board guested Rana Municipality, where they were informed among other things about the municipality´s industrial base. The Board had the opportunity to visit the steelworks Norsk jernverk A/S, Svein Grotnes´ company, and look over the industrial estate at Grubhei.

In September the Board visited ARCO Alaska, including visits to Prudhoe Bay, Valdez and the Phillips´ installations at Kenai. Also present at these visits was the Statoil Board.

1.3.2 Organization

During the report period no organizational changes took place.

However, it turned out that it may be rational to make changes of the organizational situation of the petroleum economics functions. The Director has therefore implemented a study and evaluation of the consequences of transplanting the (petroleum) Economic Planning Section from the Legal and Economic Department to the Resource Management Department. This work at the expiry of the report period had progressed so far that negotiations had been initiated with the staff unions on the subject.

In October the Directorate advertised a position vacant as information manager. Instigation of the post was proposed in the budget for 1982, but was cancelled during processing of the budget in the ministries. The Director was of the opinion that the special powers given to the Directorate to become more competitive in relation to the oil industry in the fields of recruiting and wages, were also sufficient authority to appoint an information manager. The Ministry of Petroleum and Energy did not agree with this interpretation of the special powers, and by letter of 1 November 1983, the Directorate was asked to hold the appointment question until further notice. The matter was then drafted by the Directorate´s Board, who requested the Ministry to reassess its view, so that a position as information manager could be filled as soon as possible. At the end of the report period, the issue was being dealt with by the Ministry of Finance.

The question of expansion of the Norwegian Petroleum Directorate´s Divisional Office is discussed in the Annual Report for 1982. In 1983, the Board dealt with the administrations´ evaluation of the need for expanding the divisional office. After these evaluations had been sent to the Ministry of Petroleum and Energy last year, the Directorate was asked by letter from the Ministry of Petroleum and Energy on 10 October 1982 to do the necessary planning and budget-related preparations, so that the Norwegian Petroleum Directorate´s Harstad Office could be presented to the Storting in connection with the state budget for 1985. This work was initiated immediately, and will be included in the Directorate´s budget for 1985 as a proposal for expansion of the office in Harstad.

1.3.3 Personnel

In the budget for 1983, two new positions were established. At the end of the report period the Directorate had 284 authorized permanent positions, three positions with a transitional status, and two positions salaried by the Directorate for Development Aid (NORAD). During the year, two of the transitional positions ended because the employees retired. At the end of the report period there were 289 persons employed, cf. Figure 1.3.3.a. Staff members include 34 per cent women, a figure which has remained steady the last few years. Figure 1.3.3.b shows the proportions of men and women in the various job categories within the Norwegian Petroleum Directorate.

In addition, 11 positions were salaried through other agencies´ budgets, either as disabled persons or youth seeking work. Two pensioned state employees work on pensioner conditions, and a scholarship holder from Mozambique has during parts of the year been under training in the Directorate with a NORAD grant. Also working in

the Directorate is one of NORAD's special advisors on oil matters in developing countries. The work tasks are tied to projects in several countries, including Tanzania.

During the report period the Directorate took on 36 new members of staff. Of the newcomers, 16 have moved here, 10 come from oil companies and 8 are newly qualified.

Resignations in 1983 were the smallest since 1978 with 25 employees leaving their positions, cf. Table 1.3.3.a. This constitutes 9 per cent of total authorized positions, against 11 per cent in 1982 (31 members of staff). Table 1.3.3.b shows the drain and states the leavers' new jobs.

Figure 1.3.3.c shows the personnel transfer from the Norwegian Petroleum Directorate to various oil companies during the period 1973-1983.

During the report period there has also been a tendency towards greater interest in applying for vacancies, but there continue to be relatively few applicants with experience from the oil industry.

Codetermination

Generally, cooperation with the employee organizations has followed the same pattern as for previous report periods, with monthly meetings between the employee delegates and general management. During the period, 11 meetings were held which dealt, among other subjects, with:

- budget proposals
- annual report
- company doctor arrangement
- contract between NPD and NORAD for 1983
- action public
- reorganization of the NPD's two petroleum economy sections
- personnel policy guidelines
- advertisement of vacancy for information manager
- computer based personnel records
- equal opportunities agreement.

1.3.4 Training

The training budget for 1983 amounted to NOK 2,352,000. The total number of course days in 1983 ran to 2,863. Of these, training with the oil companies accounted for 1,018 course days.

Distribution by company was as follows:

Gulf	42 days
Esso	457 days
Shell	109 days
Mobil	83 days
Conoco	40 days
Elf Aquitaine	139 days
Arco	22 days
BP	69 days
Phillips	24 days
Statoil	33 days

"On the job" training and traineeships are not included in the figures.

During 1983, two members of the Drilling Section held internships lasting 6 months at Elf Aquitaine and Saga Petroleum.

At various administrative courses arranged by the Training Division of the Ministry for Consumer Affairs and Administration, the Norwegian Petroleum Directorate had 30 members of staff participating. In all, training through this ministry accounted for 170 course days.

In-house training in 1983 amounted to 322 course days. Internal courses included:

- course in non-destructive test methods
- English language course
- report and letter writing course
- computer course.

1.3.5. Budget and economy

In 1983, a total of NOK 147,765,000 was allocated to the various Directorate tasks. The amount was distributed as follows:

- Operating budget	NOK 86,865,000.-
- Inspection costs	NOK 10,000,000.-
- Engineering of new facilities	NOK 4,900,000.-
- Geological and geophysical surveys, etc.	NOK 39,300,000.-
- Safety and emergency preparedness research	NOK 2,500,000.-
- Clearing up the seabed	NOK 4,200,000.-
	NOK 147,765,000.-

NOK 54,485,000 from the operating budget goes to wages costs and NOK 9,510,000 to the running of buildings and premises. The remaining NOK 22,870,000 represents other expenses such as travelling, training, electronic data processing (EDP), procurements, etc., and external consultant services. In the report period, no more than NOK 5,000,000 was used for such expert assistance, if one ignores the extraordinary grant of NOK 2,500,000 by the Ministry of Local Government and Labour for safety and emergency preparedness research.

The difficult budget situation confronting the Norwegian Petroleum Directorate makes ever greater demands on the Directorate's list of priorities. To be able partially to ameliorate this, emphasis has been placed on developing better planning and control systems as a means to determine proper priorities among a large number of resource intensive measures.

Revenues

In addition to the royalties and acreage fees paid (Chapter 4) the Directorate received revenues totalling NOK 76,905,682. Income development in the period 1973-1984 is shown in Table 1.3.5.

1.3.6. Information

Also during this report period, there has been a brisk demand for information both from Norwegian and foreign institutions, the media, enterprises, and individuals. In the course of the year, the Norwegian Petroleum Directorate was visited by a number of official delegations from other countries. Furthermore, many foreign journalists, individually or in groups, have visited the Directorate to obtain information about it and the oil activity. For their part, Norwegian Petroleum Directorate staff have participated in large measure as speakers in various forums.

The interest shown by members of the media for insight into the Norwegian Petroleum Directorate's case documents has been increasing continually. To assist the task of retrieving documents, and to ensure that the question of handing them over is considered at the correct level, the Directorate has during the report period laid down special routines for this. In 1983 there were 95 enquiries for documental insight, 9 of which could not be allowed because the enquiries fell outside the Publicity Act.

The Norwegian Petroleum Directorate's 10-year anniversary was celebrated in the period 11-15 April 1983. Events started with an anniversary gathering of the Directorate's employees and Board at the Conference Center at Tjensvoll, where the Minister of Petroleum and Energy, the Rogaland County Governor, the County Mayor and the Stavanger City Mayor all participated.

The arrangements also included exhibitions, film programs and lectures which were open to the public. The exhibitions were in part made by Directorate staff, and consisted otherwise of exhibits willingly loaned by the industry.

The public arrangements were very well attended. School classes and city senior citizens were specially invited and were catered for with special tours. On one day the Directorate held "open house" for family, friends and former employees. In connection with the jubilee a special anniversary publication was prepared.

The Norwegian Petroleum Directorate's annual report is a central feature of the Directorate's information activities. The 1982 annual report and the Directorate's map of the continental shelf became available in April in connection with the celebration of the Norwegian Petroleum Directorate's 10-year anniversary.

In conjuction with this, representatives of the press were invited to meet with the Directorate's general management.

The Norwegian Petroleum Directorate's petroleum outlook, which is a continuation of previous petroleum analyses, was submitted to the Ministry of Petroleum and Energy in October 1983. By resolution in the Ministry, the petroleum outlook is for the time being withheld from public view. An extensive press release on the petroleum outlook was issued on 13 October 1983 to satisfy some of the demand for information on the report. This demand was clearly expressed by questions and enquiries to the Norwegian Petroleum Directorate.

During 1983 there were issued 70 press bulletins. Most of these were published in conjunction with new wells, for which the Norwegian Petroleum Directorate seeks to provide maximum information.

1.3.7. The office in Harstad

The office is the Norwegian Petroleum Directorate's liason link with the regional and local authorities and north Norwegian industry.

Contact with fisheries organizations is an important aspect of the office's field of work. Among other activities, a study tour to Stavanger/ and the North Sea was arranged for representatives of the fishing industries in Norland County.

The office has also represented the Directorate at steering committee meetings for production licences off North Norway.

1.3.8. The library

In 1983 there was a great demand for library services by internal and external users. We registered a considerable increase in the number of applications for loans, photostats and reference enquiries in relation to the year before. More than one third of all enquiries come from external users. These include Norwegian and foreign libraries, private individuals, oil companies and other firms within the petroleum sector.

The library personnel have also provided guidance on the library's computer based catalogue (ODIN) and the library's services for research institutions, administrative agencies and other libraries.

The number of literature searches from national and international data bases has been more or less stable the last few years, but an increase in the use of national data bases (OIL, INFOIL II) has been noted. No new contacts with data bases were set up during the year.

1.3.9. The INFOIL secretariate

Use of the data base OIL, with its associated printed reference works, Olje-indeks and Oil index, show clearly that the external subscribers still prefer the printed version rather than the data base. Income from this service was approximately the same as the previous year.

Use of the data base INFOIL II is increasing uniformly, as is the number of abstracts of project data submitted to the base. This data base, which has been publically accessible since 1982, contains information on petroleum related research projects from Norway and Great Britain. At 31 December 1983, the base contained 800 project references, about half from Great Britain and half from Norway.

Trial installation of the data base in London was undertaken in the report period. The prospects of a permanent installation in Great Britain are good.

Active marketing of both data bases takes place continually.

1.3.10. Rationalization/ effectivization

The budget situation confronts the Norwegian Petroleum Directorate with ever larger challenges with regard to priority allocations among a series of resource intensive work tasks. The Directorate therefore places great emphasis on developing better planning and control systems. This has led for one thing to the Norwegian Petroleum Directorate's departments having initiated work to formulate terms of reference for their activities. Further, in 1983 there was also a great increase in the utilization of electronic computer services with the intention of rationalizing work.

1.3.10.1 Safety Control Department

General terms of reference

"Norwegian Petroleum Directorate safety related control — an outline specification of the Safety Control Department's activity" was prepared in 1983. The document describes the basis for safety related control, control principles, working areas for the Norwegian Petroleum Directorate's Safety Control Department, a description of the Safety Control Department organization, and allocation of work tasks within the organization. The purpose is to provide a unified and coherent description of the Safety Control Department's functions. Within these frameworks, the individual shall be given by his immediate superior a more detailed description of targets and constraints for his or her work. In this way, conditions have been improved for allowing the individual member of staff's efforts to contribute more effectively to the Safety Control Department functioning purposefully and efficiently.

Use of computers

There has been a substantial increase within computer services in the Safety Control Department in 1983. The use of computers has increased by 100 per cent in 1983 compared with 1982. This is due in part to extended use of the individual systems, and the fact that further tasks have been converted to electronic media. The target has been, and will continue to be, to put the individual staff member in a better position to fulfil his or her work tasks. Experience so far in this respect is favourable.

Drilling data bank

The first drilling data bank was operated on trial in the summer of 1982. In this phase, one well per operator was followed up and analysed using the system. Further, close contacts were tied to the operating companies for exchange of views with regard to future plans.

At present work is being done on specifications for a final operating version. Substantial changes in relation to the "trial version" of the system involve the recording work itself. The plans entail that this shall now be done by the operating companies through an on-line link to the Directorate's computer facility in the Safety Control Department. Great emphasis is placed on developing a modular system which later can relatively easily satisfy new needs.

A final version of the drilling data bank is scheduled for operation early in 1984.

Drilling licences

To simplify the overall view of drilling, testing and plugging permits issued on the Norwegian continental shelf, the Safety Control Department has brought into use a system for registring such permits.

Coordination of well data

During the present year under the direction of the Norwegian Petroleum Directorate´s computer committee, an electronic data processing system was developed with the objective of securing better coordination of the basic well details which are common knowledge for several departments within the Directorate (well identification, field, licence number and date, drilling licence number and date, position, contractor, drilling vessel, etc). The advantages of such a system will be substantial:

- it will ensure better updating of data
- a unified statement of the above mentioned identities secures a suitable key for other computer systems which are linked to this common facility
- relevant common well data information will be more readily available.

The system assumes a decentralized responsibility with respect to maintenance. This means that each individual department keeps its part of the register up-to-date in relation to its area of responsibility.

Attempts will be made to interface the well data bank to this. Depending on experience, the computer system in other departments will subsequently be tied in to the same common system for well information. In the long-term, it may well be that development of the system will also include other types of common information in the Directorate.

Accidents on the continental shelf

A system for recording personal injuries has been developed and previously operated. The many and varied opportunities with respect to further processing of the recorded accident data now also include straightforward statistical methods for computation of different types of accident probabilities and accident incidence rates.

There exist plans for more detailed recording of working hours performed, distributed by different personnel categories. This is necessary for preparation of realistic risk evaluations.

On the presentation side, there now exist opportunities for graphic display of the analysis results (curves, bar graphs and pie charts in several colours).

Registration of injunctions

A computer system has been developed for registration of injunctions given, for example following survey inspections offshore. This includes injunctions which are given in the areas of worker protection and the working environment in 1981, 1982 and 1983. Active use of the system will better enable the Directorate, among other things, to follow-up deadlines. The system further provides better opportunities to reveal special problem areas.

Damage to structures, riser pipes and pipeline systems

In 1983 the Norwegian Petroleum Directorate started its computer based damage register for structures, riser pipes and pipelines. Upon instigation, the register will provide a status concerning damage and repairs in 1982-83. Subsequently, we will record all previous damage and repairs with the installation data. The plans for further use of computer processing include historical summaries of each individual installation, and inspection summaries for planned and performed inspections.

Diving systems

The Directorate has for a long time been operating a system for registration of diving certificates. In the present year, further computer systems have been brought into use for recording diving accidents, together with basic data tied to diving operations themselves.

Further, the plans assume development of systems to record activity reports from the operating companies.

Drilling personnel

The Directorate has for a long time been operating a computer system for recording drilling personnel qualifications.

Links to Main Rescue Coordination Centre

In 1983 it was resolved to plan a trial interconnection to the Main Rescue Coordination Centre and Action Committee concerning a catastrophe system for resources and log summaries. This system is assumed to be able to make the Directorate´s crisis staff better in a position to follow all operations. The system makes possible operation of simulated actions internally, or in collaboration with the Main Rescue Coordination Centre and Action Committee management

1.3.10.2 Legal and Economic Department

Outline specification and planning system

As a component part of the work of making conditions suitable for an efficient and purposeful management of the Department's activities, a special outline specification has been prepared in 1983 with a unified and coherent description of the Department's tasks and functions. The specification is assumed to state the outlines for the work of the individual sections. Within these limits, the individual member of staff will be provided with closer details of his or her objectives and work tasks.

As a continuation of this rationalization work, we have initiated efforts within the Department's two petroleum economics sections aimed at evolving an administrative system for planning and following up the work within the petroleum economics functions in the Norwegian Petroleum Directorate. The system is predicted to be operational in 1984.

Use of computers

During the year the Legal and Economic Department has expanded and rationalized its computer applications. This was done with the aid of inhouse training and by bringing into use more and better equipment. Jointly with the Resource Management Department, the Legal and Economic Department has available a ND-500 computer with associated periferals, which has provided several executive officers with the opportunity to make use of the computing power. It seems that much routine work has been removed in this way, and the important work tasks receive greater attention.

During 1983 a tariff model was developed which provides the opportunity to evaluate present and future tariffs, and to test the capacity and capacity utilization of different transportation arrangements.

The model for economic field and company analyses (the "Company Model") has been further developed on the basis of empirical observations made in 1982, and has shown itself to be extremely useful in the day-to-day work and in connection with the petroleum outlook analysis. The planning model ("Portfolio Model"), which is a joint project with Statoil, is used for time phase evaluations of fields on the basis of given assumptions.

The model for estimation of royalties (PABS) is being further developed in order also to be able to take account of deductible expenses.

The system for registration of production figures (PPRS) is showing itself ever more effective in the Norwegian Petroleum Directorate's work for better and more rapid reporting of production figures from the various fields in the North Sea.

1.3.10.3 Resource Management Department

Use of computers

The practical application of the Norwegian Petroleum Directorate's GEODATABASE is being furthered continually. By developing general, user-friendly programs, aids and tools are gradually being built up so that the professionals — geologists and geophysicists — themselves can use modern computer systems in their daily work. This reduces the manual routine, and in turn increases the productivity of the interpretation task proper (cf. Section 2.2.1.3).

In 1983 in the Resource Exploitation Division one has made a commitment to build up a complete system for three dimensional (3-D) reservoir simulation on a stand-alone computer facility. This includes a data base for storage of reservoir data, a system for reading-in maps and generating block models, a 3-D reservoir simulation model, and routines for processing the results graphically. The intention in the not too distant future is to tie all these systems together.

The reservoir data base is being constructed internally and will be ready to receive data during 1984. External experts will be employed to develop software periferal to the reservoir data base.

Collaboration has been entered into with the Institute for Energy Technology (IFE) which has loaded a 3-D reservoir simulation model with post-processing routines. The map-block model is now being tested. Collaboration with the IFE for further development will continue in 1984.

This build up on the computer side will simultaneously provide a necessary professional upgrading of the Department's personnel.

A Norsk Data ND-500 facility was installed in the spring of 1983 to cover the Norwegian Petroleum Directorate's increasing requirement for computer power in connection with economic analyses, petroleum outlooks, prognoses and reservoir simulation. A powerful expansion both of machine capacities and storage capacities is necessary to satisfy this need.

1.3.10.4 Administration Department

Use of computers

The Norwegian Petroleum Directorate's Administration Department continued in 1983 to expand its use of electronic data equipment.

The Personnel Section has started using several terminals and a new, computer based personnel register.

The Publications Office has now started using computers to register orders and automatically print consignment slips and invoices.

The secretarial pool has gone over to an improved word processing system.

The Norwegian Petroleum Directorate's files have since 1981 registered all incoming and outgoing correspondence electronically. In 1983, the system was upgraded and expanded to also include registration of

drawings, memoranda and minutes. The electronic archives now contain information on almost 100,000 documents.

In the drawing office, 1983 saw the introduction of computer assisted drafting equipment.

At the end of 1983, work was being done on an expansion of the word processing capacity, and on a transition to a term-oriented budgeting and financial management system.

1.3.11 Premises

The office situation was again satisfactory during the period.

The work with preparations for a new building in the Ullandhaug area is going according to the plans set out, but the work itself is somewhat ahead of schedule. For one thing, excavation of the site started in mid-November 1983, while the plan called for February-March 1984 (cf. Figure 1.3.11).

2. ACTIVITIES ON THE NORWEGIAN CONTINENTAL SHELF

2.1. Exploration and production licences

2.1.1. New production licences

In 1983 there was allocated one new production licence (Table 2.1.1.a). The production licence 085 (Blocks 31/3, 31/5 and 31/6) was allocated following finds of hydrocarbons in Block 31/2 (production licence 054). The licensees for production licence 085 undertake jointly with the licensees for production licence 054 to enter into organizational and activity-wise cooperation regarding research and development of the Troll field (Blocks 31/2, 31/3, 31/5 and 31/6).

2.1.2. Exploration licences

At 31 December 1983 there had been allocated a total of 113 commercial exploration licences. The following licences were awarded in 1983:

Total Marine Norsk A.S	Licence no. 104
BP Petroleum Development Ltd., Norway	105
Siismic Profilers A/S	106
Phillips Petroleum Company Norway	107
Amoco Norway Oil Company	108
Superior Norge Exploration Company	109
ARCO Norway, Inc	110
Texas Eastern Norway Inc	111
Deminex (Norge) A/S	112
(Norw.) Institute for Continental Shelf Studies	113

2.1.3 Share transfers

During 1983 the following share transfers were approved pursuant to § 48 in King's Resolution of 8 December 1972.

Production licence 022
Gulf Production Company A/S has transferred its part to Norwegian Gulf Exploration Company A/S.

Production licence 019 A (Ula)
Svenska Petroleum A/S has taken over 15 per cent from Norske Conoco A/S. The
distribution on production licence 019 A following this is:

BP Petroleum Development of Norway A/S	57,500 %
Svenska Petroleum Exploration A/S	15,000 %
Den norske stats oljeselskap a.s	12,500 %
Norske Conoco A/S	10,000 %
K/S Pelican & Co A/S	5,000 %

Production licences 025 and 039
For these two licences, Norske Hudbay A/S has sold its shares to Lasmo Norge A/S.

Production licence 032
Svenska Petroleum A.B. has transferred its part to Svenska Petroleum Exploration A/S.

Production licence 079
Statoil, Hydro and Saga have received respectively 3.5 per cent, 1 per cent and 0.5 per cent of the retained 5 per cent share. Distribution on production licence 079 following this is:

Den norske stats oljeselskap a.s	73,500 %
Norsk Hydro Produksjon a.s	16,000 %
Saga Petroleum a.s	10,500 %

2.1.4 Relinquishments

In 1983, areas having production licences were relinquished on four production licences. These are given in Table 2.1.4.a.

Blocks 24/9, 33/2, 15/2 and 33/6 were relinquished in their entirety.

Relinquishment occurred in accordance with the relinquishment rules pursuant to the Royal Decree of 8 December 1972.

The concession holders for production licence 047 received dispensation from the relinquishment rules. This resulted in Block 33/2 being relinquished in its entirety, while Block 33/5 was retained in its entirety. The total relinquishment of production licence 047 amounts to 82.57 per cent, which corresponds to 304.16 sq.km. The allocated area at 7 January 1983 made up 64.203 sq.km.

Licensees for production licence 048 have received dispensation from the relinquishment rules. This has resulted in Block 15/2 being relinquished in its entirety, while Block 15/5 was completely retained.

The total relinquishment on production licence 048 amounts to 33.29 per cent, or 107,019 sq.km. The allocated area at 18 February 1983 amounts to 214,481 sq.km.

2.2. Surveys and exploration drilling

2.2.1. Geophysical and geological surveys

2.2.1.1. Planned geophysical surveys

On the background of the Storting's desire to give priority to exploration activity north of Stad (Storting Report no. 58 1983-83 and Storting Recommendation no. 278 1982-83), the Norwegian Petroleum Directorate has, in collaboration with the Ministry of Petroleum and Energy, prepared a 5-year plan for the Norwegian Petroleum Directorate's surveys north of Stad.

A principle element of the 5-year plan is a systematic maturation of new areas with an eye to subsequent exploration drilling.

This means that the Norwegian Petroleum Directorate will cover the area down to an approximately 4 x 4 km seismic grid to be able to evaluate whether it contains drillable structures.

From and including 1984 the intention is to have a different routine with regard to seismics under company direction. In Storting Report no. 1 for 1983-84, the way was paved for being able in the future to allow the oil companies to shoot seismics immediately after the Norwegian Petroleum Directorate has performed and sold its semi-regional seismics (normally limited downwards to a 4 x 4 km grid). Such opening of areas for collection of seismic data by the oil companies will be provided without obligations for later opening of areas for exploration activity.

The Norwegian Petroleum Directorate has, against the background of the Storting's wish for an escalation of the exploration activity in the north, received a considerable increase in its budget for seismic surveys in 1984. Plans are for the collection of at least 10,000 km in 1984, and the aim is to increase to approx 20,000 km at the end of the 5-year period.

Based on the plan for 1984, the Norwegian Petroleum Directorate will make ready for further examination an area corresponding to approx 100 blocks. In addition, there will also be collected regional seismics over larger areas which are a necessary basis for expansion in the long run.

The Norwegian Petroleum Directorate considers that the arrangement as sketched out in the 5-year plan is a suitable exploration strategy.

In this manner the authorities will obtain an early insight into which areas may be interesting, and thus have the opportunity to direct developments in tune with political targets. By the oil companies receiving data in good time before allocation is ripe, they will also have the necessary time to interpret the data. It is important to have a certain maturing process to obtain a good geological understanding. In particular, it is important that the oil companies have at least one year to interpret the Directorate's regional and semi-regional data before they shoot detail seismics.

The Norwegian Petroleum Directorate also believes it is useful to have a gradual expansion of the exploration areas. Then it will be possible to draw advantage from drilling results, and thus increase the chances of making a find. In addition, one will have greater certainty as to what pressure conditions can be expected in the diverse formations, a factor which is important considering the geological safety planning of new drill holes.

The 5-year plan is intended to roll forward. This is necessary in order at all times to be able to adjust the plan in the light of drilling results. In this connection, the Norwegian Petroleum Directorate is intending to have annual meetings with the companies operating north of Stad so that, to the greatest possible extent, it is able to incorporate the views the companies have on the expansion of exploration areas in the light of the last year's drilling results.

2.2.1.2. The Directorate's geophysical surveys 1983

During 1983 the Norwegian Petroleum Directorate collected seismics from two areas. Some 3,600 km were shot off Troms 1, and 4,635 km in the area between Haltenbanken and Trænabanken (Nordland 2), in all 8,235 km (Figure 2.2.1.1). Gravimetric data was also gathered from

these areas. On Nordland 2 there was additionally collected magnetometric data. All data were collected by GECO a.s.

The surveys were divided into four areas: 2414 km were collected north of the original Troms 1 area (Figures 2.2.1.b and c). These data, together with previous data, mean that the area from 71.30 to 72.00 deg N and 16-22 deg E have now been covered by a grid measuring approximately 4 x 4 km. This area contains four blocks which were announced in the eighth round of concessions, and the twenty most westerly blocks are planned for inclusion in the tenth concession round. These data, together with the data from 1982 in the area, were processed by Geophysical Service International in England. An escalation is planned of surveys north of this area in 1984.

Some 1,060 km seismics were collected from the Finnmark West area, east of Troms 1. There were also shot two regional lines totalling 126 km south of Troms 1. These data will be processed in 1984. Plans include further surveys of these areas in 1984.

Some 4,635 km seismics were collected between Haltenbanken and Trænabanken (Nordland 2) (Figures 2.2.1.d and e). These data, together with earlier data in the area, mean that the Norwegian Petroleum Directorate has covered the area with a network of approx 4 x 4 km, and the Directorate has thereby concluded its surveys in this area. The Nordland 2 area includes 30 blocks and is planned for inclusion in the tenth round of concessions. Data are at present being processed by GECO a.s in Stavanger, and will become available for the oil companies during the spring, so that the companies can evaluate the data in connection with planning of any detail surveys under their own direction. Reprocessing has also been undertaken of 641 km seismics from 1973-75 at Horizon Exploration in England. The results of reprocessing have been encouraging, and it will presumably be interesting to do further reprocessing of more recent data off Nordland in 1984.

Otherwise, the Norwegian Petroleum Directorate has processed 4,050 km seismics from the north-eastern Barents Sea at Seismograph Service Limited (SSL) in England. These data were collected in 1982.

Since July 1982, the Norwegian Petroleum Directorate has also been using its own processing facility, NORSEIS, which is a combination of GECO's software and Norsk Data's hardware. The system has functioned very satisfactorily, and has been useful in connection with test processing and reprocessing of seismics from selected areas. It has furthermore been of great assistance in connection with quality control of contractors' efforts.

2.2.1.3. Geophysical surveys under company direction

In 1983 there were shot a total of 60,300 km seismics on the Norwegian continental shelf under oil company or contractor direction.

Of this amount, 39,100 km were shot in the North Sea, and 21,200 km north of Stad in the areas Haltenbanken, Trænabanken and Troms. Figure 2.2.1.f shows the total geophysical surveys performed on the Norwegian continental shelf.

The three Norwegian companies Statoil, Hydro and Saga have shot a total of 36,900 km, while the foreign companies have shot 7,200 km. The companies NOPEC and Western Geophysical performed 9,800 km speculative surveys. Of these seismic measurements, three were 3-D investigations. This type of data is collected in limited areas over fields which have been proven and are being considered for development. Two of the surveys were performed by Statoil (Blocks 30/2, 30/3 and 7120/8). The third survey was done by Esso and GECO a.s on 34/7. Here some 6,400 km seismics were collected.

As a result of the large amounts of data in connection with 3-D surveys, there has arisen a large demand for computers in connection with interpretation of these data.

During 1983 the Norwegian Petroleum Directorate has had representatives with the companies GSI (USA) and GECO a.s (Stavanger) to try out their interpretation stations for 3-D data. The Directorate has also had demonstrated Western Geophysical's interpretation station in London.

These interpretaion stations are continually being developed and the experience harvested shows that such equipment will undoubtedly be of great assistance in interpretation work, also for 2-D data.

The Norwegian Petroleum Directorate plans to procure an interpretation station during 1984.

2.2.1.4 The costs of seismic surveying

The total costs of seismic surveys performed by the Norwegian Petroleum Directorate and under company direction were of the order of NOK 300 million in 1983.

2.2.1.5 Sale of seismic data

In 1983 the Norwegian Petroleum Directorate offered the oil companies seven packages of seismic data. As Table 2.2.1.a shows, six of these were ordered by different companies.

In addition there is the "Package 2 Nordland 83" which contains 4,635 km seismics. This was processed by GECO a.s and the package is expected to cost NOK 5-6 million.

Moreover, seismic data packages have been sold which were offered to the oil companies in previous years. These include "Træna bank package" which was sold to Japan National Oil Corporation.

Income from sales in 1983 were approx NOK 50 million. Corresponding figures for 1982 were NOK 24 million.

The incomes are expected to be substantially larger in 1984.

2.2.1.6 Release of data and material from the shelf

In connection with the Norwegian Petroleum Directorate's follow up of the oil activities on the Norwegian continental shelf, the Norwegian Petroleum Directorate receives, among other things, copies of well

logs and continual, representative selections of drill cuttings and drill cores. Samples of drill cuttings are taken every 10 meters down the well hole, and each 3 meters in formations which may contain hydrocarbons. For wet samples, which shall weigh at least 0,5 kg, the same sampling frequency applies.

As regards drill cores, the Norwegian Petroleum Directorate receives complete longitudinal sections containing at least one fourth part of the core.

Among its duties, the Norwegian Petroleum Directorate counts responsibility for the publication of data and release of material for educational and research purposes.

The Norwegian Petroleum Directorate does not release data which have been interpreted by the operators, and data and material cannot be released until 5 years after completion of the well.

Well Data Summary Sheets (WDSS) are published annually, and provide a synopsis of wells which are 5 years old. The purpose of this series is to show which well holes have been released, and what core and log material is available for the various wells. Furthermore, some technical data and test results are provided, with an outline sketch of the lithography of the individual wells.

Seismics are released in packages which cover one block, and can only be released from blocks which are, or have been, licensed, and then only if the seismics are older than 5 years.

At 31 December 1983, 50 blocks had been released, 13 of them in 1983. In all, 23,790 section kilometers have been released, of which 7,156 km in 1983.

Figure 2.2.1 shows a summary map with a statement of which blocks data have been released for.

2.2.1.7 Scientific research

As of 31 December 1983, a total of 178 licences for scientific research had been awarded on the Norwegian continental shelf. As seen from Table 2.2.1.b, 23 such licences were granted for 1982.

Most research stressed geophysics, with some geology and biology work.

2.2.2. Exploration and appraisal drilling

At the end of the year 1982-83 there were 12 exploration and appraisal wells being drilled. Ten of these were finished in 1983, and two have been temporarily abandoned. Well 7/11-7 will be plugged in the first half of 1984, and 15/9-17 will possibly later be put in production. Well 34/10-7, which was temporarily abandoned at last year's end, was tested and finalized in the summer of 1983.

There has been a decrease in the number of exploration and appraisal wells spudded in 1983 compared with 1982. A slight reduction was forecast for 1983, but the fall was larger than expected, largely due to a strike during the best drilling season, the time of allocation of Blocks 31/3, 31/5 and 31/6 (Troll), and because many deep and time

consuming wells were drilled during the year.

In the course of 1983, 40 new wells were initiated, 33 of which were exploration wells and 7 appraisal wells, against 49 wells in 1982 (Figure 2.2.2.a).

Some 25 of the spudded wells were finished during the year. Two wells, 31/5-1 and 30/6-12, were abandoned at shallow depth due to technical problems, and 5 wells were temporarily abandoned. One of these will be replugged later, two (on Troll) will be tested this summer, and two (on Oseberg) may perhaps be put in production. Ten wells were being drilled at the end of the year.

In all, the following 20 wells had been temporarily abandoned on the Norwegian shelf at year's end:

1/9-1	7/11-7	30/2-1	31/2-5
1/9-4	7/11-8	30/6-9	31/5-2
1/9-6	7/12-2	30/6-13	31/6-2
2/7-14	7/12-4	30/9-2	34/10-3
2/7-19	15/9-17		34/10-5
2/11-6 S			

At year's end there was a total of 400 exploration and appraisal wells on the Norwegian shelf. A break-down of these showed 293 exploration wells and 107 appraisal wells (Table 2.2.2.a).

Exploration drilling was opened on Trænabanken in 1983. Here five wells have been drilled in four blocks without finds of hydrocarbon being made as yet.

Figures 2.2.2.b, c, d and e show the well holes in the four areas on the Norwegian shelf for which exploration drilling has been opened (North Sea, Haltenbanken, Trænabanken, Troms 1) in relation to the structural main features.

As appears from these figures, activity has been spread over the entire shelf.

About one third of the drillings were made north of Stad. Extra large activity was experienced on the Troll field, where seven new wells were spudded. On Oseberg five wells and on Gullfaks four wells were started.

This accounts for 40 per cent of all spudded wells in 1983.

The Norwegian companies Saga, Norsk Hydro and Statoil have had operator responsibility in 1983 for 33 wells spudded, while the remaining seven are split among four foreign companies. Statoil has drilled 14 wells, while Norsk Hydro stood for 13 and Saga six.

Since the start in 1966, a total of 17 different companies have been operators on the Norwegian continental shelf. Statoil has drilled the most wells (76), followed by Phillips with 52 and Norsk Hydro with 48. Fifty-three different drilling vessels have operated during the period on the Norwegian shelf.

2.2.2.1 Distribution by prospect type

In 1983 too, exploration activity has almost exclusively been focused on Jurassic sandstone reservoirs. Thirty-six of the 40 spudded wells have had as their main objective the exploration of different Jurassic sandstone prospects. Several of these wells have also had secondary objectives at other levels.

The other four wells include two in the lower Cretaceous (Senja Ridge and Tromsø Basin), one in the Triassic (34/4-5) and one in limestone of Cretaceous age (1/3-4).

All the wells being drilled at the previous year's end which had not reached down to their primary prospect (nine wells), had Jurassic strata as their primary targets.

2.2.2.2 Svalbard

No drillings were made for oil or gas on Svalbard in 1983 (Figure 2.2.2.f). On the contrary, a number of coal drillings have been made as usual. Table 2.2.2.b lists the drilling licences given on Svalbard in connection with drilling for gas and oil.

2.2.2.3 Experience gained from this year's drilling season

There has been a tendency towards movement northwards of exploration activities. There has also occurred a slight increase in the number of temporarily abandoned drilling localities.

Experience from the year's drilling season north of Stad provides no indication that the continued opening for year-round drilling on Trænabanken and Tromsøflaket during the immediate years should provide insurmountable problems. The general impression is nevertheless that operations in the winter half year will be delayed by environmental factors, and will therefore be more expensive than similar operations in more southerly waters.

Operationally, drilling off South Norway has progressed more or less normally.

An unusual feature of the year's operations was that there was drilled an exploration well from a production platform (Well 7/11-7 was drilled from the Cod platform in the Ekofisk area).

2.2.2.4 Costs of exploration drilling

The total costs of exploration drilling in 1983 will probably run to NOK 3,700 million. The corresponding figure for 1982 was NOK 4,900 million. In the cost figures, the total cost of all exploration and appraisal wells spudded during the year is included. At year's end, final cost data for started drillings in the latter part of 1983 were not available. The cost estimate for 1983 is therefore a provisional one.

In terms of operational days for mobile drilling rigs, the activity in 1983 fell in relation to 1982 by approx 12 per cent. Average costs per well fell from approx NOK 100 million in 1982 to approx NOK 92 million

in 1983. The number of started drillings fell from 49 in 1982 to 40 in 1983.

Figure 2.2.2.g shows the costs of exploration drilling in the period 1966-1983, i.e. the period during which exploration drilling has taken place on the Norwegian continental shelf. From the figure it may be seen that the wildcat activity on the Norwegian continental shelf constituted a market in steep growth until 1982, while in 1983 there was a recession.

In current prices, the total cost of exploration drilling was approximately NOK 21 billion for the period 1966-1983.

2.2.3 Finds and fields being evaluated

2.2.3.1 Finds in 1983

Several new, interesting finds were made on the Norwegian shelf during 1983. Particularly encouraging was Statoil's find in Block 6407/1 on Haltenbanken. Hydrocarbons were proven in two different wells on the same structural complex, but it has not yet been determined whether there is communication between the two reservoirs. Most likely, there are two separate reservoirs (gas condensate in 6407/2 and gas over oil in 6407/1-3). Moreover, several lesser finds have been made north of Stad.

Saga proved a new gas find on Haltenbanken in Block 6407/2 to the immediate south of the gas find in Block 6507/11, and Norsk Hydro and Statoil proved three new, minor finds on Tromsøflaket (7120/7-2, 7119/12-3 and 7120/12-3).

On Trænabanken, which is the fourth area to be opened for exploration drilling on the Norwegian shelf, no hydrocarbons of commercial significance could be found. With a view to later exploration activities, however, a positive aspect was that hydrocarbon residues were recorded in some of the wells.

Results from three wells on Troll East, which was allocated in 1983, confirm the supposition that this structure contains large amounts of gas (an estimated 825 billion Sm3). The oil zone under the gas reservoir is thinner on Troll East (0-7 meters) than on Troll West, where it varies from 10-12 meters to all of 27 meters further west.

Statoil drilled a number of promising wells in Block 34/10 in 1983. Well 34/10-17 is a new find (oil) which stretches into Block 33/12, while the results of Well 34/10-16 on Gullfaks South have triggered a sizeable increase in the estimated proven reserves in this structure.

Moreover, new gas reserves have been proven in the Sleipner area (15/9-17), as has oil in two wells, 7/11-7 (Cod) and 7/8-3, in Jurassic rocks in the southern North Sea.

At year's end 1983 there were ten exploration and appraisal wells being drilled, of which four had reached the reservoir level.

In all drillings took place on 30 new prospects in 1983. Fourteen new finds were made. This represents a finds ratio of 47 per cent, which is excellent for exploration drilling.

2.2.3.2 Drilling on new structures

Block 2/1

Block 2/1 was originally allocated to Gulf in 1965 on production licence 019. In 1971 Gulf decided to withdraw, and Conoco assumed operatorship. In connection with this transfer, the state secured a 12.5 per cent share. In 1977, BP took over parts of Conoco's share at the same time as they assumed operatorship. Statoil was allocated 50 per cent ownership and the group had to undertake a further work program.

Well 2/1-5 was drilled on a separate structure in the southeast of the block. Oil was proven in thin Jurassic sand strata at approx 4,200 meters. The well was not tested, and the find did not contribute to any substantial increase in the total reserve estimates for the block.

Block 2/5

Block 2/5 was originally allocated to the Amoco/ Noco group in 1965 on production licence 006, and they have retained 68 per cent of the block, including Tor and the South East Tor fields. The relinquished part of the block was newly reallocated in the sixth round of concessions to Shell as operator.

Well 2/5-7 is the first on production licence 067. The main prospect, Jurassic sandstone, was water bearing, but traces of oil were detected in chalk rocks of upper cretaceous age. It is still uncertain whether this oil is recoverable, and three production tests will be made.

Block 7/8

Block 7/8 was originally allocated to the Phillips group in 1965 on production licence 016. The block was relinquished in its entirety following two dry wells, and subsequently reallocated in the sixth round of concessions with Conoco as operator.

Well 7/8-3, which is the first on production licence 069, was drilled on a new structure which lies on the boarder line between Blocks 7/8 and 7/11. An oil column of approx 35 meters has been proven in Jurassic sandstone. The well was tested to a maximum production of 206 Sm3 oil and approx 7,000 Sm3 gas per 24-hour day through a 25 mm choke.

Block 7/11

The block was allocated to the Phillips/ Petronord group in 1965 on production licence 018, with Phillips as the operator. That part of the block which includes the Cod structure was retained. The remainder was relinquished and newly reallocated in the sixth round on production licence 070 with Norsk Hydro as operator.

Production licence 018
Phillips drilled an exploration well, 7/11-7, from the Cod platform. The work with this well took an extremely long time, almost one year. During drilling there were indications of hydrocarbons in Jurassic and Triassic levels alike. Two test attempts on the Triassic level were unsuccessful. The zones were tight however, so the tests would hardly have provided a positive result. After many technical problems, one succeeded in producing oil from sandstone strata of Jurassic age. The maximum production was measured to 20 Sm3 oil per day through a 1.6 mm choke. The reservoir is very tight, and despite the small choke bore, production soon fell to zero. The reservoir cannot be produced.

Production licence 070
Norsk Hydro drilled a dry well in the north of the block this year.

Block 29/9

The well was allocated in the third round of concessions on production licence 040, which includes Blocks 29/9 and 30/7, with Norsk Hydro as operator.

Well 29/9-1 was being drilled at year's end 1983. The well was drilled on a separate fault block to the southwest of previously proven gas reserves on the Norwegian side of the Hild area. A 9 meter thick gas column in sandstone strata of Jurassic age has been proven. The reservoir thickness is substantially less than in the other wells in the area. The reservoir will be tested.

Block 30/11

The block was allocated in 1969 with Shell as operator. Previously, two dry wells were drilled which were terminated in rocks of upper cretaceous age.

Well 30/11-3 was drilled on a structure in the southerly part of the block, where traces of oil and gas were encountered in Jurassic sandstones. Due to the high formation pressure, the well bore did not reach to the deepest part of the mapped prospects, nor was it tested. A new well will be drilled in 1984.

Block 34/4

The block was allocated in the fourth round of concessions with Saga as operator.

Well 34/4-4 was drilled far to the south of the block, on a large and relatively flat structure which stretches into Block 34/7.

A 172 meter oil column was proven in sandstone strata of Triassic age. The greatest production was measured to 1,730 Sm3 oil and 111,200 Sm3 gas per day through a 17.5 mm choke. The test was among the best achieved on the Norwegian continental shelf.

Well 34/4-5, which is being drilled on a separate structure further to the northeast of the block, had not reached the prospective strata by the end of the year.

Block 34/10

The block was allocated in 1978 with Statoil as operator.

Four exploration wells were drilled in Block 34/10, of which two proved hydrocarbons, one was dry, and one was still being drilled at year's end.

Well 34/10-16 was drilled on the western part of the Alfa structure. A gross hydrocarbon column of 250 meters was proven, consisting of 180 meters gas over 70 meters oil. The net recoverable reserve rock in the reservoir is approximately 50 per cent. The find boosts the previous estimates of the Alfa structure considerably. One test was performed in the oil zone and one in the gas zone. The oil test produced 962.5 Sm3 oil per day through a 19 mm choke. The oil has a specific gravity of 0.86 g/cm3. The gas test produced 1.65 million Sm3 per day through a 19 mm choke.

Well 34/10-17 was drilled on a separate structure in the southeast of the block. The structure extends into Block 33/12. Gas was proven over oil in a column 235 meters tall in the reservoir, and the oil test produced 805 Sm3 oil and 540,000 Sm3 gas per day through a 19 mm choke.

Well 34/10-20 was initiated on a separate structure in the south of the block (Gamma structure). To what extent further wells will be drilled in the block depends primarily on the results from this well.

Haltenbanken

Two new exploration wells were drilled on Haltenbanken during the year, and both made finds (Figure 2.2.3.a).

Tyrihans (Block 6407/1)

This block was allocated in April 1982 with Statoil as operator.

Well 6407/1-2 was drilled on a structure in the southwestern part of the block (Tyrihans South). Well 6407/1-1 was spudded in the same vicinity but had to be interrupted due to technical difficulties. Well 6407/1-2 proved a 42 meter tall column of gas and condensate in Mid-Jurassic sandstone. The reservoir was tested and produced 460 Sm3 condensate and 394,000 Sm3 gas per day through a 19 mm choke. The oil's specific gravity is 0.793 g/cm3. The carbon dioxide content is 3 per cent.

Well 6407/1-3 (Tyrihans North) was drilled on a structure just north of 6407/1-2. Gas was proven here over relatively heavy oil (0.87 g/cm3) in rocks corresponding to Well 6407/1-2. A 108,5 meter hydrocarbon bearing column was found. The reservoir was tested and produced 825 Sm3 oil and 150,000 Sm3 gas per day from the oil zone, and 200 Sm3 condensate and 725,000 Sm3 gas per day from the gas zone through a 19 mm choke. There is probably not any communication between the two finds in the reservoir zone. It is still too early to state figures for the total recoverable reserves for the entire Tyrihans field. The field probably extends into the neighbouring Block 6406/3 in the west.

Block 6407/2

The block was allocated in 1982 with Saga as operator.

Well 6407/2-2 was drilled on a structure in the north of the block. A hydrocarbon bearing column of 58.5 meters was proven. By testing, 994,400 Sm3 gass and 119 Sm3 condensate were produced per day through a 23.8 mm choke. Well 6407/2-2 was drilled on the same structure as 6407/11-1.

Tromsø Patch (Tromsøflaket)

Five exploration wells and one appraisal well were drilled on Tromsøflaket during the 1983 drilling season. Three finds were made (Figure 2.2.3.e).

Block 7119/12

The block was allocated in 1980 with Statoil as operator.

Well 7119/12-3 was drilled on a structure in the northwesterly corner of the block. Gas was proven in very tight sandstone. The total gas column may be up to 140 meters, but the porosity is very low, lying in the region 4-6 per cent. The production test gave 956,000 Sm3 gas and 17 Sm3 condensate per day through a 25.4 mm choke. The test is considered to be very good, considering the reservoir is almost tight. It is very interesting to note that a reservoir rock with such a low porosity can produce so well.

Block 7120/7

The block was allocated in April 1982 with Statoil as operator.

Well 7120/7-2 was drilled on the boarder to Block 7120/8, on a structure which extends into both blocks. A gas column of 78 meters was proven, and a test performed produced 703,000 Sm3 gas and 29 Sm3 condensate per day through a 25.4 mm choke. The reserves are probably relatively small, but may be of importance as supplementary fields (satellites) in the case of any development of the Askeladd field.

Block 7120/12

The block was allocated in 1980 with Norsk Hydro as operator.

Well 7120/12-3 was drilled on the Alke North structure. The well proved a 22 meter gas column in sandstone strata of Mid-Jurassic age. Measurements showed that the reservoir was extremely tight. It was not production tested. The find is assumed to contain small amounts of gas. Gas has previously been proven in corresponding strata in the block.

2.2.3.3 Fields being evaluated

Tommeliten

The field lies in Block 1/9, which was allocated in 1976 under Statoil's operatorship (Figure 2.3.2.a, Ekofisk area).

The Tommeliten (Tom Thumb) field consists of two structures, the Alfa in the south, and the Gamma in the north. In both structures, gas/condensate was proven.

Recoverable reserves are provisionally estimated at 6 million Sm3 oil and 23 billion Sm3 gas. The oil represents condensate which separates out during production.

The operator has to date recommended six prime alternatives for development of the Tommeliten field.

Most development alternatives are based on transport to Eldfisk, onward through existing lines to the Ekofisk Centre and into the Emden line.

When gas prices and tariffs have been finalized, the operator will make his final proposal for selection of the development concept. The operator is planning to submit a commerciality declaration in the summer of 1984, and a field development plan and landing application in October 1984.

Hod

Block 2/11 was allocated in 1969 with Amoco as operator.

The Norwegian Petroleum Directorate's estimated recoverable reserves are 9.0 million Sm3 oil and 7.0 billion Sm3 gas.

The Hod field consists of two lesser structures. These have been examined by a total of five wells, two on West Hod and three on East Hod. The last of these wells was 2/11-6.

Before drilling Well 2/11-6, the field had been considered so promising that a wellhead template was emplaced between the two structures. Well 2/11-6 was directionally drilled from here and can be used as a production well later.

Amoco is now working on a report on possible production from subsea completed wells. Such a solution could reduce the development costs for the Hod field. If the study shows that both economically and technically it is interesting to use subsea completion wells, production can start in spring 1985, by recompleting Well 2/11-6. Production would be routed by pipeline to Valhall. The operator considers he will require 1-2 year's trial production from this well to harvest experience with subsea completions, before a decision can be made concerning any further development of the Hod field.

The Sleipner area

The Sleipner area is made up of Blocks 15/5, 15/6, 15/8, 15/9 and 16/7 and includes a number of structures. See Figure 2.2.3.b.

Allocations, production licences, operator responsibilities and the number of wells drilled as per year's end 1983, were as follows:

Block	15/5	15/6	15/8	15/9	16/7	Total
Allocation year	1977	1969	1970		1981	
Operator	Norsk Hydro	Esso	Statoil		Esso	
Production licence	048	029	046		072	
Total wells	3	6	1	18	4	32
Drilling in 1983	0	0	0	2	0	2

The first find in the area was made in Well 15/6-2 by Esso in 1974 on the Dagny structure.

New finds in the Sleipner area

Well 15/9-17, which was drilled on the Theta structure in the northeast of the block, proved gas in sandstone strata of Paleocene and Jurassic/ Triassic age. The Paleocene reservoir, which has a 36 meter gas bearing layer, was production tested with the following result: 530,000 Sm3 gas and 276 Sm3 condensate per day through a 19 mm choke. The Jurassic/ Triassic reservoir has a total thickness of approx 100 meters, and the best test produced 600,000 Sm3 gas and 215 Sm3 condensate per day through a 19 mm choke.

Well 15/9-18, which is being drilled on the Sigma structure in the middle of the block, had not reached its prospective strata by year's end.

Reserves estimate

Recoverable reserves on the Sleipner field, which includes the Alfa, Beta, Epsilon and Delta structures, are estimated to amount to 124 billion Sm3 gas and 17 million Sm3 oil (see Table 2.4.3). The oil is the condensate which separates out during production. The Sleipner field gas contains some carbon dioxide (CO_2). In the estimates of the reserves in place, carbon dioxide has been deducted. On average, the carbon dioxide content is 9 per cent.

For the Gamma structure, the recoverable reserves in the Heimdal formation are estimated at 55 billion Sm3 gas and 10 million Sm3 oil (in the form of condensate which separates out during production). The carbon dioxide content of the structure is minimal. Reserve estimates are 10 billion Sm3 gas in the My structure, 0.5 million Sm3 oil and 12 billion Sm3 gas in the Theta structure, and 5 billion Sm3 gas in the Gamma Jurassic structure.

Development of the Sleipner area

The concession holders are expecting to be able to present their commerciality declaration in the course of 1984, and assume that production start will occur, at the earliest, in 1990. Statoil has performed extensive field development studies and has reached a development solution which the licensee has recommended.

The development solution involves an integrated platform on the Gamma structure, and two integrated platforms on the main field. In addition, there will be a requirement for a simple development unit on the northerly part of the main field. The field development plan will be designed so that lesser structures in the area can be tied in. Equipment for removal of carbon dioxide may be installed either on the platform, or following transportation by pipeline to shore. This depends on the buyer and landing site.

The choice of transportation arrangement for gas and condensate depends on the results of the sales negotiations still continuing at year's end.

Balder

Block 25/11 was allocated in 1965 (production licence 001) with Esso as operator. Additionally, Esso acquired Blocks 25/8 and 25/10 in 1969 (production licences 027 and 028).

The field was proven in 1974 by the drilling of Well 25/11-5, in which oil was found in Paleocene sandstone. In Block 25/8, small amounts of oil were also proven in corresponding sandstone layers.

As yet, no final decision has been made as to development of the field. No wells have been drilled in the block since 1981.

The recoverable oil reserves are now estimated to run to 35 million Sm3.

The landing application was submitted in December 1980, but because of a heavy fall in the estimated reserves and consequent poor project economy, the landing application was withdrawn. The operator is evaluating the field.

Oseberg (30/6 - 30/9

Block 30/6

Block 30/6 was allocated in 1979 with Statoil as operator (Figure 2.2.3.c). In the spring of 1982, Norsk Hydro took over operator responsibility. Six structures on the block have been drilled till now: Alfa, Alfa North, Gamma, Beta, Epsilon and Delta. A new structure (Zeta) was being drilled at year's end.

New wells

Well 30/6-10 was drilled to determine the gas-oil contact on the Alfa structure, and hydrocarbons were proven through the entire reservoir section of 118 meters. It was nevertheless not possible to determine with accuracy any gas-oil contact. The well was plugged some distance down and deviation drilled to arrive higher up the structure, with the intention of determining the gas/ oil contact more exactly. This deviation leg of the well was designated 30/6-10A.

Gas-oil contact was then established and Well 30/6-10A was production tested at four intervals, one of which was in the oil zone and three in the gas zone. The oil test produced 560 Sm3 oil and 81,000 Sm3 gas per day through a 12.27 mm choke. The best gas test produced 800,000 Sm3 gas and 275 Sm3 condensate per day through a 15.4 mm choke.

Well 30/6-11 was drilled in the northwest of the block on the Delta structure. Delta is a common structure between Blocks 30/3 and 30/6.

During drilling of this hole, slight traces of hydrocarbons were registered, and the well was tested to see if these could be produced. The test results were negative, and the well was plugged as dry.

The intention of Well 30/6-12 was to hit the reservoir on the Alfa structure in the oil zone and run a combined production and injection test. Due to technical difficulties, the well had to be abandoned and plugged 616 meters downhole.

A new wellhole, 30/6-13, was spudded a few meters from 30/6-12. The reservoir was struck as expected in the oil zone. Oil bearing sand was proven, 100 meters thick. Three production tests were performed, of which one was a combined production and injection test. The best test produced 450 Sm3 oil and 55,000 Sm3 gas per day through an 11.1 mm choke. The specific gravity of the oil is approx 0.85 g/cm3.

Block 30/9

Because the main (Alfa) structure in Block 20/6 stretches into Block 30/9, parts of the latter were allocated in the autumn of 1982, also with Norsk Hydro as operator.

The first bore, Well 30/9-1, was drilled to the south on the Alfa structure. A 40 meter thick oil column was proven in Jurassic sandstone. An injection test was run in the water zone and two production tests in the oil zone. The best test produced 373 Sm3 oil and 40,400 Sm3 gas per day through an 11.1 mm choke.

Well 30/9-2 was drilled on the Gamma structure, where Well 30/6-9 had previously proven gas and oil. An oil column 143 meters tall was proven in 30/9-2 in sandstone strata dating from the Mid-Jurassic era, and oil-water contact was established. An injection test was performed in the water zone and three production tests in the oil zone. The best test produced 1,570 Sm3 oil and 162,000 Sm3 gas per day through a 22.2 mm choke.

Well 30/9-3 is being drilled on a separate structure to the west of the Gamma structure. It was spudded just prior to year's end.

Reserve estimates

The gas-oil and water-oil contacts have been well defined on all structures. In 1983, several new wells were drilled, and some of the seismics were reinterpreted. On the basis of this, the Norwegian Petroleum Directorate prepared a new map in the autumn of 1983. This basic map gives the following estimates for recoverable reserves:

	Oil (million Sm3)	Gas (billion Sm3)
Gamma	47	18
Alfa	103	47
Alfa North	23	6
Total	173	71

These estimates include the reserves in all the three formations in the reservoir: Etive, Ness and Tarbert. The Etive formation contains the main bulk of the reserves.

The operator in his field development plan has submitted a reserves estimate which only includes the reserves in Etive and parts of the Ness formation. This is due in part to the operator's evaluation of the geological model of the Tarbert formation. The Norwegian Petroleum Directorate has discussed this with the operator, who subsequently presented a geological model which to a great extent concurs with the Norwegian Petroleum Directorate model. The operator thereby increases his reserve estimates, such that these now agree with the Directorate's figures.

Reservoir studies have shown that oil recovery increases by 5 per cent if the associated gas is reinjected. The associated gas, however, is insufficient to maintain the pressure in all structures. In the plans which have been submitted for the field, it is intended to inject gas into the Gamma structure. By means of a balanced production between the Alfa and Gamma structures, one will achieve full pressure maintenance in Gamma. In the Alfa and Alfa North structures, water flooding is planned. In this connection, the use of chemicals to increase recovery is being considered.

The gas cap and associated gas will be produced after the main bulk of the oil has been finally produced.

Field development plans

The field development plans for Oseberg were handed to the Ministry of Petroleum and Energy on 5 December 1983. The prime concept in this plan is based on a divided field center: an accomodation and process platform connected to a drilling platform. The field center will be located just south of the block boundary between 30/6 and 30/9 in order to drain the Gamma and southern Alfa structures. The central area will in the plan be depleted using subsea completion well systems, while the northern part of Alfa and Alfa North are planned for draining by a separate drilling platform. The well systems and this platform will be phased-in to maintain the oil production plateau.

The operator's plans embody production start in April 1989.

The oil will then be stabilized and transported by pipeline to shore. The associated gas will be reinjected into the reservoir to increase recovery of oil, so that gas production for sale is estimated to start after the turn of the century.

The Troll field

The Troll field extends over several blocks: 31/2, 31/3, 31/5 and 31/6. Allocation of Block 31/2 was made in 1979, while the other three blocks were allocated in July 1983. The operator on Block 31/2, Norske Shell, declared in November 1983 that part of the Troll field lying within Block 31/2 commercial. Block 31/2 is on production licence 054. Blocks 31/3, 31/5 and 31/6 are production licence 085. Operator responsibility here is divided among Statoil, Saga and Norsk Hydro.

The reservoir lies in geological formations of upper Jurassic age (approx 140-150 million years old). The uppermost formation (Sognefjord) is dominated by a medium to coarse grained sandstone with good reservoir properties. These properties seem to be rather less good in Troll East. This formation, which is the most prevalent in the reservoir, runs into the underlying middle formation (Heather) which consists of silt and fine grained sandstone with a relatively high content of mica. Its flow properties are therefore poorer than in the top formation. The bottom formation consists of sandstone with variable reservoir properties.

On the top of Troll West in Block 31/2, and on top of Troll East in Blocks 31/6 and 31/3, there is a gas column a good 200 meters thick. The gas column varies over the field and is significantly less in the westernmost parts of the Troll field. This westernmost part of the field, which lies primarily in Block 31/2, has an oil column of 22-27 meters below the gas, compared with 10-17 meters further east in the block. In Troll East, the proven oil layer varies in thickness from a few meters to zero.

The Troll field has been characterized by very high activity as regards the drilling of exploration and appraisal wells:

Wells drilled in 1983

Well	Status	Operator	Penetrated HC column
31/2-11	Appraisal	Shell	8 m gas over 27 m oil
31/2-12	Appraisal	Shell	205 m gas over 8-10 m oil
31/3-1	Exploration	Statoil	220 m gas over 7.5 m oil
31/5-1	Abandoned shallow	Saga	
31/5-2	Exploration	Saga	53 m gas over 13 m oil
31/6-1	Exploration	N Hydro	221 m gas, residual oil
31/6-2	Exploration	Statoil	
31/6-3	Expl outside Troll	N Hydro	Dry

Test results

Well	Test interval	Choke (mm)	Rates per day
31/2-11	Oil test	17.5	1251 Sm3 oil, 69160 Sm3 gas
31/2-12	Gas test	2 x 25.4 + 2 x 50.8	3.5 million Sm3 gas
31/3-1	Gas test	25.4	900,000 Sm3 gas
31/6-1	Gas test	38	1.25 million Sm3 gas

Wells 31/5-2 and 31/6-2 are to be tested in summer 1984.

The production rates of Well 31/2-12 are the highest ever achieved on the Norwegian continental shelf, and the oil test of Well 31/2-11 has to be considered good. This is also the case for the gas tests of Wells 31/3-1 and 31/6-1.

Well 31/6-3 was drilled on a separate structure southeast of the Troll East field. The reservoir was water bearing. Nevertheless, this is of no consequence for the reserves on the Troll field proper.

To date on Blocks 31/2, 31/3, 31/5 and 31/6, there have been drilled twelve, one, one and three wells, respectively. The Norwegian Petroleum Directorate's present reserve estimate for the Troll field is 1,287 billion Sm3 recoverable gas deposits, and 58 million Sm3 recoverable oil deposits. The recoverable reserve estimates have been reduced by approx 50 per cent in comparison with the 1982 Annual Report. About half this reduction is due to a reduction in the estimated in place reserves resulting from new maps. The other half (a good 30 million Sm3) is due to the provisional ignoring of oil deposits in those parts of the field which possess a 10-17 meter oil zone, because the uncertainties tied to production of this oil are large at the present point in time. New recovery methods or more favourable geological conditions in parts of the field not yet drilled, may alter this picture.

The recovery factors for oil and gas are encumbered with some degree of uncertainty, among other things being dependent on the size and extent of the underlying water zone. The reason for this is that the reservoir approximates hydrostatic pore pressure. If the water volume is small, for example, pressure near the wells will most likely be greatly reduced under production, causing relatively early problems in lifting the oil and gas to the surface.

Norske Shell, the operator of Block 31/2, has presented a development alternative which entails production of oil from the western part of Block 31/2 and gas production from areas having a thin oil zone and thick gas zone (near Well 31/2-4). This alternative provides a large gas-oil ratio (plateau production 16 million Sm3 gas and 4 million Sm3 oil per annum).

The total gas production level which the 31/2 group are planning, will thus be the determining factor for when possible new platforms (fixed or mobile) will be able to start production on Troll East. One will also evaluate the development of Troll East using only subsea completion wells. The advantage of this is that there is more flexibility with regard to sale of gas. Various alternatives for transportation of the oil and gas are being evaluated. Which alternative will be chosen will depend on the market, production level

and other factors, including for example possible exploitation of existing pipeline systems.

Due to the great water depth, development of the Troll field will be very complicated and exhaustive. This means that one will be forced to select a small number of concepts which are then further evolved up to development maturity. The selection which has to be made of concept will therefore reduce the flexibility one has to select production strategy, as the concepts selected will to a great degree predetermine the production ratio between oil and gas.

Based on the interpretative work existing, the Norwegian Petroleum Directorate has concluded that there is pressure communication between the main structures in Troll West and Troll East. Until otherwise demonstrated, the Norwegian Petroleum Directorate believes that, upon production, there will occur flow communication between the two structures. According to "Provisional regulations for sound exploitation of petroleum reserves", § 1, both structures should therefore be considered to be one reservoir. Pursuant to these regulations and Storting Report no. 99 (1982-83) with associated Storting Recommendation no. 145 (1982-83), the development plan for both structures must thus take account of this fact. The entire Troll area must therefore be viewed as an entity before the authorities can take a stand regarding the field development plan.

The Norwegian Petroleum Directorate assumes that one in the work which remains will expound several alternative coordinated development solutions, so that one, if possible, achieves further improvements in the exploitation of the reserves over the whole area. The Directorate has noted with satisfaction that the plans so far worked out include production of oil from the western structure. The authorities are heavily in favour of a coordinated plan for development that gives at least as good a solution for oil production.

Gullfaks - Phase II

The block was allocated in 1978 with Statoil as operator, see the description of Gullfaks, Phase I.

Phase II included the area east of the main fault between Wells 34/10-4 and 34/10-9. The depth of water in this area is considerably greater than in the area covered by Phase I.

So far, eight wells have been drilled in the vicinity of the Delta structure which belong to Phase II of the development.

Well 34/10-16, an appraisal well on this part of the Gullfaks field, turned out to be dry.

Reserves

Due to the complicated delimitation of the field towards the east and southeast, the reserve predictions are highly uncertain. The Norwegian Petroleum Directorate's estimate for recoverable reserves on Delta East, Phase II, is of the order of 102 million Sm3 oil and 12 billion Sm3 gas. Presumably these will have to be reduced somewhat due to the results from Well 34/10-19.

Any development of the area must be submitted to the authorities as a separate matter. A reduction in the reserves for the Phase II area will probably lead to the development solution with two platforms being changed. Several new solutions are being assessed, and the most probable is a solution with an integrated platform located in the northerly part of the field, where there is least depth of water. Subsea completion wells will be used to the extent this is necessary to secure good depletion of the reservoir.

The operator is considering speeding up the development of Phase II in relation to the original plan, which was to start production in 1995. The plan for Phase II incorporates an option for production start in 1990.

Tromsøflaket

A total of six wells have been drilled on Blocks 7120/7, 7120/8 and 7120/9. Five of these have proven hydrocarbons in four different structures. The locality and reservoir-related similarities cause these three blocks to be evaluated collectively.

The operators in 1983 have continued with technical and economic studies for possible development and production of gas from the area.

Block 7120/7

The block was allocated in 1982 with Statoil as operator. Statoil proved gas in the first well on a structure centrally placed in the block. In 1983 the second well was drilled on a structure on the boarderline to Block 7120/8 (Askeladd). In this well too, gas was proven with a gas column of 78 meters. A production test provided 703,000 Sm3 gas and 29 Sm3 condensate per day through a 25.4 mm choke.

Proven reserves in the block after the first well were estimated to 23 billion Sm3 recoverable gas. Following the second well, this estimate will probably be revised upwards. In Block 7120/7 there are still structures which have not been tested, and which can provide an addition to the block's resources.

Askeladden (Block 7120/8)

The block was allocated in 1981 with Statoil as operator. The first well on the Askeladden structure was drilled in the summer of 1981 and provided test results among the best attained in the North Sea. The second well was drilled in 1982 on a southerly fault block on the same structure and lies some 8 km further south. Both wells proved gas in sandstone strata dating from the Jurassic.

A larger east-west fault separates the northern and southern parts of the Askeladden structure from each other. There does not seem to be any direct communication between the two parts at reservoir level, as the gas-water contact lies 16 meters higher in Well 7120/8-2 than in 7120/8-1.

In 1983 the third well was drilled. This well was to delimit the field towards the north and was located north-northeast of Well 7120/8-1. It was expected to hit Jurassic sandstone at the gas-water contact level

proven in Well 7120/8-1. In fact, Well 7120/8-3 hit Jurassic sandstone deeper than this level. This means that the well was dry because the strata tip more to the north than assumed.

Against the background of the result from Well 7120/8-3, the reserves in the field have been reduced somewhat, meaning that the Directorate is now operating with reserve estimates of 46 billion Sm3 recoverable gas.

Block 7120/9

The block was allocated in 1982 with Norsk Hydro as operator. The field was proven by the first well on the block. This well was drilled into a structure in the north of the block. The reservoir lies in Jurassic sandstone, and a 65 meter gas column was proven. The best production was measured at 300,000 Sm3 gas and 9.5 Sm3 condensate per day through a 20.3 mm choke.

Mapping of the field indicates that it extends into the northward Block 7120/6 and eastward Block 7121/7. These blocks were announced in the eighth round of concessions.

Proven recoverable reserves on the field are estimated to 35 billion Sm3 gas. The block has structures which have not been tested, but which will be tested in the coming years.

2.2.3.4 Fields declared commercial

During 1983 the Oseberg and Troll fields were declared commercial.

2.3. Fields being planned, developed or in production

Production drilling and well maintenance

During the year, drilling licences were given for 21 production/injection wells. Further, well maintenance has been performed on 19 wells. Production from the subsea completed wells on North East Frigg started in 1983, and production drilling started on the Odin platform.

2.3.1 Valhall

Production licence 006
Concession holders:

Amoco Norway Oil Company A/S	28.33 %
Amerada Petroleum Corporation of Norway	28.33 %
Texas Eastern Norway Inc	28.33 %
Norwegian Oil Consortium A/S & Co	15.00 %

Block 2/8 was allocated in 1965 with Amoco as the operator.

The Valhall field lies mainly within Block 2/8. The southern part of the block reaches into Block 2/11, production licence 033. In this licence, each of the companies mentioned above have a 25 per cent interest.

Production facilities

Development includes in the first phase (Valhall A) an accommodation, a drilling, a production and a riser pipe platform. The three first mentioned platforms are placed on the Valhall field and interlinked with bridge connections. Figure 3.2.1.a shows these installations. The riser platform, which Phillips Petroleum Company Norway has the operatorship for, is connected to the Ekofisk tank.

The oil is separated on Valhall using two separation units, before being pumped to the Ekofisk facility, where it is metered and led on into the Teesside pipeline. The gas is compressed, dried and its dew-point checked on the production platform before being despatched by pipeline to the Ekofisk installation, where it is sent on via the Emden line. Denser gas fractions are separated out on Valhall using a stabilizer, and then injected into the oil.

Recovery of reserves

Valhall can be compared to the fields in the Ekofisk area as regards reservoir properties and geology.

The Norwegian Petroleum Directorate estimates that some 19 million Sm3 oil, 1.3 million tons NGL and 16 billion Sm3 gas will be depletable from the Valhall A site by pressure amelioration.

Drilling of production wells has provided new geological information on the field, and in 1983 the Norwegian Petroleum Directorate considerably down-adjusted its reserves estimates. The fact that these figures now lie substantially below those of the operator, is due mainly to the Directorate assuming a lower recovery factor, largely because smaller parts of the field will be depleted via Valhall A.

Further, the rock volume in the Tor formation is assumed to be rather less than the operator believes.

Production from Valhall A started on 1 October 1982, and by 31 December 1983 a total of seven wells had been tied in to the production facility. Gas sales through the Ekofisk installation started in July 1983. The productivity of the wells has been substantially less than predicted, with a mean rate of 970 Sm3 per day at year-end.

On the Valhall field the rock properties are highly complicated, and this has sometimes caused large difficulties in connection with drilling and completion of wells. The operator has nevertheless worked doggedly to find improved procedures, and developments seem now to have turned for the better. The wells drilled in the latter half of the year have also offered fewer technical drilling problems. At the same time, new completion methods seem to have provided considerably better productivity than formerly.

Exploitation of the resources on the Valhall field depends on the time of development and the development strategy for those parts of the field which cannot be reached from Valhall A.

Gas flaring

The volume of gas flared in 1983 on Valhall was on average 0.12 million Sm3 per day, corresponding to 20.2 % of the total gas production. It should be mentioned that the platform was in a start-up phase during the first months of the year. After the gas system had been tested, and the gas held the sales agreement's specifications, gas could finally be dispatched from Valhall on 13 July 1983 through the Ekofisk Center into the Emden line. The flare permit was reduced on 15 July 1983 from 0.5 million Sm3 per day to 0.2 million Sm3 per day. Gas flaring from the field fell drastically following initiation of gas deliveries. In December, the mean flaring was 0.11 million Sm3 per day (Figure 2.3.1.b).

Costs

Total investment costs are assumed to be NOK 6.5 billion in current value and NOK 8.0 billion in fixed 1983-kroner. (For conversion between current and fixed kroner, the National Accounts Price Index for investments in oil activities has been used, together with an 8 % price increase from 1982-83).

Safety and the working environment

Load-bearing structures

On the Valhall installation PCP, a dent in a diagonal brace underwater has been discovered, together with a damaged stiffening ring. The damage has been evaluated to be of no significance for the structure's integrity. Additionally, a fracture has been discovered in the affixture of a main leg. The fracture is of no immediate importance for structural integrity, and no final decision has been made regarding possible repair.

Fire pumps

Due to corrosion and erosion problems, new idler wheels have been installed of improved quality in the fire pumps. The fire pump riser has also been exposed to severe corrosion. All risers will be inspected and treated with a rust-inhibitor coating.

Crude oil pumps

The special conditions in the reservoir have resulted in large amounts of sand entering the production equipment, with the result that sealings have been ruined, and the crude oil has diluted the lubrication oil, causing the axial bearings to burn out. A new type of gland utilizing overpressure has been installed.

Downhole safety valves

Resulting from the good statistics from testing and operation of DHSV, Amoco has been given permission to extend the interval between each test from once a month to each quarter.

Ventilation in drilling mud module

Registrations of air quality in the drill mud room on Valhall did not comply with the occupational hygiene requirements. Evaporation from the drilling mud was particularly great due to the high temperature of the returning liquids when drilling the lower part of the well. Measurement results showed for one thing that the solvent content of the working atmosphere was greatly in excess of the administrative norm values. An improvement of the ventilation system did not produce the expected result. For these reasons, an injunction was given to implement the necessary measures to secure satisfactory air quality.

It was proposed to solve the problem by increasing the number of air changes using larger ingress and exhaust capacities, combined with a better ducting system for distribution and extraction of air, and improved design on the extraction hood over the cuttings grader.

Measurements made since completion indicate that the working atmosphere in the drill mud module has improved.

Expansion of accommodation block

On several occasions the companies during the planning phase have under-estimated the need for bed capacity on fixed installations. Lately one has sought to solve this problem by increasing capacity, either by expanding the accommodation block, or by hiring flotels.

In connection with the flotel which was used during the installation phase on Valhall having to be moved, there arose a need for extra living accommodation. Application was made for permission to install 19 temporary accommodation modules with 38 beds on top of the existing living quarters.

The new storey would be located under parts of the helideck and would prevent the free passage of air. This could affect aircraft operations.

Further, there would be small clearance between the helideck and the accommodation block. It was therefore important to clarify to what extent the new accommodation unit would be affected by any helicopter crash. Both these questions were drafted and evaluated before the solution was approved.

The Norwegian Petroleum Directorate saw the situation such that the need was a permanent one, and that this matter should be considered to be a permanent annex. The same standard and technical building requirements which apply for the accommodation quarters on fixed installations would therefore have to apply.

The number of lifeboat places on the accommodation block would have to be increased to provide 200 % cover. This was achieved by placing a new lifeboat station on the accommodation unit.

Noise in control room

A control room on the production unit was located above a diesel generator room and alongside large fans. The noise conditions in the room were therefore unsatisfactory, and the Directorate gave an injunction to take noise abatement measures. Sound traps, floating flooring and acoustic isolation of one wall did not provide the required result.

A consultant firm was therefore employed by Amoco to clarify the factors involved and make suggestions for a solution. It was decided to insulate the walls, floor and ceiling with anti-vibration and noise absorption materials, rebuild the HVAC system, and isolate all penetrating cables, pipes and structures from the generator room. Measurements taken after the work had been completed showed good abatement and satisfactory noise conditions.

This example illustrates the importance of making a thorough study of the expected noise conditions as early as the planning stage, so that the measures needed to secure a proper working environment can be taken. In addition, all modifications and rebuilds on the field are always disproportionately expensive.

2.3.2 The Ekofisk area

Production licence 018 ("Phillips group")

Concession holders:

Phillips Petroleum Company Norway A/S	36.960 %
Norsk Fina A/S	30.000 %
Norsk Agip A/S	13.040 %
Norsk Hydro Produksjon A/S	6.700 %
Elf Aquitaine Norge A/S	8.094 %
Total Marine Norsk A/S	4.047 %
Eurafrep Norge A/S	0.456 %
Coparex Norge A/S	0.399 %
Cofranord A/S	0.304 %

The above companies (the "Phillips group") hold the concessions to the Ekofisk, West Ekofisk, Cod, Eldfisk and Edda fields (Figure 2.3.2.a). The two first named fields lie in Block 2/4. Cod lies in Block 7/11 and Eldfisk and Edda in Block 2/7.

Albuskjell is split between production licences 018 and 011, and the Tor field between production licences 018 and 006. Albuskjell lies in Blocks 1/6 and 2/4, the Tor field in Blocks 2/4 and 2/5. The distribution is as follows:

Albuskjell:	
Production licence 018, "Phillips group":	50 %
Production licence 011, A/S Norsk Shell:	50 %
Tor:	
Production licence 018, "Phillips group":	75.3612 %
Production licence 006, "Amoco group":	24.6388 %

Production licence 006 ("Amoco group")

Concession holders:

Amoco Norway Oil Company A/S	28.33 %
Amerada Petroleum Corporation of Norway	28.33 %
Texas Eastern Norway Inc	28.33 %
Norwegian Oil Consortium A/S & Co	15.00 %

Thus, the Ekofisk area consists of seven fields: Ekofisk, West Ekofisk, Cod, Tor, Eldfisk, Edda and Albuskjell. The first of these, Cod, was discovered in 1968. In 1969, the Ekofisk field was found, and as early as 1970, the field was declared commercial. In the period from 1969-72, the other fields in the area were discovered. Phillips operates all seven fields.

Development took place in four phases:

Phase 1: Test production on the Ekofisk field from four wells completed on the seabed. This phase lasted from June 1971 to May 1974.

Phase 2: Development of the platforms on Ekofisk.

Phase 3: Development and tying in of the fields West Ekofisk, Cod and Tor to the Ekofisk Center, together with the laying of an oil pipeline to Teesside and a gas line to Emden. The lines were taken into operation in October 1975 and September 1977 respectively.

Phase 4: Development and tying in of the Eldfisk, Edda and Albuskjell fields to the Ekofisk Center.

A fifth phase, consisting of the installation of a new platform for injection of water into the Ekofisk field, was resolved in 1983. This is discussed below.

Figure 2.3.2.b gives a bird's eye view of the installations in the Ekofisk area.

Transport

Oil and gas from the Ekofisk area are brought ashore via pipelines to Teesside in England and Emden in West Germany, respectively.

The oil line to Teesside is 354 km long and has a diameter of 864 mm. The average flow rate through it in 1983 was 42,597 Sm3 oil and 3,577 tons NGL per day. The gas line to Emden is 442 km long and 915 mm in diameter. During 1983, the average amount of gas transported through it per day was 35 million Sm3.

Waterflood project

The Norwegian Petroleum Directorate and licensees alike have for several years been heavily preoccupied with the possibility of increasing recovery from the Ekofisk field by water injection. The Norwegian Petroleum Directorate therefore views it as highly positive that the waterflood project was decided in 1983 to be realized, and it is desirable to describe the project in some detail here.

Despite water injection being a well established method for increasing oil recovery in other types of reservoirs, there have been great uncertainties attached to the possibility of successful water injection on Ekofisk. The reason is that there is absolutely no experience from similar fields to build upon. It has also turned out to be necessary to collect experience from a long production history to be able to foresee the behaviour of the chalk reservoirs in the Ekofisk area. Collection and analysis of data has therefore been extremely time consuming.

The reservoir

The reservoir rock on the Ekofisk field consists of chalk with small pores. The oil prone layers are up to 350 meters thick. The reservoirs in the field are associated with two formations: the Tor formation underneath, and the Ekofisk formation on top. Between the formations there is a tight zone resulting from a higher clay content in the rock. The tight zone will wholly or substantially prevent fluids from flowing from one reservoir to another. It is a characteristic of chalk reservoirs that the rock types permit little through-flow. In large parts of the reservoir there is nevertheless a net of small fractures which contribute to increasing the flow rates considerably. The best reservoir properties in the Ekofisk field are found in the top of the Tor formation, and it is first and foremost this part which will be the target for waterflooding in the existing plans. The Ekofisk reservoir originally contained oil with dissolved gases. The field has been in production since 1971, however, and the pressure has therefore fallen off, causing the pore and fracture network in the chalk now to contain oil with free gas. Moreover, a considerable amount of gas has been injected at the top of the Ekofisk formation, so that the gas concentration here is particularly large. Gas injection has contributed substantially to increasing recovery.

Effect of waterflooding

In other reservoirs water injection works by pushing out the oil from behind. In Ekofisk it is assumed that the water will first fill the crack system and be absorbed into the reservoir rock, from which the oil will be pressed out into the fracture system and will flow towards the production wells. Many experts feared originally however that the water might flow through the fracture web without pressing out oil. Therefore, a program was planned for analysing the effect of water injection by extensive laboratory trials on rock samples. Phillips also performed comprehensive computer simulation studies to compute the effect of water injection on the field. Moreover, the licensees wanted to test water injection in a pilot project. For this purpose, a water injection well was drilled from 2/4-B and equipment for injection was installed on that platform.

The objective of the project was to examine what injection rate could be maintained in the tight chalk, how the water percoluted through the rock, and what effect the water had on production in neighbouring wells.

Injection started in March 1981 and was still continuing at year-end 1983. Injection has only been made into the Tor formation. To be able to analyse the result of injection, regular production tests were made in six neighbouring wells. In addition, the operator made a separate detailed simulation model for the test area. It was particularly interesting to see if the water followed the fracture web, appearing quite soon in the closest production wells. In fact this did not happen. It took more than one year before the water penetrated through to the first production well, and over two years before it reached the next. Experience from the pilot project regarding the efficiency of water injection is therefore favourable. It has been demonstrated that high rates of injection, above those planned for the main project, can be sustained over long periods.

The water does not only flow through the fracture system, as some people feared, but is absorbed into the rock and displaces some of the oil and will thus increase oil recovery.

Nevertheless, some uncertainty attaches to how far the results of the pilot project can be transferred to other parts of the reservoir.

Development plan

Based on the results of the existing studies, a project was planned in 1982 which involves the waterflooding of the Tor formation and the lower part of the Ekofisk formation. Using a water injection platform tied to the 2/4-B installation, it was calculated that one could reach 70 % of the area of the reservoir with injection wells. By injecting into the Tor formation and lower part of the Ekofisk formation, one could therefore cover 35-40 % of the reservoir volume. The plans involve further that injection can start in mid-1987. Planned injection and production patterns are shown in outline in Figure 2.3.2.c.

The new platform, 2/4-K, is planned as an integrated steel structure whose main functions are drilling, water injection and water treatment. The platform will also have an accommodation block, flareboom and helideck. There will be a bridge connection to 2/4-B

(see Figure 2.3.2.b).

The project will also require there to be implemented a partial modification of existing platforms. These include the installation of a water separator and gas lift equipment on 2/4-B and 2/4-C. Delivery of gas to the latter will take place with the aid of an existing compressor on 2/4-C. Further plans call for three production wells, to be drilled from 2/4-C.

If it becomes necessary to have a treatment facility for sour oil (hydrogen sulphide), this will be installed on 2/4-FTP.

In all, the necessary installations and modifications calculated will require investments of almost NOK 9 billion (fixed 1983-prices). The investments are distributed over some 10 years from 1983 inclusive, with the main bulk up to 1987.

The prime features of the work schedule for the project are as follows:

Drilling of nine injection wells from a drilling vessel will start in the second quarter 1984 and continue until the beginning of 1986.

The contracts for construction of the platform base and deck will be entered into in mid-1984, with a subsequent construction phase up to the first quarter of 1986.

Tow out of the platform will occur in the second quarter 1986, and completion work on the field will continue until the second quarter 1987.

Clarification of the previously drilled wells can start in the beginning of 1987, so that water injection can start between the first two wells in the middle of 1987.

Further drilling of a total of 20 injection wells will continue until 1991.

Additional production

In addition to Phillips, also Petrofina, Agip and the Petronord group have prepared their own reservoir studies with simulations to calculated the effect of water injection.

After the injection plan was ready in 1982, calculations of the gain using water injection according to this plan were made with all four simulation models. The models are based in part on different assumptions regarding reservoir conditions. Among other things, there are different opinions as to the possibility of flow between the geological formations. The four simulation models therefore provided rather different results.

To reach a more complete understanding, the companies decided jointly with the Norwegian Petroleum Directorate to give an independent consultant firm (Franlab Consultant) the task of evaluating the technical reservoir aspects of the project. On the basis of the already existing studies, Franlab produced figures for the most probable extra production which, converted to sales figures, correspond to approx 27 million toe. This is equivalent to more than

three times the annual Norwegian consumption of petroleum products and can provide a gross production value of over NOK-1983 50 billion.

In the discussions with the authorities prior to the decision to go ahead, the licensees emphasized that there are great uncertainties attached to the additional production. These largely result from the there still being conditions and mechanisms down in the reservoir which are not well enough understood. In its economic evaluation, the Phillips group assumed as a basis that 90 % of Franlab's estimate would be realized. The Norwegian Petroleum Directorate considers Franlabs figures to be the most probable.

Even though there were still uncertainties connected to the production bonus of the water injection project in 1983, in the Norwegian Petroleum Directorate's opinion it was important to make the decision to complete the project. This was both because the effect of water flooding declines with time, and because substantially better information cannot probably be obtained before project start.

If the waterflood project had not been resolved in 1983, there is much to indicate that it would never have materialized, and there was therefore the possibility that enormous assets could have been lost.

A more detailed exposition of the waterflood project on Ekofisk is given in Storting Report no. 18 (1983-84).

Flaring of gas in the Ekofisk area

During Phase I of the Ekofisk development from 1971 to 1974, test production was performed with a loading platform, and all gas was flared. Since 1977, the gas has been landed and sold through the Emden gas line, with surplus gas being injected into the Ekofisk field. Since the line to Emden was taken into use, the amounts of gas flared have decreased significantly. Gas flared in 1983 on the Ekofisk area was an average of 0.13 million Sm3 per day, and corresponded to 0.3 % of the total gas production from the fields. The year 1983 has demonstrated that the flare rate is stable and satisfactorily low. The amount of gas flared is shown in Figure 2.3.2.d.

The metering system

Continual inspections of the metering systems in the Ekofisk area are performed.

Inspections of the metering systems at the point of sale for the gas in Emden have taken place at monthly intervals.

A routine inspection arrangement for the metering system for oil and wet gas at Teesside has been initiated.

Costs

The total costs on the Ekofisk area including Tor, Albuskjell and Norpipe are predicted to amount to about NOK 44.9 billion in current kroner, or NOK 74.4 billion in fixed 1983 kroner (for conversion, see Valhall).

Safety and the working environment

Pipeline

The preparatory work for replacment of the damaged riser pipe on the Ekofisk-Emden pipeline (incoming riser on B-11) has started. Replacement is planned for August 1984.

Fire: gas compressors (2/4T)

During this report period, too, there have been cases of fire in connection with compressor shaft packing systems. It has been decided to rebuild both these systems. Design and construction have been initiated, but thorough trials will be necessary before the packing system is allowed to be installed.

Pilot project for waterflooding (2/4B)

Air filters for power turbines for the water injection pumps have not been good enough. Fine mud and cement dust has passed the filters and accumulated on the compressor and turbine blades. This has caused complete breakdown with extensive repair work. Better filters will be installed.

Use of personnel basket in connection with shift change on "Seaway Falcon"

"Seaway Falcon" is a diving vessel on contract with Phillips Petroleum Company Norway. Since August 1981 it has been engaged in inspection work on Ekofisk. Crew changes are made of 25 people each eight days, and because the vessel is not equipped with a helideck, the crew is transported to a fixed installation on the field, where transfer takes place using a personnel basket.

This transfer has long been a cause for concern in the Norwegian Petroleum Directorate as well as the interested organizations affected. Present regulations include provisions stating that a personnel basket shall only be used for transfer of personnel in emergencies. It is therefore claimed that the diving vessel must go to port to shift the crew, an arrangement which, if implemented, would cause great difficulty for accomplishment of diving operations and inspection programs.

Following careful consideration of possible alternative solutions and the safety aspects, the Norwegian Petroleum Directorate decided that, with the consent of the "Seaway Falcon" crew, it could accept the use of a personnel basket for transfers to and from the ship.

Demanning of pump station 36/22 A to Teesside

In connection with the laying of the pipeline from Ekofisk 2/4-P to Teesside in England, two pump stations were installed in 1975, each on the UK shelf.

However, the operating company soon realized that the total pump capacity was much more than necessary, and that the transport capacity could be maintained without the one station 36/22 A.

It was therefore planned to de-man the installation, and the project was accomplished in the autumn 1983. The Norwegian Petroleum Directorate's use permit for the accommodation quarters was therefore withdrawn.

In terms of preparedness, the platform is equipped with power sources for approx one year's operation and is not considered to represent any hazard to navigation.

New accommodation quarters

The work of replacing accommodation quarters on Ekofisk has continued in 1983 with the installation of a further three modules. Five of a total of seven production facilities have now been equipped with new accommodation modules with a bed capacity which varies from 96 to 112. The last two facilities will have new accommodation modules installed in 1984. (Reference is made to the Norwegian Petroleum Directorate's Annual Report for 1982 as regards the reason for the replacement).

Jurisdiction over pump platforms on Teesside pipeline

The oil pipeline with associated pump platform is, as is known, subject to Norwegian jurisdiction and law.

However, in 1982 Great Britain passed its Oil and Gas (Enterprise) Act. The act came into force in November 1982 and was made applicable for all fixed installations on the UK shelf, including the booster platforms on the oil pipeline. This means that UK legislation is also applicable on the facilities.

The application of both Norwegian and UK law on these installations has brought about practical problems for the owner, Norpipe, and the operating company. During 1983, there took place several meetings between the affected parties to review the UK codes.

The matter was discussed by the Ekofisk-Teesside Commission, and a special group with members from the UK and Norwegian authorities has now been appointed to harmonize the relevant regulations which have been brought to bear on the installations, and lay the groundwork for their practical follow-up. The first meeting of the group is scheduled for January 1984.

2.3.3. Ula

Production licence 019 A
Concession holders:

BP Petroleum Development of Norway A/S	57.5 %
K/S Pelican A/S	5.0 %
Norsk Conoco A/S	10.0 %
Den norske stats oljeselskap a.s	12.5 %
Svenska Petroleum Exploration A/S	15.0 %

Conoco has transferred 60 % of its previous owner shares to Svenska Petroleum Exploration A/S.

The field lies in Block 7/12 some 70 km northwest of Ekofisk. It was discovered in 1976 and declared commercial in December 1979. Statoil acceded the declaration in September 1980. BP is the operator for the production licence.

The concession holders decided in December 1982 to go ahead with the project.

Development

The concept forming the basis of the development includes three conventional steel platforms (Figure 2.3.3) for production, drilling and accommodation, respectively. Nine production wells and six water injection wells are planned. Drilling start is anticipated in the second half of 1986, with production start in the first half of 1987.

Recovery of reserves

The Norwegian Petroleum Directorate's estimate for recoverable reserves is 30 million Sm3 oil, 1.3 million tons NGL and 2 billion Sm3 gas.

The field will be produced with pressure support from water injection. A relatively high plateau production is planned, and the annual extraction in per cent of recoverable reserves is among the highest planned on the Norwegian continental shelf. Nevertheless, the Norwegian Petroleum Directorate does not expect that this will reduce the recovery factor on the field.

Transport

The licensees have agreed on the transport of oil through a pipeline via the Ekofisk center to Teesside. Statoil shall finance and be the operator for the pipeline.

The gas will be transported by pipeline to Cod and from there via the pipeline system to Emden.

Metering system

The operator's first draft for the design of the oil and gas metering stations is under way.

Costs

Total costs are expected to be some NOK 9.8 billion (current value), or NOK 8.0 billion in fixed 1983 kroner.

2.3.4 Heimdal

Production licence 036

Concession holders:

Den norske stats oljeselskap a.s	40.000 %
Marathon Petroleum Norge A/S	23.798 %
Elf Aquitaine Norge A/S	9.639 %
Bow Valley Exploration Norge A/S	8.000 %
Norsk Hydro Produksjon A/S	6.228 %
Total Marine Norsk A/S	4.820 %
Sunningdale Norge A/S	3.875 %
Saga Petroleum a/s	3.471 %
A/S Ugland Construction Company A/S	0.169 %

Production licence 036 was allocated in 1971 and covers Block 25/4, which is situated some 215 km northwest of Stavanger. On that part of the concession which includes Heimdal, the state has received a 40 per cent interest. Elf Aquitaine Norge A/S is the Heimdal operator.

The field was discovered in 1972 by the drilling of Well 25/4-1, and was declared commercially viable in April 1974. The commerciality declaration was withdrawn in 1976 due to low prices on gas.

During 1980, the gas marked altered and Heimdal became the centre of discussion regarding a landing solution for Statfjord gas. The landing application for gas to the continent was submitted in January 1981 and approved by the Norwegian Storting on 10 June 1981.

Development

The reservoir lies some 2100 metres below sea level in Paleocenic sand. The total recoverable reserves are estimated at 34 billion Sm3 gas and 3 million Sm3 oil. It has been decided to develop the Heimdal field with an integral steel platform, comprising drilling, production and accommodation functions (Figure 2.3.4). The installation work on the field will start in the summer of 1984, while production is expected to begin in the summer of 1986.

Transport

Gas from the Heimdal field will be transported via Statpipe, and the pipeline from Heimdal will be tied in to the Statpipe system at Riser Platform 1. The condensate will be carried by a separate pipeline to the Brae field in the British sector, and from there to Cruden Bay via the Brae-Forties system.

The metering system

Design controls and the testing of parts of the metering stations for gas and condensate have been performed by the manufacturer in collaboration with the British Department of Energy.

Costs

The total costs are estimated to amount to about NOK 8.7 billion (current value), or NOK 8.6 billion in fixed 1983 kroner.

2.3.5 The Frigg area (Frigg, North East Frigg, Odin)

2.3.5.1 Frigg

Concession holders:

Norwegian share (60.82 %) (production licence 024)	
Elf Aquitaine Norge A/S	25.19 %
Norsk Hydro A/S	19.99 %
Total Marine A/S	12.60 %
Den norske stats oljeselskap a.s	3.04 %
British share (39.18 %)	
Elf Aquitaine UK Ltd	25.97 %
Total Oil Marine Ltd	12.98 %
BP Ltd	0.23 %

Elf Aquitaine Norge A/S is the operator for the Frigg field, while Total Oil Marine Ltd is the operator for the pipeline system and St Fergus terminal in Scotland.

The Frigg field lies in Block 25/1 on the Norwegian continental shelf and Blocks 10/1 and 9/5 on the British shelf (Figure 2.3.5.a). The field has been unitized. Of the gas reserves, the agreement assumes that 60.82 per cent belong to the Norwegian concession holders, and the remaining 39.18 per cent to the British concessionaires. The agreement on distribution of the reserves may be renegotiated every four years, the first time on 1 January 1985, or at any time if extra reserves are proven which seem to be connected to the Frigg reservoir. In 1982, the British group and BP agreed that 0.588 per cent of the British Frigg reserves lie in Block 9/5, which is wholly owned by BP. The BP interests in the Frigg field are looked after by Total Oil Marine.

The production system

The Frigg field was discovered in the spring of 1971 and declared commercial on 25 April 1972. The field has been developed in three phases. Phase 1 consisted of one production and one treatment platform on the British side of the field and an accommodation platform (CDP1, TP1 and QP). Production from Phase 1 started on 13 September 1977.

Phase 2 consisted of one production and one treatment platform on the Norwegian side of the field (DP2 and TCP2). Production from the Phase 2 platforms started in the summer of 1978. Figure 2.3.5.b depicts the Frigg installations.

Phase 3 of the development included the installation of three turbine driven compressors of 38,000 horsepower on Platform TCP2. The booster facility is necessary to compensate for the reduced reservoir pressure. The facility started operation in the autumn of 1981.

Gas from North East Frigg and Odin will be treated and metred at Frigg. New modules for treatment of the gas and condensate from these fields have been installed on TCP2. The operating licence was given on 18 November 1983.

Transport

The gas is transported to St Fergus in Scotland by two 813 mm pipelines. To increase the capacity of the transport system, two 38,000 horsepower turbo-compressors have been installed on the pump platform MCP-01, which lies midway between Frigg and Scotland. The increase in capacity is necessary to be able to transport the gas from the Odin field. For the same reason, an extension to the St Fergus terminal has been made, to give six process lines rather than five. The sale of Odin gas began in October 1983, with pre-delivery from the Frigg field.

Recovery of reserves

The oil-water and gas-oil contacts on the Frigg field are checked several times a year. Logging (TDT) of Observation Well 25/1-A22 was carried out in September 1983 to check the movement in the liquid contacts. The observation well has been sited in a part of the reservoir where there is a good deal of shale in the sand. The shale content will make it difficult to follow the movements in liquid contact for several years to come. New measurements will be performed in 1984.

The pressure has been higher than expected in both the Frigg and Cod sand. This may perhaps be due to the extremely low summer deliveries, increased water thrust or greater amounts of gas reserves in place.

Metering systems

Inspections of the metering systems on Frigg and MCP-01 were performed according to a fixed inspection arrangement in collaboration with the British Department of Energy.

Testing of new computers for metering systems on Frigg were performed in collaboration with the same Department of Energy.

Costs

The total costs for the development of Frigg are predicted to amount to about NOK 21.2 billion in current kroner, or 39.9 billion fixed 1983 kroner. Included in the estimate, apart from the field installations themselves, are: the pipelines to St Fergus, compressor platform, terminal and new equipment on TCP2 to receive gas from Odin and North East Frigg. The Norwegian share of the investments will amount to NOK 13.3 billion in current kroner, or 24.0 billion fixed 1983 kroner.

Safety and the working environment

Loadbearing structures

Extensive submarine repairs and reinforcement of conductor pipe frameworks on the Frigg field's DP2 platform were successfully carried out in 1983.

Pipeline

During the autumn of 1983, equipment for the surveillance of ice formation about pipelines in operation at low temperatures was installed on the Frigg - St Fergus pipeline.

Condensate level regulation tank

During a normal routine inspection, a lack of fusion of the welds was found in the CV3 condensate level regulation tank (Condensate Surge Tank). The tank has been in use since the start up of TCP2, without the fault having previously been registered. Improved control procedures are presumed to be the reason for the uncovering of the fault.

Extensive repairs to the tanks were carried out on the field. After new inspections and pressure trials, the tanks have again been put into operation.

It is presumed that all faults in the pressure vessels on the field have been registered and repaired.

Flare systems

Several surrounding fields (North East Frigg, Odin and Alwyn) are tied into or are planned to be tied into the Frigg field. Elf Aquitaine Norge has therefore made a survey of existing flare systems. The results of this uncovered, among other things, a need to look more closely at capacities, temperatures and reliability. On the basis of this, Elf Aqitaine has launched new methods for protecting the sales gas header against excess pressure, thereby reducing the number of safety valves and the amount of gas to the flare. It has been suggested on safety grounds that the traditional safety valves be replaced with advanced, computer-based instrumentation systems. The matter is still being dealt with by the Norwegian Petroleum Directorate.

Radiation accident with radioactive isotopes

In connection with the repair of a fire line to the helideck on DP-2, photographs were taken of the welding seams with a 1.8 Curie source.

It was assumed that the area had been blocked off in a regulation manner (warning lights and signs, etc).

It was found, however, that within the exposure area, there was an office containing two persons. The distance from the source to the office was 8 metres. Exposure time was 5 minutes.

To calculate the radiation dose to the two persons in the office, a new "shot" was undertaken. Exposure outside the door was measured at 1-1.5 mR/h, while inside the office, it was measured at 0.8 mR/h. The radiation dose therefore did not present any serious health risk for the workers.

The operating company was ordered to make a review of existing procedures to prevent the occurrence of any similar accidents in the future.

2.3.5.2 North East Frigg

Production licence 024 (Block 25/1)
Concession holders:

Elf Aquitaine Norge A/S	41.42 %
Norsk Hydro A/S	32.87 %
Total Marine Norsk A/S	20.71 %
Den norske stats oljeselskap a.s	5.00 %

Production licence 030 (Block 30/10)
Concession holders:

Esso Exploration & Production Norway Inc	100 %

Statoil is entitled to 17.5 per cent of the net surplus before tax.

The North East Frigg field lies in Blocks 25/1 and 30/10, and the gas reserves are distributed with 60 and 40 per cent respectively on each of the blocks. Elf Aquitaine Norge A/S is the development operator.

Production facilities

The North East Frigg gas field was proven in 1974. This is a part of the same pressure system as the Frigg field. The final development plan was resolved in 1980. The field was developed with six wells completed on the seabed. These were drilled through a template placed on the bottom. In addition to the well heads and christmas trees, there is also a manifold to collect the gas from the six wells. The gas is transferred to the Frigg field for processing through a 406 mm pipeline. Each of the six valve trees will be controlled through separate service and control lines from the control station (an articulated column) located 150 meters from the well heads. The control station was installed in July 1983 and will be remotely controlled from the Frigg field. The tow-out and hook-up between the control station and the concrete base were performed in June 1983. The construction work was completed and production started on 8 December 1983.

Sales of gas from North East Frigg initiated on 1 October 1981, i.e. before any of the production wells had been drilled. This was possible because the Frigg field supplied gas on behalf of North East Frigg until this latter came on stream. Frigg will similarly supply gas on behalf of North East Frigg after production there has terminated. The "reimbursment" assumes an arrangement whereby North East Frigg, during its short production life, supplies gas on behalf of Frigg in addition

to the North East Frigg contract amount. Thus, a more normal, long-term sales profile is achieved for the gas from North East Frigg, even though its production life is short.

Metering systems

Testing of the metering system was performed in collaboration with the British Department of Energy.

Costs

The total costs are expected to reach some NOK 1.9 billion in current kroner, or 2.0 billion in fixed 1983 kroner.

Safety and the working environment

The operating licence for the first subsea production system on the Norwegian continental shelf (North East Frigg) was granted on 2 December 1983.

Start-up has proceeded without problems of major importance. Packing surfaces for the hook-up of a christmas tree had been damaged. The damage was repaired under water with the help of a newly developed technique.

2.3.5.3 Odin

Production licence 030
Concession holder
Esso Exploration & Production Norway Inc 100 %

Statoil is entitled to 17.5 per cent of the net profit before tax.

The Odin field lies in Block 30/10, with development operated by Esso.

Production facilities

The Odin gas field was proven in 1974, and the development plan approved in 1980. The development option chosen consists of a steel base platform with four legs and integral deck. The drilling rig Treasure Supporter was rebuilt and used as a utility platform during development and production drilling, Figure 2.3.5.d.

All modules for the platform were completely constructed before the summer of 1982, and the steel base was positioned on the field on 4 July of the same year. Hook-up work ran ahead of schedule, such that the platform was completely hooked up as early as 1983. Permission to commence production drilling was given on 2 December 1983 and Esso began production drilling immediately. Production start is now scheduled for early 1984.

The production platform may be provided with treatment plant, though only to a limited extent as the gas will be dispatched unprocessed to the Frigg field through a 508 mm line. This pipeline had been laid and tied in to the TCP2 platform on Frigg by August 1982.

Metering systems

Testing of the metering systems on Odin has been performed in collaboration with the British Department of Energy.

Costs

The total costs are expected to hit some NOK 3.0 billion (current value), or, in fixed-1983 values, NOK 3.0 billion (for conversion details, see Valhall). A mobile facility will be used as a production installation.

Application of the rules. With Storting Proposition No. 87 (1979-80) concerning Landing from the Odin Field among others, the Storting was informed of the plans for field development and principle approval on safety grounds of the development solution in the landing application presented by Esso. The development plan was resolved in 1980.

The development concept consists of a fixed pile installation Odin A, and the semi-submersible, Norwegian registered rig "Treasure Hunter", which shall function as a utility facility (TSV) in the construction and drilling phase up until autumn 1985. The TSV incorporates integrated parts of the drilling, hotel and workshop/ storage functions on the Odin field, and is connected with Odin A by a permanent gangway.

The two separate facilities are considered by the authorities to be an integrated whole on which the individual functions of each unit must be evaluated in context with each other.

The safety and working environment factors have therefore in principle been evaluated as a whole as regards the development solution.

As regards the application of the Continental Shelf Act of 1963 and King's Resolution of 9 July 1976 concerning Safety for Production, the Odin concept is defined in its entirety as a production installation, cf. the Resolution of 1976, § 2, first paragraph and § 1, Literas d, e, f, g and h. When a facility registered under the Norwegian flag, the TSV, is used in the development plan, the TSV is then in principle covered by the requirements set by the 1976 Resolution, and by established practices for dealing with hotel facilities pursuant to the resolution. Procedures for control and approval by the authorities, and the duty of the operating company to perform internal control, are therefore applied in their entirety to the Odin concept and in the same way as on other production installations. As the TSV is Norwegian registered and therefore comes under the jurisdiction of the Maritime Directorate's certification arrangement according to the Seaworthiness Act, certificates issued by the Maritime Directorate have been evaluated on the same basis as other certificates or documentation presented by the operating company, so that requirements made pursuant to continental shelf legislation have been met.

As regards the Working Environment Act's application to the Odin concept, this Act's sphere of application is more closely defined in § 2 Points 2 and 3, cf. King's Resolution of 1 June 1979 §§ 1 and 2. Exceptions to the Act have been made for Norwegian and foreign mobile drilling facilities. In the Resolution's § 2, 3rd subsection, the Act

is further limited to include employees who work on fixed installations, i.e. those so-called hotel guests who stay on a flotel in their off-duty time.

It follows from the preparatory work for the Act that the Act's sphere of activity was to be limited, such that the Working Environment Act was to apply primarily to stationary activities. Maritime legislation was to take care of working hours and the safety side as suitable for an activity constantly on the move and/ or when the facility was underway from one destination to another.

On the basis of the fact that both Odin facilities are included as an integrated part of the development concept and are of a stationary nature with necessary production functions which must be evaluated in their proper context, the authorities have concluded that the Working Environment Act is applicable to the Odin concept, i.e. Odin A and the TSV. In this evaluation, the authorities have placed emphasis on the fact that the project is subject to a collective evaluation and control of safety and the working environment. No basis has therefore been found for differentiating between groups of employees according to their function on the production installation or whether they work on Odin or the TSV. Working hours, working environment conditions and protection of contract therefore follow from the Working Environment Act's provisions for all groups engaged on the Odin field, with the Norwegian Petroleum Directorate as the control body. In addition, however, Norwegian flag legislation is applicable to the extent conditions in this legislation are not regulated by either continental shelf or working environment legislation.

2.3.6. Gullfaks

Production licence 050

Concession holders:

Den norske stats oljeselskap a.s	85 %
Norsk Hydro Production A/S	9 %
Saga Petroleum a.s	6 %

Statoil is the operator. Esso was the technical assistant during the exploratory phase. Conoco has been engaged as technical assistant for the development phase.

Production facilities

The first find on the block was made in 1978. On 10 June 1981, the development plan for Gullfaks Delta East was dealt with by the Norwegian Storting and the Government was given authority to approve the first phase of the development, following approval of the development plan by the Norwegian Petroleum Directorate and the Ministry of Petroleum and Energy.

Phase I will consist of two platforms (Figure 2.3.6). Platform A will be an intergrated drilling, treatment and accommodation platform with a capacity of about 39,000 Sm3 per day. The platform will be located on the southwest part of the structure in about 135 meters of water. The platform base will be a concrete construction with a T-shaped deck frame of steel.

Platform B will be a drilling, accommodation and water injection structure with a concrete base, equipped with some process machinery. The B platform will be sited on the northwest part of the Delta East structure where the water is also about 135 metres deep.

Oil from the field will be transported through a pipeline system via Oseberg to Norway. As a reserve loading system for the pipeline, a loading buoy has been tied in to the A platform. This has oil storage in the bottom section. The previously passed resolution was to transfer the oil with the help of two loading buoys on the field over into oil tankers. The new pipe system has been planned such that other fields may be connected up in the future.

The gas from the field will be transported through the Statpipe system via the Statfjord C platform.

The construction of the concrete base for the A platform started in 1983, and the majority of the design and hook-up contracts were assigned during the same year.

The operator expects the A platform to be ready for production by 1 July 1987, while Platform B is scheduled to come on stream some two years after that.

Recovery of reserves

The field lies in the northeastern part of Block 34/10 and covers an area about 200 square kilometers in size. The proven reserves all lie within the block. Figure 2.3.7.a shows where the field is situated in the Statfjord area.

The Delta structure is a relatively shallow-lying field, divided by north-south faults into several upturned and rotated segments of Jurassic strata. The segments, or blocks, vary in their degree of upturn, though all point westward. In the east, the field has a more diffuse structure, the area being highly segregated by faults and in places heavily eroded. The structural details of the eastern part are more difficult to plot due to poor seismic data. The field is bounded in the south, east and northeast by faults with vertical displacements exceeding 100 meters. Gullfaks is definitely the most geologically complex field so far dealt with in the context of developments on the Norwegian continental shelf.

The Norwegian Petroleum Directorate's reserves estimate from 1981 shows recoverable reserves of 93 million Sm3 oil and NGL and 6 billion Sm3 gas. These figures will be adjusted when the results from the latest drillings have been looked at more closely.

Oil has been proven with little dissolved gas in three Jurassic formations: Brent, Cook and Statfjord. In the eastern part of the field, there is an additional oil find in Triassic strata. The reservoir rocks are rather similar to the Statfjord and Murchison ones, i.e. sandstone of high permeability and relatively high porosity. Under the oil, there exists a water zone of variable volume, which is not, however, large enough to maintain the pressure in the reservoir as oil is removed. It will therefore be necessary to inject water right from the start of production. Also gas injection has been evaluated as a method of extraction. However, this would give a less favourable result than water injection.

Metering system

Function tests of the metering systems for oil and gas have been carried out by the manufacturer. The standard loop for the proofing of turbine metering units for oil has been calibrated.

Costs

The total costs are expected to run to about NOK 39.7 billion at current kroner, or approx NOK 25 billion in fixed 1983-prices. Consideration has not been given to the consequences which would follow as a result of a tie-in to any new oil transport pipe system.

Safety and the working environment

To undertake safety control of the deck installations on Gullfaks A, an internal project group was appointed in the Safety Control Department. The group's main efforts have been focused in this project on quality assurance in accordance with the Norwegian Standard NS 5801, which Statoil has introduced into the project. Statoil seems to have won through with its philosophy as regards the engineering industry, both at home and abroad, something the Norwegian Petroleum Directorate feels is positive.

The organization of a group with experience in most areas of knowledge has proven to be an effective method of operating the control activity. This internal co-ordination of activities in the Norwegian Petroleum Directorate ensures the co-ordination of safety control with that of the operating companies, such that unnecessary double control is avoided to a greater extent than before.

This model is also being tried on other fields.

2.3.7 The Statfjord area

The Statfjord area includes the Statfjord field, Fields 33/9 Alfa, 33/9 Beta and 33/9 Delta.

Concession holders:

Norwegian share (84.09322 %) (production licence 037)	
Mobil Development of Norway A/S	12.61400 %
Den norske stats oljeselskap a.s	42.04661 %
Norske Conoco A/S	8.40932 %
Esso Exploration and Production Norway A/S	8.40932 %
A/S Norske Shell	8.40932 %
Saga Petroleum a/s	1.57674 %
Amoco Norway Oil Company A/S	0.87597 %
Amerada Hess Norwegian Exploration A/S	0.87597 %
Texas Eastern Norway Inc	0.87597 %

British share (15.90678 %)

Conoco North Sea Inc	5.30226 %
Britoil Ltd	5.30226 %
Gulf Oil Corporation	2.65113 %
Gulf UK Offshore Investments Ltd	2.65113 %

On 10 August 1973, the concession holders on the Statfjord field were allocated production licence 037. This includes Blocks 33/9 and 33/12. Mobil is the operator (Figure 2.3.7.a). The only field so far resolved for development is Statfjord.

The Statfjord field itself was discovered in the spring of 1974, and declared commercial the same year. Statfjord extends into Field 211 on the British side, where Conoco is the operator. The initial field development reports were submitted to the authorities in the spring of 1976. Since then, several development reports have been presented. It has been resolved that the field shall be developed in three phases with fully integrated platforms: A, B, and C (Figure 2.3.7.b). The Statfjord A platform is centrally located on the field, the B platform stands to the south of it, and the C will be sited to the north.

The total quantities of oil and gas in place in the field were originally estimated by the concession holders to 1033 million Sm3 and 180 billion Sm3 respectively. Later calculations performed by the Norwegian Petroleum Directorate showed 811 million Sm3 oil and 142 billion Sm3 gas. By injecting water into the Brent reservoir and gas into the Statfjord reservoir, one expects to attain a recovery factor of some 50 per cent. This means that the total recoverable amounts of oil are 405 million Sm3, including the British share. The amount of recoverable associated gas has been estimated at 50 billion Sm3 dry gas, and 12 million tons of NGL. The proportioning of the reserves in the field, as approved by the authorities in 1979, assigns 15.9068 per cent to the British side, and 84.0932 per cent to the Norwegian. The reserves may be the subject of re-proportionment at intervals of a few years, next time as of 1 January 1986. One of the two concession holding groups must request re-proportionment by 1 May 1985 if the option is to be effective.

Production facilities

Statfjord A

The Statfjord A platform is located at the center of the field, and comprises three columns and 14 cells, all of concrete. The deck is of steel. The rated production capacity is 47,600 Sm3 per day. The platform started production on 24 November 1979 and will undertake the operator's final drill program, consisting of 22 production and 15 injection wells.

Statfjord B

Statfjord B, sited as it is in the southern part of the field, consists of four columns and 24 cells, all in concrete. Its production capacity is 28,600 Sm3 per day. Production started on 5 November 1982, and its capacity is now being almost fully exploited.

The drilling program, which consists in all of 31 wells, will comprise 21 for oil production and 12 for injection.

Statfjord C

The third and final phase of the Statfjord field development is now being completed with the construction of the Statfjord C platform. This is being built as an integrated Condeep, with four columns and 24 cells of concrete, and a deck of steel. The equipment necessary to facilitate production and storage of oil, together with machinery for gas injection, dehydration and water injection, will all be provided. Statfjord C will boast 42 well openings, and will make it possible to tie in nine sea-bottom completion wells. According to the progress plan, the platform will be towed onto the field in June 1984, and production start is scheduled for December 1985.

Recovery of reserves

The drilling of wells in 1983 has provided valuable information on the reservoirs on the Statfjord field. On the basis of geophysical and geological interpretations, it was possible to hope for oil reserves in downthrust blocks on the east side of the field. After having drilled a few test wells in this area, it should probably be concluded that these more speculative reserves are smaller than estimated. By directional drilling of these easterly wells towards the main reservoir, good productivity was established, and the wells are now used as injection wells.

The gas injection installations on both A and B platforms have settled into normal operations. During 1983, 87.8 % of the gas produced has been put back into the Statfjord reservoir.

The injection of water into the Brent formation started in 1982 on the A platform.

Water is being produced from several wells on the Statfjord field. During 1983, however, water production from several wells has been greatly reduced. This is because the wells now produce higher up in the reservoir. At the same time, water breakthroughs in other wells have been registered. So far, water production has not led to limitations in oil production on the field.

The effect of injecting gas into the Statfjord field is still uncertain. If it turns out that gas drives out the oil efficiently, it would be appropriate, as far as resources are concerned, to continue injecting gas even after the gas line comes into operation.

Gas flaring in the Statfjord area

The amount of gas flared on Statfjord A in 1983 was some 0.35 million Sm3 per day on average, corresponding to 4.9 % of the total gas production from the platform. Statfjord A has entered a relatively stable operative phase, such that the amount of gas flared is well below the flaring permit of 0.50 million Sm3 per day. The main reason for flaring the gas has been because of compressor and instrumentation problems. Further, there was some flaring after the stimulation of the gas injection wells.

In the same period on Statfjord B, 0.36 million Sm3 per day, which corresponds to 9.1 % of the total gas production, was flared on average. The comment should be made that the platform entered its

start-up phase in the first few months of the year, and in such periods, a lot of gas is normally flared. The flaring permit was lowered step by step each month from 1.3 million Sm3 per day in January, until in April, it was 0.5 million Sm3 per day. The maximum flare amount was constant for the rest of 1983. Statfjord B reached a stable operative phase relatively quickly with very little gas flaring. In December, the average amount of flaring was 0.1 million Sm3 per day (Figure 2.3.7.c).

Metering system

The metering system for oil produced by Statfjord A and B is subject to monthly inspections. Further control and testing of the metering system for Statfjord C still remains. This will take place when the platform starts producing. The metering systems for gas from Statfjord B and C have been fully tested by the manufacturer. Similar factory tests for the metering system for gas from Statfjord A are soon to be performed.

The manufacturer has begun inspections of the gas metering systems which are to be supplied by Great Britain. Regulation and inspection are performed in collaboration with the British Department of Energy.

Costs

The total investment costs for the development of Statfjord are expected to run to some NOK 49.0 billion (current value), or NOK 51.4 billion (fixed 1983 kroner). The Norwegian share of this is NOK 41.2 billion, or NOK 43.2 billion, respectively. (For conversion, see Valhall).

Safety and the working environment

Loadbearing structures

During this year's inspections of loadbearing structures, extensive indications of fractures were found in the southern flare stack foundations on Statfjord A. An extensive work program has been started to repair the damage and to reinforce the structure.

Pipelines and risers

In connection with making ready for the export of gas from Statfjord, Mobil presented plans for using 20" riser pipes on Statfjord A.

The riser pipes are placed in the water-filled drilling shaft. The Norwegian Petroleum Directorate made it clear that a condition for the start-up permit was that a satisfactory inspection program was to be presented. It was found that the drilling shaft could not be emptied of water. Because of this, external inspections cannot be made in a dry shaft. Conductor pipes and conductor guides associated with them obstructed diving inspections as well as inspections with intelligent inspection devices (pigs).

Mobil was ordered to present alternative solutions to the inspection problem before permission to use the riser pipe could be evaluated.

The inspection program which has now been approved by the Norwegian Petroleum Directorate is based on the inspection of the riser pipe with the help of divers. A system for saturation diving will be built on the platform. To allow for diving inspections, a conductor pipe and some guideframe sections must be removed from the shaft.

In connection with gas pipelines connected with the Statfjord field, the Norwegian Petroleum Directorate has emphasized to the operating company Mobil, that the pipeline system is to be equipped with launching/ receiving facilities for internal control and maintenance equipment (pigs). Mobil has been advised that it must report on its plans for the development of equipment which will enable internal inspection of the pipeline system at Statfjord.

Cracks in christmas trees

During maintenance work on Statfjord A, fracture-like defects were discovered in a christmas tree. Further inspections resulted in similar defects being found in as many as 18 christmas trees. These have arisen because of faults in the casting (heat cracks and pores). On some trees, the defects were extensive, but none had propagated during operations.

The program and procedures for the repair work were prepared, and the repair work was three-quarters complete at the end of the reporting year. Investigation of similar christmas trees on Ekofisk was begun. These were made of a different material, however, and no faults were found.

Buoy loading at Statfjord

The extreme wind conditions in the North Sea at the beginning of the year proved that buoy loading on Statfjord can be maintained under more severe conditions than originally supposed. However, one hawser did break on the loading buoy for the B installation on 5 January 1983. Closer investigations resulted in the improvement of design details on the mooring arrangements.

The first investigations showed that there are good opportunities for further improving the mooring set-up. Further, the introduction of advanced positioning equipment on tank ships can further increase regularity, and at the same time raise the safety level. Statoil and Mobil have appointed a committee to consider which improvements may be of value. The Norwegian Petroleum Directorate participates as an observer on this committee.

Cranes on loading buoy

Cranes for use on the loading buoys for loading and unloading of supply ships on the Statfjord field have proved to be unsatisfactorily equipped.

The cranes have been designed with a too low hoisting speed. Further, it has not been possible to move the load in multiple directions to compensate for any sideways movements (swing). Even though the procedures for the operation of cranes state that they are only to be used in moderate weather conditions, the cranes have not functioned satisfactorily.

In 1983, the operating company therefore decided to modify and build new cranes for the loading and unloading of supply ships at the loading buoys. The new cranes have been constructed for a minimum hoist speed of 100 meters per minute and they have swingable crane booms (telescope arms).

It is expected that the new cranes will offer acceptable conditions in the loading and unloading of supply ships.

Gas transport, the Statpipe system

The pipeline company Statpipe was formed with the following concession holders:

Concession holders:

Den norske stats oljeselskap a.s	60 %
Elf Aquitaine Norge A/S	10 %
Norsk Hydro Produksjon A/S	8 %
Mobil Development Norway A/S	7 %
Esso Exploration and Production A/S	5 %
A/S Norske Shell	5 %
Total Marine Norsk A/S	3 %
Saga Petroleum a.s	2 %

Statoil is the operator for the building and operation of the system.

The transport system will include:

- a rich gas pipeline from Statfjord to Kårstø
- a separation and fractioning facility on Kårstø, including storage farm and loading facility
- pipelines from Heimdal and Kårstø to a riser platform in Block 16/11, and a pipeline to the riser platform at the Ekofisk Centre.

The work of laying the pipelines at sea started in the spring of 1983. The crossing of the Norwegian Trench, with the pipeline at its deepest point of 300 meters, was made without any great difficulties. At the end of the season in 1983, two-thirds of the total pipeline length of 840 km had been laid. Total progress for the project at the end of the year was going according to plan. In 1983, the two steel jackets for the riser installations were towed out and fixed permanently to the seabed with piles. The deck frames and equipment modules are under construction.

A map of Statpipe is shown in Figure 2.3.7.e indicating pipeline lengths.

The transport capacity from Statfjord to Kårstø is 9 billion Sm3 gas annually, and from Kårstø to the riser platform south of Heimdal, some 7 billion Sm3 per year. The pipelines between Heimdal and the riser platform, and between the two riser platforms, have been designed to transport maximums of 14 and 20 billion Sm3 per year, respectively.

This exceeds the capacity requirement for Statfjord, Gullfaks and Heimdal, and has been so designed to accommodate possible future tying-ins from other fields. If it is desired to increase the transport capacity of the Statpipe system, a booster platform will have to be built beside the riser platform in Block 16/11.

A framework agreement with Norpipe a/s and the Phillips group has been entered into concerning the use of the Ekofisk Centre and the pipeline to Emden, and with the terminal company in Emden. The concession holders on Statfjord, Heimdal and Gullfaks have also entered into sales agreements for the gas with buyers on the continent.

Metering systems

Design checks of the metering system for gas and condensate at Kårstø have begun. One factor in this connection is to ensure that all metering stations tied into this gas transport system are harmonized to the extent necessary.

Costs

The transport system is scheduled to be ready for operation in January 1986. Total investment costs, including the terminal installations, are expected to reach some NOK 20.3 billion at current kroner value.

2.3.8 Murchison

Concession holders:

British share (74.94 %)	
Conoco North Sea Inc	24.98 %
Britoil Ltd	24.98 %
Gulf Oil Corporation	12.49 %
Gulf Offshore Investment Ltd	12.49 %
Norwegian share (25.06 %) (production licence 037)	
Mobil Development of Norway A/S	3.16 %
Den norske stats oljeselskap a.s	10.45 %
Norske Conoco A/S	2.11 %
Esso Exploration and Production Norway A/S	2.11 %
A/S Norske Shell	2.11 %
Saga Petroleum a/s	0.40 %
Amoco Norway Oil Company A/S	0.22 %
Amerada Hess Norwegian Exploration A/S	0.22 %
Texas Eastern Norway Inc	0.22 %

The above concession holders are the same as on the Statfjord field. The Murchison field was discovered in August 1975. It lies in Block 211/19 on the British side and Block 33/9 on the Norwegian. Development of the Murchison field was started in 1976 by the British concession holders. The 037 group declared the field commercial in the summer of 1977, and Statoil acceded to the declaration in the summer of 1978. For the whole of 1983, re-distribution negotiations have been under way. The concession holders have reached agreement as to distribution and the calculation of reserves. British and Norwegian authorities have approved the new distribution of the Murchison field, which was 74.94 % to the British part, and 25.06 % to the Norwegian. This agreement entered into force on 1 November 1983 and repayment in

kind of the Norwegian deficit starts on 1 January 1984. The recoverable reserves for the whole field are 53 million Sm3 oil and 2 billion Sm3 gas.

Production facilities

The field has been developed with an integral steel platform with a production capacity of 26,200 Sm3 per day (Figure 2.3.8.a). On 28 September 1980, oil production started from the two submarine well completions. The present plateau production lies at about 17,640 Sm3 per day.

The drilling program consists of a total of 27 wells. To date, 25 wells have been completed as follows: 12 oil production wells, 2 satellite production wells, 9 water injection wells and 2 gas injection wells. Conoco is presently investigating the possibility of installing 6-8 extra well slots for future wells.

Recovery of reserves

Well drilling went very quickly on Murchison. The field has therefore been producing at maximun treatment capacity since 1981. By drilling production and injection wells alternately, the water injection capacity has recently been sufficient to balance the pressure drop from oil production.

Gas injection started in one well in 1981, while one further well started injection in 1982. This was done to conserv the greatest possible amount of produced gas until transport facilities exist.

The Government consented by King's Resolution of 24 September 1982 to land the Norwegian Murchison gas via the NLGP (Northern Leg Gas Pipeline) to the Brent field on the British side, and further via FLAGS, the Far North Liquified and Associated Gas Gathering System, to St Fergus in Scotland. Gas deliveries through the NLGP started on 20 July 1983.

Oil from Murchison is forwarded by pipeline to Sullom Voe on the Shetland Isles. The fractioning facility for wet gas at Sullom Voe came into use in the spring of 1982.

Metering system

Operating inspections are now performed annually in collaboration with the British Department of Energy.

Costs

Total developmental costs are expected to amount to about NOK 8.9 billion (current kroner), or NOK 13.3 billion (fixed 1983 kroner). The Norwegian share of this is respectively NOK 2.2 or 3.5 billion.

Flaring of gas

Up until 31 October, an average of 36.9 % of the total gas production was flared in 1983. The regularity in the gas system at the beginning of the year lay at about 50 %. This is mostly because of problems with the gas injection compressors. After the start-up of the NLGP, the regularity has increased to about 80 %, and associated gas flaring has fallen to about 15 % of gas production (Figure 2.3.8.b).

2.4 Petroleum resources

2.4.1 Resource accounts

Petroleum resources belong to the group of non-renewable energy resources. The exploitation of these resources is decided by the amounts present, possibilities of recovery and economic backing. Petroleum resources are classified according to how well the amounts are known (identification criterium), and whether it is economically viable to exploit them (commerciality criterium).

Petroleum reserves are those parts of the discovered resources which are recoverable under given technical and economic conditions.

The certainty or probability that given amounts of hydrocarbons can be produced with satisfactory yields, is dependent on the certainty of the estimates for economic parametres such as cost and price.

Several different classification systems for petroleum resources are in use today. One aim of the Norwegian Petroleum Directorate has been to work out and introduce a consistent classification system for estimating amounts of petroleum on the Norwegian continental shelf. In this connection, discussions have been held with Statoil, Norsk Hydro and Saga.

The main elements of the classification system which was used for the first time in connection with this annual report, are as follows:

Resources are categorized according to criteria of identification and commerciality. Identification criteria represent the degree of geological investigation. For undiscovered resources, the degree of seismic investigation and knowledge of the geology in the area will form the basis of the categories.

Included in the criteria of commerciality, is the degree of certainty of economic recovery of a hydrocarbon amount.

For presentation in the annual report, resources have been classified into three categories of field or find:

I Declared - Reserves connected with development projects for which approval to start has been given, are under development or in production.

II Mature - Reserves which are being considered for development.

III May mature - Resources proved by drilling, but where the size of the reserve is yet to be defined with greater certainty with the aid of appraisal wells.

Some undrilled prospects are also included in the category of petroleum resources which may mature.

Figure 2.4.1.a illustrates how these three definitions of resources fit in with the Norwegian Petroleum Directorate's future resource classification systems.

In Figure 2.4.1.b, a classification of the possible recoverable resources south of Stad is presented.

2.4.2 Resources base for declared fields

As of 1 September 1983, decisions had been taken to carry out 16 development projects on the Norwegian continental shelf. The amounts of petroleum represented by these developments are given in Table 2.4.2. All reserves figures are the Norwegian Petroleum Directorate's estimates unless specifically stated otherwise. Operating companies may have other estimates for reserves on some fields.

In total up until 31 December 1983, 0.33 billion toe had been produced on the Norwegian continental shelf.

2.4.3 Resources base for mature fields

In Table 2.4.3, there is a list of fields and finds which will most likely be developed.

2.4.4 Resources base for fields developable on certain conditions

Table 2.4.4 shows other finds made on the Norwegian continental shelf. The Norwegian Petroleum Directorate expects that some of these, both because of their size and locality in relation to other fields, may be developed.

The presence of hydrocarbons has also been proven in: 1/3-3, 2/1-5, 2/2-1 and 2, 7/11, 7/12-6, 34/10-Beta, 16/7-4, 2/6-2, 18/10 and 34/4-4.

2.4.5 Changes in resource estimates from previous annual report

Table 2.4.5 shows the most important changes from the previous annual report (1982).

Total proven resources on the Norwegian continental shelf as of 31 December 1983 are: 1,468 million Sm3 oil and 2,513 billion Sm3 gas, i.e. 3.74 billion toe. Of this, a total of about 224 million Sm3 oil and 143 billion Sm3 gas has been recovered.

Cod
Changes in the reserves estimate are based on a review of the field's recovery factor.

Ekofisk
Because of the decision on water injection, recoverable oil and gas reserves will increase to 192 million Sm3 and 125 billion Sm3 respectively, and NGL to 8 million tons.

Murchison
In connection with the reallocation of the field, new reserve calculations have been made. The estimated reserves for the field have increased because new reserves in the southern part of the field have been proven. New distribution of the field raised the Norwegian share from 16.25 % to 25.1 %.

Valhall A
New mapping and new reserves estimates have led to a downwards adjustment of the reserves.

Askeladd
Drilling results have led to a downwards adjustment of the reserves.

Oseberg
New mapping and reserves estimates for the entire field (Alfa, Alfa North and Gamma), have led to an increase in the reserves.

Sleipner satellites
In addition to 15/8-Alfa, the estimates include new finds in 15/9-My and 15/9-Theta.

Tommeliten
New mapping and reserves estimates.

Troll West
New mapping and a re-evaluation of the recovery factor, have led to a reduction of the estimated recoverable reserves in parts of the Troll West field.

Troll East
In relation to the 1982 Annual Report, new reserves have been proven in Troll East as a result of drilling in Blocks 31/3 and 31/6.

In the Norwegian Petroleum Directorate's Petroleum Outlook which was published in the autumn of 1983, the proven reserves in Troll East were estimated at about 1,100 billion Sm3 recoverable gas. The reserves estimate was based on volumetric parametres from Troll West, and no well results were included from Troll East.

New mapping and reserves estimates for the field indicate, however, that the preliminary estimate was somewhat too high. The reduction is mainly because of poorer reservoir properties in this part of the field. The reservoir rocks are more fine-grained here and contain a great deal of mica minerals.

During the autumn of 1984, more extensive reserve estimates will be made.

Valhall (remainder)
Comprises the remaining reserves not drained by the Valhall A platform.

Gullfaks South (34/10 Alfa)
Proven reserves increased as a result of Well 34/10-16. The operator's estimate is given here.

Tyrihans (6407/1)
The Tyrihans field consists of a northerly and a southerly structure. These were proven by wells 6407/1-3 and 6407/1-2 respectively. The Norwegian Petroleum Directorate's reserves estimate covers the southerly structure. Preliminary calculations show that the northerly structure is of the same volumetric order of magnitude.

Block 6507/11
New drilling has proven larger resources.

2.4.6 Resource potential south of Stad

The Norwegian Petroleum Directorate has estimated that the probable recoverable resources potential south of Stad are about 5 billion toe (Figure 2.4.6).

Until now, 3.6 billion toe have been proven by drilling. In addition to the hypothetical 1.4 billion toe, there may also exist some speculative resources.

2.4.7 Resource potential north of Stad

It is still too early to comment on the total resources potential north of Stad. Proven and low-risk resources are respectively 0.181 billion toe and 0.037 billion toe.

3. SAFETY CONTROL

The operating companies' responsibility for ensuring that laws and regulations are adhered to through the establishment and use of internal control - quality assurance systems, has been given considerable attention during the reporting period. The Norwegian Petroleum Directorate's philosophy and working methods have been more clearly defined and strengthened through working groups, internal seminars, as well as the implementation of system and detail audits at the operating companies, in projects, engineering firms and at the contracting companies.

The audits which have been carried out have contributed to increased understanding for the Norwegian Petroleum Directorate's objectives within the area of internal control. They have also led to improvements in the Norwegian Petroleum Directorate's working methods. The operating companies, too, have also in this period worked more systematically with their quality assurance systems, and these have thus been improved in many areas. In time, therefore, this activity will constitute a contribution towards further concreteness of the quality assurance systems in all phases of the activities.

It has been the Norwegian Petroleum Directorate's general experience that the internal control is best taken care of in the detail engineering and fabrication phases, while some work still remains as regards the implementation of such control systems in the operating phases, viz. the production and drilling phases. The Norwegian Petroleum Directorate, accordingly, will particularly focus its attention on these activities in the period ahead.

In 1983 there occurred an instance where a leased foreign vessel did not have the expected degree of quality as regards its evacuation equipment. The equipment was immediately upgraded, however, once the deficiency was pointed out.

The Norwegian Petroleum Directorate has been expecting a clarification of further regulations and delegate resolutions concerning the control of foreign vessels, and on 5 October 1983 the Ministry of Local Government and Labour issued the following statement:

> **"Safety-related control of foreign registered service vessels, construction vessels, crane vessels and pipelaying vessels etc. on the Norwegian continental shelf - control procedures - delegation of authority.**
>
> Pursuant to King's Resolution of 19 March 1982, the Ministry of Local Government and Labour's authority for safety-related control of foreign construction and service vessels etc. on the Norwegian continental shelf was further amplified.
>
> The statutory provisions are inserted in new Section 4 a and Section 5 a in, respectively, the regulations of 3 October 1975 relating to safety etc. regarding exploration and drilling for submarine petroleum resources, and the regulations of 9 July 1976 relating to safety concerning the production etc. of submarine petroleum resources. The new sections were inserted in order to elaborate on and amplify the legal basis for control over foreign construction and service vessels etc. on the Norwegian continental shelf.

> Pursuant to Section 4 a and Section 5 a, the Ministry has authority to establish further regulations in the form of directions or to issue such specific decisions as might be required concerning the requisite control of such vessels, and to delegate such authority if necessary ...
>
> In accordance with the above mentioned regulations, the Norwegian Petroleum Directorate is delegated the authority to control in specific cases that the mentioned vessels maintain acceptable safety standards ...
>
> To the extent necessary, the Norwegian Petroleum Directorate's control will be supplemented by random sampling and technical checks which the Norwegian Petroleum Directorate may find necessary, or by consultation with any other authority which may be delegated responsibility in accordance with the safety regulations referred to.
>
> Before the Norwegian Petroleum Directorate conducts a composite evaluation of the offered documentation, plans or the safety-related measures which have been carried out on the vessel, the Norwegian Petroleum Directorate shall obtain the Maritime Directorate's professional assessment. In this connection, it is assumed that the Maritime Directorate to the extent necessary may supplement its consideration of the offered documentation etc. by an inspection of the vessel. The carrying out of such inspections are to be arranged with the appropriate licensee, through the Norwegian Petroleum Directorate ..."

Since the aforementioned procedures and regulations were adopted, so far two operating companies have worked out standards with quality criteria for the consideration of safety conditions of leased or chartered foreign vessels.

The contact between the parties in the industry and the public authorities has focused on the debate concerning the organization of the cooperative precautionary safety measures. Even though it had not been planned during the course of 1983 to carry on any follow-through of the previous "Bryne conferences", where the involved employee groups had an opportunity to discuss principal approaches to safety and environmental problems with the authorities and the employers, there has nevertheless been a many-faceted contactual activity between the Norwegian Petroleum Directorate and the parties in the industry. Both through the participation in conferences, arranged on behalf of the various employee unions, as well as through co-operative meetings between the parties in the various companies, the Norwegian Petroleum Directorate has been able to keep abreast of such matters and problem areas which at any given time are present in the industry. Even though from certain quarters there has been expressed a desire to formalize such contact through the establishment of contact committees for the parties connected with the offshore petroleum activities, the Norwegian Petroleum Directorate has not found it desirable to establish such a permanent function. This on the basis of the satisfactory experiences obtained by electing to take contact with the different parties at different levels, depending upon the requirements of each particular case. The Norwegian Petroleum Directorate will, however, seek to arrange the means for the conduct of conferences which can thoroughly debate specific problem areas.

In 1983, the Norwegian Petroleum Directorate was also given responsibility for controlling, by means of surveys and follow-ups, the technical operability of those pipelines and appurtenant equipment which are in operation on the Norwegian continental shelf.

Both in accordance with the safety laws pertaining to continental shelf activities currently in force and pursuant to Odelsting Proposition No. 72 (1982-83), the draft Petroleum Act, the safety concept is composed of conditions which involve measures to safeguard persons, prevent direct injury to other activities, protect the environment and secure the economic values represented by the equipment.

Accordingly, the Norwegian Petroleum Directorate has also been given the assignment of making technical evaluations of safety-related and other conditions affecting the regularity of production, including the tie-in of equipment through transport systems and the like.

The work will be especially focused towards problems related to the interruption of production, as for example by attempting to calculate the probability of different occurrences arising, suggestions for precautionary safety measures and consideration of the cost-effectiveness of such measures.

Insofar as possible it will also be considered whether, from a technical and safety-related point of view, the requirements of the safety laws in a satisfactory manner express safety standards and risk levels so as to maintain or identify technical operating conditions which can influence regularity in the production and transport of petroleum etc. This also applies to interruptions caused by accidents or mishaps relating to circumstances of importance to safety.

Attention will be directed towards both technical and operational conditions of existing equipment, transport solutions and field developments which one plans to tie to existing installations, as well as towards whether the regulations sufficiently stimulate the operating companies to a search for the identification of problem areas which may result in technical failures, accidents causing operating interruptions, etc.

In 1983, the Norwegian Petroleum Directorate began efforts with a view towards acquiring an overview of the systematic work the individual employers are doing to ensure that North Sea workers do not become unemployed as the result of failure to keep their health certificates.

This survey will constitute the basic material for the further follow-up of Section 13 of the Working Environment Act, which amplifies the employers' responsibility towards occupationally handicapped employees.

REGULATIONS AND GUIDELINES

The work relating to the preparation of rules for submarine pipelines and risers is nearing completion. It has been decided to remove some of the specific detail requirements from the regulations and present them in the form of guidelines. It is expected that the regulations and appurtenant guidelines will be completed during the course of 1984.

The revision of "Regulations for the structural design of fixed structures" continued in 1983. As with respect to the pipeline regulations, these too will be divided into regulations with appurtenant guidelines. The work is expected to be completed in 1984.

Work on up-dating guidelines for the safety evaluation of platform design concepts was started in 1983. The work on revising the guidelines is expected to be completed in 1984.

The Norwegian Petroleum Directorate's guidelines for the inspection of primary and secondary structures etc. also include submarine production systems. Some special circumstances in connection with those systems, however, have not been adequately described. The Norwegian Petroleum Directorate, therefore, has begun work on adapting the guidelines to also follow up on the operation of the submarine production systems. The guidelines ought also to be revised in order to more effectively cover floating production installations subject to the Norwegian Petroleum Directorate's area of responsibility.

In cooperation with the British Department of Energy, the Norwegian Petroleum Directorate has issued "Guidelines for the specification and operation of dynamically positioned diving support vessels". This is a revised edition of the edition which first was issued in 1980 and which now has also been translated into Norwegian.

The internal work on revising the drilling regulations was completed in 1983 and the revision will be sent out for hearing early in 1984. The main purpose of this revision has been to bring the drilling regulations in line with the principles of the Norwegian Petroleum Directorate's guidelines for the licensees' internal control. The specific technical requirements have, in the main, not been changed.

Within the area of preparedness, the Ministry of Local Government and Labour has determined that there shall be prepared guidelines with a view towards improved planning and, if possible, greater standardization as well as simplification of the preparedness system. The Norwegian Petroleum Directorate has been assigned the task of seeing to the completion of this work.

"Regulations relating to noise etc. in connection with petroleum activities" as well as "Guidelines for noise reduction in connection with petroleum activities" have been out to hearing, and the Norwegian Petroleum Directorate assumes that these will be adopted during the course of the summer 1984. The Norwegian Petroleum Directorate has in earlier annual reports accounted for the work done in the preparation of these regulations and guidelines.

In cooperation with the State Institute for Radiation Hygiene, the Norwegian Petroleum Directorate has worked out a draft regulation in order to arrive at exposure criteria for personnel working with radioactive materials in the offshore petroleum industry.

Section 21 of the Working Environment Act requires employers to report on work accidents and illnesses which may have been caused by the work or by the conditions at the work sites. The Norwegian Petroleum Directorate is working on regulations/ guidelines relating to the extent and implementation of this reporting and notification duty.

It has long been a matter of importance to prepare regulations for offshore hoisting/lifting devices, as well as revising the crane regulations. A first draft of joint regulations covering both cranes and elevators was prepared in 1982. This was largely based on detailed requirements, and in 1983 these were revamped with a view towards being able to function in a more satisfactory manner. In addition, it is considered desirable to prepare guidelines for the regulations, based upon a model corresponding to that used in conjunction with the regulations and guidelines applying to noise.

Work on revision of the regulations for transfer of personnel to and from production platforms continued in 1983 and the Norwegian Petroleum Directorate expects to send the suggested new regulations out for hearing early in 1984.

On 28 December 1983 the Ministry of Local Government and Labour adopted new regulations pertaining to auxiliary vessels.

The Norwegian Water Courses and Electricity Board (NVE), the State Explosives Inspectorate (SSI) and the Norwegian Petroleum Directorate have jointly worked out guidelines for area classification.

REGISTRATION OF ENVIRONMENTAL AND PLATFORM DATA (E&P DATA)

In 1983 the operating companies Mobil, Phillips Petroleum Company Norway and Elf Aquitaine assumed responsibility for the analyses of environmental data relating to ocean currents, waves etc. which are collected at Statfjord A, Ekofisk 2/4 H and Frigg TCP 2. The earlier division of responsibility had been that the operating companies were responsible for the collection of data while the Norwegian Petroleum Directorate was responsible for implementation of the requisite analyses.

In addition to measurement of environmental data, there are collected at these installations data (P data) which show how the installations behave when subjected to external forces, amongst other things with regards to the registration of movements, settlement and strain etc. Analyses relating to Valhall QP, Frigg DP2, Ekofisk 2/4H, Statfjord A, B and ALP have been made during the course of the year. The two first were conducted under the auspices of Amoco and Elf Aquitaine Norge respectively, the remainder by the Norwegian Petroleum Directorate. A final safety evaluation of these analyses is expected in 1984.

THE MARINE ENVIRONMENT ON TROMSØFLAKET (TROMSØ PATCH)

In connection with the planned drilling activities on Tromsøflaket there was started in 1976, under the auspices of the Norwegian Petroleum Directorate, an extensive data-gathering project. The basis for this project was the desire to obtain knowledge of the meterological and oceanographic conditions before test drillings were commenced. In addition, it was felt desirable to obtain sufficient measurements so that, on the basis of the measured data it would be possible to calculate extreme values, including 100-year maxima.

The weather ship "AMI" was chartered from Kåre Misje Co Rederi A/S in Bergen. This ship has been stationed in a fixed position, at 71 degrees 30 minutes North and exactly 19 degrees East, since September 1976, and has carried out measurements and tended instruments placed

in the sea. The vessel only leaves its fixed station once a month, in order to effect crew change and the maintenance of instruments.

The project has been financed by the Norwegian Petroleum Directorate with participation by several Norwegian institutions in the project: the Norwegian Hydrodynamic Laboratories have carried out ocean wave and current measurements and have been responsible for project coordination and reporting; the Norwegian Metereological Institute has had responsibility for the metereological measurements, which are carried out every 3 hours and reported to shore; the Oceanographic Research Institute of Bergen has been responsible for hydrographic measurements (temperatures and salinity) and for biological measurements.

In addition to these regular activities, the vessel has also been used by several other institutions, for example, in connection with the measurement of corrosion, icing, drifting of oil, satellite remote measurements etc.

The project results have been very valuable, with data retrieval ranging between 90-100 per cent. By way of example, during the first five years more than 2 million ocean waves have been measured, with the highest wave over 20 meters. Ocean currents are measured every 10 minutes at 5 different levels. This is one of the longest and best data series relating to ocean currents which is known.

On the basis of the measurements which have been made it may be concluded that the oceanographic environment does not deviate substantially from that which is customary in the North Sea. A peculiar feature, however, is that the weather conditions change more rapidly than in the North Sea. There has, amongst other things, been registered an increase in wave height of from 4 to 16 meters during a 3-hour span. The 100-year wave, however, appears to be of the same order as in the northern North Sea. The 100-year wave for Tromsøflaket is estimated at 29 meters.

January is the month with the strongest winds, while August is the month with least winds. Wind velocities of up to approximately 28 m/s or 54 knots have been registered, with the estimated 100-year value at 39 m/s, which is approximately the same as for the North Sea.

The current conditions vary greatly throughout the Tromsøflaket area and, on the average, are stronger than in the North Sea, mainly owing to the tides.

Precipitation in the form of snow is frequent throughout the winter months, amounting to approximately 20 days per month on the average. A peculiar phenomenon during the summer months in the north is the arctic oceanic fog. During July there has been registered such fog for up to 16 days during the month.

The sea temperature has ranged from 2.6 to 12.5 degrees Centigrade, with the average ranging between 5 and 10 degrees Centigrade. The air temperatures have ranged between minus 14.5 and plus 15.0 degrees Centigrade, from winter to summer. On the average, the sea temperatures are higher than the air temperatures.

Data obtained from this project, which are freely available, are now used by all who operate in the Northern seas in connection with petroleum activities. A large number of research projects have used

and are currently using these data.

In addition, telegraphic weather reports are transmitted to the Tromsø Weather Reporting Service every 3 hours. These form part of the background for the daily weather reports for Finnmark, Troms and the surrounding oceans.

Even though "AMI" during these five years has registered storms with accompanying waves exceeding 20 meters, the period has nevertheless proved to be climatologically quiet.

The Norwegian Petroleum Directorate in July 1983 issued the report "Environmental Conditions at Tromsøflaket 71 degrees 31 minutes North - 19.00 degrees 00 minutes East", Report No. 8 Five Year Report, which summarises the first 5 years of measurements relating to the oceanic environment at Tromsøflaket.

STRUCTURES

Data based upon experience from operating inspections of load-bearing structures reveal that the demand for a research effort, to determine the importance of marine growth on oceanic installations, appears to be increasing. The same appears to be the case with respect to the importance of pitting corrosion at nodal points.

Structural damage to fixed installations in the splash-zones, in connection with marine operations, have in recent years occasioned in part extensive underwater repairs. The Norwegian Petroleum Directorate has started a research project to analyse the structures in the involved areas, mooring and fender systems, as well as the maritime operations connected with the operation of fixed installations.

CONSTRUCTIONAL STEEL

Environmental conditions of the North Sea, together with new types of field development concepts, are placing increasingly stricter demands on the quality of steel.

For this reason, the Norwegian Petroleum Directorate has been closely following the development of new types of constructional steel. The tendencies at the steel works in Japan and Europe are clear on this point: steel is being developed with steadily less elements of impurity.

During the early 1970s, efforts were concentrated on lowering the sulphur content, today down towards 0.001 per cent. This contributes especially towards improving the steel quality insofar as thickness is concerned.

During the beginning of the 1980s, better control of steel production, temperature and rolling conditions have led to a reduction of the carbon content from 0.16 - 0.18 per cent carbon to 0.08 - 0.10 per cent carbon, and retaining the same yield stress. Particularly for the large material thicknesses, up to 90 mm on loadbearing structures, this steel has resulted in few problems with tempering cracks during fabrication. This has also resulted in considerable economic gains because the preheating temperatures connected with welding can be considerably less.

The use of low-carbon constructional steel, however, has also proved to be attendant with some problems. In one of the Norwegian Petroleum Directorate's projects during fracture mechanics testing, local brittle areas were discovered in the heat affected zone. The measured fracture toughness in these zones has been very low. The possible consquences of brittle fractures or a low fatigue life have been considered. The Norwegian Petroleum Directorate through its own staff as well as through hired consultants has closely followed-up on this work. Great research effeorts are still being made in order to discover the cause of the problem and its importance for the specific constructions involved.

Cooperation and greater frankness by the steel suppliers and oil companies can contribute to the reaching of solutions to these problems, without having to revert to the old types of constructional steel.

CORROSION

The extent of registered pittings on North Sea steel structures has increased in recent years. The cause of these attacks has still not been fully established, but they are assumed to be caused by:

- insufficient dimensional criteria for cathodic protection
- bacterial corrosion

Work is continuing to establish the cause and to evaluate the importance of the severity of the attacks.

EMERGENCY SHUTOFF VALVES

In connection with the tie-in of the gas pipeline from Statfjord to the Statpipe system and the Northern Leg, Great Britain, there has been considered the need for barriers which can prevent backflow of gas in the gas pipeline in the case of fracture or leakage. In this connection, Mobil has carried out a very extensive safety analysis.

This analysis shows that the probability for damage to risers and pipelines in the vicinity of the installations is small but, because of the extremely serious consequences such accidents might have, there is nevertheless a need for safety barriers. On Statfjord, therefore, the gas pipelines have been equipped with non-return valves on the seabed.

During the course of the past year, the Norwegian Petroleum Directorate has carried out considerable work in studying this problem generally, amongst other things by reconsideration of safety analyses for both Statfjord as well as other fields. In addition, the reliability of existing equipment, such as emergency shutoff valves and non-return valves on the seabed, has been thoroughly evaluated in cooperation with both manufacturers and oil companies. There is shown to be a need for further development of the submarine valves which are presently available, in order that the demands on the Norwegian continental shelf as regards diameters and working pressures may be covered. This development work has been started.

DEVELOPMENT WITHIN SAFETY AND MONITORING SYSTEMS

Data processing facilities and related systems are rapidly developing as regards capacity and capabilities within the area of safety systems. This technology is now in the process of introducing entirely new system solutions, which makes it difficult to determine whether superior safety conditions may be regarded as being satisfied, in as much as the prevailing regulations and standards are based upon entirely different technological premises.

During the course of 1983, considerable work was done in connection with the establishment of basic attitudes to the most pressing of these problem areas, as well as with the preparation of regulatory changes which are deemed necessary to keep abreast of the most recent developments and, if possible, to incorporate the dynamics required to maintain the further developments which may be expected in this area.

The Norwegian Petroleum Directorate visualizes a clear potential for both safety-related and economic gains through a well considered application of the possibilities inherent in data processing technology. In retrospect, however, it may be affirmed that technology which today is regarded as very reliable went through a series of adolescent complaints. There is no reason to suppose that this should not also apply with respect to future developments. It is considered necessary, therefore, to exercise a certain amount of restraint in order to accumulate practical experience before each new phase of this development.

REQUIREMENTS TO DRILLING AND COMPLETION EQUIPMENT

Drilling and completion equipment is supplied largely by major US-based multinationals and, as regards most components, pursuant to standards established by the American Petroleum Institute (API), the American oil industry's trade association.

The API standards are internationally recognized and are very useful, but in many instances they represent minimum requirements. The individual operating companies may have their additional requirements as regards equipment for special fields. In addition, the Norwegian Petroleum Directorate regulations contain some additional requirements, especially with respect to the requirement of design review, independent of the manufacturer, and for the documentation of quality.

During the years there have been repeated discussions between the Norwegian Petroleum Directorate and the operating companies and between the manufacturers and API, to arrive at standards which to a larger extent are acceptable to all parties.

In 1983, API commenced extensive work on up-grading a series of other standards, so that these to a greater extent would accommodate the wishes of operating companies and public authorities in Europe. API will presumably also tighten up important standards and requirements with respect to quality control by the manufacturers.

This signifies an interesting development which, in the long run, can lead to a greater degree of standardization for both operating companies and public authorities.

ELECTRICAL INSTALLATIONS

In its work of controlling electrical installations in 1983, the Norwegian Petroleum Directorate has paid particular attention to personnel safety and appurtenant counseling and information in this connection.

Further, the Norwegian Petroleum Directorate has regarded it as very important that experiences won are transferred from installations which are in operation, to new installations which are in the engineering stage or under construction. As an example it may be mentioned that an ordinarily used circuit breaker proved to be the cause of a serious fire in a large electrical switchboard panel. Experience transfer and follow-up has led to improvements in both old and new switches, as well as new handling/ assembly directions from manufacturer to switch panel fitter.

There were also in 1983 registered fires and personal injuries caused by electrical installations and equipment. Accordingly, the Norwegian Petroleum Directorate in the period ahead will continue to give preferred attention to this area.

The corrosion problem remains large, although the Norwegian Petroleum Directorate appears to detect certain improvements in this field. This has connection with the operating companies presently selecting equipment which is better suited for use on the installations.

Nevertheless, it seems that corrosion and wear and tear will remain a serious and costly problem area in the time ahead. The Norwegian Petroleum Directorate is very much preoccupied by this because worn and poorly maintained electrical installations represent a big risk as regards fire and explosion.

OPERATIONAL STRATEGY FOR MOBILE INSTALLATIONS ANCHORED IN THE VICINITY OF FIXED INNSTALLATIONS

By way of continuation of the reports and risks analyses by the operating companies concerning the risk of collision between mobile and fixed installations, the operating companies have worked out an operational strategy for mobile installations in the event they should come adrift. The strategy explains the specific measures which must be carried out in order to bring the mobile installation into such a position that it will not represent a threat to the fixed installation in the event of anchor dragging or the parting of anchor wires. This becomes part of the total preparedness in case of accident or emergency situations. The operational strategies are currently under review by the Norwegian Petroleum Directorate.

ANCHORING OF MOBILE INSTALLATIONS

By visual inspection during the rebuilding of a mobile installation, a series of cracks were found in two of the anchor chains. More extensive investigations established that nearly every link contained cracks owing to damage from the welding clamps, as well as lips remaining after the removal of thickening resulting from impact welding. By and large, the cracks and lips disappeared following

extensive grinding, but several links continued to show cracks after being ground way beyond acceptable tolerances.

In another instance, in connection with the anchor handling of a flotel platform, there was discovered some excessive wear and tear on seven of eight anchor wires. These had to be replaced. One of the wires was but three months old.

This resulted in a decision to use flotels equipped with anchor chains in the future, and the flotel in question was replaced in 1983.

The cause for this wear and tear has not yet been determined, but there is reason to suppose that the topography of the seabed has been of importance.

As a result of this, with respect to mobile platforms which may come in under the Norwegian Petroleum Directorate's area of responsibility, the Norwegian Petroleum Directorate will attach great weight to a thorough control during fabrication and to the inspection of such anchoring systems.

CRANES AND LIFTING GEAR

Follow-up of crane accidents in 1982

In the Norwegian Petroleum Directorate's Annual Report for 1982 it is reported that the Norwegian Petroleum Directorate received notifications of two special crane accidents.

The two accidents involved the same type of crane. One accident was caused by a fracture of the drum shaft for the boom raising winch; the other by shaft fracture in the hydraulic motor for the whip line winch.

All operating companies which operate this type of crane on production platforms on the Norwegian continental shelf have during 1983 carried out checks and modifications on their cranes. In addition, the operating companies have completed revisions of their crane inspection and maintenance procedures.

The modifications are relatively extensive, in as much as it has been decided to modify all hoisting drums. All operating companies plan to complete this work during the course of the summer 1984.

PREPAREDNESS

As determined by the Ministry of Local Government and Labour, the Norwegian Petroleum Directorate has commenced work with a view towards the preparation of guidelines for preparedness. The work, which is expected to be going on throughout both 1984 and 1985, has the following objectives:

- to increase the state of preparedness by having guidelines to make sure that as many safety aspects as possible are considered already at the planning stage of offshore installations;

- to introduce standards and criteria amongst other things for critical operations, so that the level of preparedness may be evaluated on as precise and objective a basis as possible;

- to simplify the preparedness system, especially alarm instructions, procedures and contingency plans, so that the probability of an awareness of the systems by all concerned is increased.

It is also sought to foster preparedness work through increased emphasis on cooperation with educational institutions at home and abroad. The fact that "Safety Administration" was started by the Rogaland Regional College as a separate educational discipline in 1983 is, in this connection, regarded by the Norwegian Petroleum Directorate as a very positive development.

Special work has been done as regards questions of communications within the general area of preparedness problems, especially in connection with the use of the Norwegian language within the petroleum industry. The Norwegian Petroleum Directorate has advanced various arguments to the concerned Ministries with respect to those areas in which it is sought to reduce the importance of the employees in the petroleum industry having to possess special knowledge of foreign languages in order to maintain safe operations, a high degree of preparedness and a good working environment. Work on this matter is continuing.

CONTINGENCY PLANS

The work of updating and developing contingency plans continued also in 1983. The standard of most of the plans must be described as being satisfactory. It should nevertheless be noted that the plans are still in part very voluminous; that contingency plans for shorter periods of activity on the continental shelf are not sufficiently well prepared; and that there is a tendency for the plans to be submitted to the public authorities only shortly before the start-up of activities. These conditions will be tightened up and subject to careful monitoring.

SAFETY ZONES

By letter from the Ministry of Local Government and Labour dated 30 June 1983, the Norwegian Petroleum Directorate was requested to conduct a safety evaluation of the need for and utility of safety zones, including the experiences won had on the basis of the existing safety zones. On the basis of an overall evaluation of the attendant safety factors, the Norwegian Petroleum Directorate is of the opinion that there ought to be prepared general regulations regarding safety zones, as well as fishing and anchorage zones.

Penetration into safety zones by vessels and drifting objects has been a repetitive problem since the commencement of petroleum activities on the Norwegian continental shelf. Operating companies as well as the public authorities are, to a large extent, preoccupied by these conditions.

MARITIME VHF IN TRANSPORT HELICOPTERS

Civilian transport helicopters today constitute a part of the general transportation arrangement for the operating companies. These helicopters can in certain emergency situations become involved in rescue operations. The authorities regard it as important that all units which may become involved have one common communicating frequency to their disposition. This fact was also discussed by the Inquiry Commission dealing with the "Alexander L. Kielland" disaster.

With this background in mind, the Norwegian Petroleum Directorate has requested all licensees to only use helicopters which have mounted maritime VHF. For the time being only the new helicopters and those used for search and rescue service have this new equipment mounted. The decision has been made, however, to mount maritime VHF in all transport helicopters.

EXERCISES

As in previous years, the operating companies have completed a series of exercises in order to test and improve preparedness onshore and offshore. To the extent resources have permitted, the Norwegian Petroleum Directorate has participated in the exercises, both with the exercise staffs and through representation on the operating companies' crisis management staffs.

The exercises have been very useful as regards various cooperative arrangements, while at the same time giving the Norwegian Petroleum Directorate a good insight into the preparedness state of the operating companies.

The exercise "SOSEX-83" was the most extensive of its kind up to now. The exercise fully engaged the Norwegian Petroleum Directorate crisis staff and provided useful experiences for all participants.

Exercise "Bright Eye" is an annual search and rescue exercise in which all of the rescue stations on the North Sea take part. To the extent the petroleum activities become involved, the Norwegian Petroleum Directorate attempts to participate in these exercises.

DIVING

Operational diving on the Norwegian continental shelf in 1983 was characterized by the work connected with the laying of the Statpipe pipeline. In order to maintain possibilities of intervention with respect to this pipelaying operation, it was found necessary to be able to master operational diving down to 350 metres. This is considerably deeper than that which has been customary up to the present. Research and development was essential. In this connection there were conducted two pressure chamber demonstration dives in Norway in 1983, in order to test personnel, equipment and procedures. Finally, the whole was tested during a sea dive in a Norwegian fjord where a welding operation at a depth of 350 metres was conducted. The Norwegian Petroleum Directorate has continuously monitored the planning and implementation of these attempts.

The possible long-term effects on a diver's central nervous system as a result of deep diving have been discussed. The Norwegian Petroleum Directorate, therefore, initiated a 2-day meeting under the auspices of a neutral professional organization, the European Undersea Biomedical Society. For the very first time one was able to assemble the world's leading experts in this area, for an exchange of knowledge and discussion on how problems ought to be handled. The results of this meeting will be published in an independent report early in 1984.

The total diving activity in 1983 was higher than in the more recent years, with 2,418 surface oriented dives and 267,841 saturation manhours. This represents an increase of approximately 66 per cent for surface oriented dives and approximately 60 per cent for saturation manhours.

Two serious accidents, involving six deaths, occurred in 1983. These accidents, which are the first since 1976, are being investigated by the police. One of the accidents is additionally being investigated by an expert commission appointed by the Ministry of Local Government and Labour.

The accidents are more specifically described under the section on Work Accidents. It is of great consequence for the future diving activity that all circumstances surrounding these accidents be clearly established to the extent possible.

On a national level, considerable further progress has been made in that both the Maritime Directorate and the Norwegian Petroleum Directorate have prepared identical regulations pertaining to the technical requirements for a diving system.

Pursuant to this new regulation, the Norwegian Petroleum Directorate will carry out the principal part of the public control of diving systems, based on the Seaworthiness Act, on behalf of the Maritime Directorate.

The Norwegian Petroleum Directorate in 1983 has exercised considerable pressure in order to have the operating companies engage employees with a good knowledge of diving operations. This is considered to be very important and quite essential if the operations are to function in a satisfactory manner.

Similarly, the Norwegian Petroleum Directorate has worked purposefully towards creating a better understanding by the operating companies in order that their representatives on board vessels and installations be given specific and definite guidelines concerning responsibility relationships during diving operations.

The Safety Departments of the diving companies have been charged with the responsibility of keeping a stricter check on whether all diving personnel have satisfactory training and knowledge of the requisite procedures. Similarly, the safety departments are required to follow up with a system whereby it may be controlled that the procedures are adhered to.

PERSONNEL QUALIFICATIONS

At the turn of the year 1982-83, the Norwegian Petroleum Directorate requested the operating companies to provide an updated status report on the work relating to job descriptions and qualification requirements for personnel working on the Norwegian continental shelf. The companies intensified their work on the systems and, by year-end, some of the companies had completed the work in so far as their own personnel was concerned.

In connection with planned installations, the Norwegian Petroleum Directorate is particularly anxious that the operating companies define their manning requirements and consider training requirements already at the planning stage. A thorough and well planned professional training program is of substantial importance to safety.

DRILLING PERSONNEL

The Norwegian Petroleum Directorate's regulations regarding the qualifications of drilling personnel on fixed installations and foreign registered mobile platforms came into effect on 1 May 1983. Based on the partial recommendation prepared by the Leiro II Committee, the qualification requirements remain the same as those in effect since 14 January 1980. The regulation is in harmony with the Maritime Directorate's qualification requirements pertaining to drilling personnel on mobile drilling rigs, and this has simplified implementation of the control work.

International qualification requirements for drilling personnel vary from country to country. The Norwegian Petroleum Directorate has accepted the public requirements of some countries, including the British pressure-test certificates, which are also valid on the Norwegian continental shelf. Work is ongoing to make this a bilateral arrangement.

THE WORKING ENVIRONMENT SITUATION FOR CATERING PERSONNEL

The working situation for catering personnel, as regards job safety, health and the working environment, has been a central theme of the industry in recent years. Based upon the results of research activities, work conferences and their own inspections, the authorities found it necessary to devote particular attention to these problems in 1983.

There has been extensive contact between the authorities and labour unions in order to define those areas which must be given preferred attention in order to improve working conditions for the employees.

The Norwegian Petroleum Directorate has dealt with these matters at some length and made suggestions on measures to be taken in a comprehensive background memorandum for the responsible Ministries, in their further follow-up of the problems involved.

On the basis of the fundamental responsibility which is placed on the operating companies, to see to it that all parts of the organization are familiar with and adhere to prevailing laws and regulations pertaining to the working environment and safety, the authorities have found it necessary to sharpen the operating companies' responsibility

for internal control, also in this central part of operations within the Norwegian offshore petroleum activity.

This control, which is supposed to cover all parts of the organization and all phases of an activity, probably ought - if it had functioned in accordance with guidelines prepared by the Directorate - to have caught indications that the catering activity was not working as it should in accordance with the assumptions of a fully sound working environment.

In the same manner that the companies today have developed and put into use quality control systems, to ensure that technical constructions, equipment and systems satisfy the specified requirements for quality and for the maintenance of this quality, the authorities also expect the operating companies to develop corresponding systems to ensure that quality is planned and maintained within the catering industry.

In order that the authorities may have a more detailed general overview and be able to monitor developments in these areas in the period ahead, there is planned a more comprehensive and systematic inspection activity in the year ahead.

In addition, one will seek to strengthen and improve the contractual provisions between operating companies and the parts of the activity which today are taken care of by contractor companies. There appears to be an increasing understanding for the importance of such improvements.

HUMAN ASPECTS OF HELICOPTER TRANSPORT

Based upon a recommendation by the Norwegian Petroleum Directorate, the Norwegian Industry Association for Operating Companies (NIFO) in 1982 formed a group to report problems related to the transport of North Sea personnel by helicopter. The group is composed of representatives from the labor unions, safety personnel, the operating companies, Helikopter Service A/S and the Norwegian Petroleum Directorate.

The terms of reference for the group are expressed in the following language: "To seek to define the character and extent of the human problems resulting from the helicopter transport with the objective of developing and implementing measures to reduce them."

In 1983, the group completed an extensive activity in order to provide background material. The main thrust of the work has been connected with the preparations for and implementation of investigations amongst the helicopter passengers, in order to obtain a reliable survey of their opinions on the helicopter trips, together with their suggestions for possible improvements. This investigation, which has been carried out in close cooperation with Agder Research (Agderforskning), was summarized at the end of 1983 and is planned to be followed up by suggested activities in 1984.

The Norwegian Petroleum Directorate regards it as especially positive that the involved parties jointly commence this type of survey and thereby assure serious follow-up.

ORGANIZED SAFETY AND ENVIRONMENTAL WORK

The organization of cooperative safety work

In 1983, too, problems connected with the organization of the cooperative safety activities in the producing fields on the continental shelf have been the subject of extensive attention, from the labor organizations as well as from the operating companies and the authorities. A suitable organization is necessary in order to assure influence on the working environment by all groups of employees.

From those organizations which primarily organize contractor personnel, increasingly strong demands have been made that conditions be so arranged as to result in the contribution of influence and improved communication in safety and environmental matters also for this category of workers.

It has been a complicating factor, however, that the various labour unions have not had a united view of how the safety work in the production fields ought to be organized: while contractor employees have largely concentrated on so-called field-based working environment committees - work environment committees which guide and coordinate the activities of all companies and firms offshore - the organizations representing the employees of the operating companies have aimed at maintaining the existing arrangement, with the operating company's working environment committee being the central organization for safety and environmental matters.

The Norwegian Petroleum Directorate has followed this development for a long time and has challenged the parties to arrive at appropriate solutions themselves. On the basis of criticism from the contractor employee organizations, and based on documentation gradually produced - including research reports related to safety cooperation - the authorities have found it necessary, however, to take a more active part in the ongoing discussion. The Norwegian Petroleum Directorate believes there ought to be good possibilities for clarification of these problems in 1984.

Annual reports from working environment committees

In 1983, for the first time, the Norwegian Petroleum Directorate received extensive report materials on the activities of the working environment committees connected with the North Sea production fields. These reports were made on the basis of directions from the Norwegian Petroleum Directorate to the operating companies to follow up on the duty of reporting which is placed upon the working environment committees pursuant to the Working Environment Act.

These reports demonstrated the limitations on today's arrangement in the largest North Sea fields, where there is no superior and coordinating body responsible for the collective reporting on all safety and environmental matters for an individual field. With the assistance of the Work Research Institute, the extensive reporting material has been reviewed. On the basis of this, the Norwegian Petroleum Directorate has made some changes with respect to requirements which the authorities will demand of such reports in coming years.

OCCUPATIONAL HYGIENE

Exposure to mercury vapour

As accounted for in earlier annual reports, the Norwegian Petroleum Directorate has worked to get the industry to develop new technology based on the employment of mercury-free testing equipment. This work has shown positive results up to now and the Norwegian Petroleum Directorate estimates that more definite results will be available during the first half of 1984.

Until the mercury problem has been brought under control, the Norwegian Petroleum Directorate has engaged the Occupational Hygiene Institute to carry out urine analyses of personnel who, during their work, become exposed to mercury, with the objective of monitoring the health risks involved.

The Norwegian Petroleum Directorate has the impression that the number of workers who have become exposed to mercury in recent years has been reduced and that the general hygiene, which is especially important when working with mercury, has improved.

New drilling vessel for northern waters

A new type of drilling vessel, planned for all-year drilling in arctic waters, is under construction (Project-85). Many of the working environment problems encountered in connection with drilling activities have been related to conceptual design. What is so special about Project-85 is that, because of the climatic conditions, it will be a closed concept, something which again requires other safety measures than those which are established in the industry. This will require fundamental technological re-thinking, for example with respect to area classification, safety systems, drilling and drilling fluid technology, as well as working procedures.

The project aims at reducing the manual handling on the drill floor connected with the addition of chemicals, as well as enclosing the drilling mud process to the greatest extent possible, and to base the monitoring to a larger extent on instrumentated systems.

Contamination in drilling mud chemicals

Analyses of drilling mud chemicals carried out on the initiative of both the operating companies and the Norwegian Petroleum Directorate have revealed that contamination in the form of components dangerous to health may be present in certain products.

By way of example it may be mentioned that crystalline quartz, which may lead to the lung disease silicosis, may be present as contamination in certain drilling mud chemicals in quantities which may be hazardous to health.

On the basis of data available to the Norwegian Petroleum Directorate, it appears highly probable that asbestos is not present as an additive to any product forming part of the drilling or production process on the Norwegian continental shelf. Asbestos has been found as a

contaminating agent in certain products, however. The extent varies and is dependent on where the product has been produced. This results in stringent requirements on the burden of documentation placed upon manufacturers and suppliers.

Oil-based drilling mud

Mobil Exploration Norway Inc. carries out chemical analyses of different types of drilling mud, as well as individual chemical components used as additives.

The objective of such analyses is to establish better knowledge regarding the chemicals, as well as to better be able to document the real risks which are tied to the handling of these chemicals. This knowledge will be useful in connection with epidemiological considerations at a lager stage, if over-incidence of certain effects becomes identified as the result of long-term exposure.

The Norwegian Petroleum Directorate regards it as positive that the operating companies themselves start investigations and surveys of possible safety and health hazards, as in this case.

Working environment aspects of oil-based drilling mud

The use of petroleum based drilling mud (diesel and mineral oil with different aromatic content) represents an increased toxicological risk for those involved in the mud handling process. The toxicological risk may be reduced and become acceptable if the process of which these chemicals form a part is so constituted that the exposure for the employees is kept at a level which is not dangerous to health. The introduction of oil based drilling mud in a process which, on the contrary, was developed with a view towards the use of water based drilling mud, led to an exposure level which at times was unacceptable. The technical safety measures which have been adopted have hitherto been limited to increased ventilating capacity, with increased noise and draft as a result. Thus new working environment problems have been created.

In addition to oil, chemicals are components of drilling mud, the possible toxicological properties of which are relatively little known. In addition,chemical reactions may take place at the drill bit, owing to increased temperature and pressure. The extent to which this may influence the toxicological characteristics of the drilling mud is unknown. The Norwegian Petroleum Directorate has no particular occupational hygiene requirements for the storing and handling of oil based drilling mud in general, or low aromatic drilling mud in particular, but generally speaking the mud handling process must be so adjusted and adapted to the various chemical components that the exposure level becomes acceptable.

In all industry there will be a compromise between the health hazards represented by process chemicals and the technical safeguard aspects which have been incoporated into the process. Parallel with the development of better reservoir technology products, it will be logical to develop a safety technology as an integrated part of the process, to take care of all aspects of safety, from the point of view of health, the environment and the material involved. This will entail the introduction of technical measures and the incorporation of

altered handling procedures, as for example by the partial or complete enclosure of the drilling mud process, with increased use of monitoring by instruments and an effective local hood extractor system.

In addition, handling procedures should be arranged which result in minimal skin exposure to the mud, as for example by the installation of testing facilities for the mud directly connected to the mud laboratory, and with instrument monitoring of the physical and chemical parameters of the mud. It ought to be possible to replace visual control of liquid levels in the tanks with liquid level sensors. This will affect the operational procedures for monitoring the mud. It is a presupposition, therefore, that parallel with the introduction of improved monitoring technology in the mud process, a training program will be completed for the employees so as to maintain the technical safety aspects of drilling.

In the view of the Norwegian Petroleum Directorate, it ought to be possible to increase the safety conditions and reduce the risk of human failure through functional automation of the control procedures relating to the monitoring of the mud process.

Sound solutions on this point will require a technological development and a change of attitudes which will require some time. This does not prevent the Norwegian Petroleum Directorate from placing stringent demands on the environment, thereby seeking to implement re-thinking and new development within processes which entail problems for the working environment.

Compounds affecting genetic messengers - drilling mud

Drilling mud is a combination of clay, water or oil, and a series of chemical substances. The Norwegian Petroleum Directorate has had carried out an investigation to determine if different types of drilling mud contain mutational compounds. Mutational compounds are substances which influence the hereditary matter (DNA) in the cells and can thereby cause genetic damage. These investigations were conducted with respect to certain bacteriological tribes. If drilling mud contains mutational compounds, therefore, this could thus represent a health hazard for persons exposed to them. Mutational compounds might be thought of as either forming part of a process formula or as being formed through chemical reactions during drilling operations, as for example the result of high pressures or temperatures. Both newly mixed and used mud, therefore, were tested during this investigation.

The examination shows that none of the extracts from the drilling mud samples induced mutations which could not be explained on the basis of the impact of residues of solvents present from the preparation of the sample. Several of the samples were, however, toxic with respect to the bacteria, and this limits the dosage area in which these tests can be carried out. It is not possible, therefore, to entirely exclude the possibility that some of these test samples may contain mutational compounds. To establish this definitely, systematic attempts with different preparation methods for the drilling mud test samples will have to be carried out.

Maintenance of occupational hygiene data sheets

The Norwegian Petroleum Directorate is of the opinion that follow-up of Section 11 of the Working Environment Act, pertaining to the establishment and maintenance of a file of occupational hygiene data sheets, reveals a positive trend.

The quality of the documentation which is supposed to be given through these data sheets, however, varies greatly and at times is unsatisfactory. The Norwegian Petroleum Directorate regards it as an important task for the operating companies to incorporate the generally stringent criteria for quality applicable to the industry into the occupational hygiene documentation which, pursuant to the law, shall be made available by manufacturers and suppliers of chemical products.

GUIDELINES FOR THE HANDLING OF ASBESTOS AND PRODUCTS CONTAINING ASBESTOS

The Working Environment establishes that toxic and other health-hazardous materials shall not be used if they can be substituted by other materials which are less hazardous to the employees. The Act further authorizes the Norwegian Petroleum Directorate to prohibit the use or storage of health- hazardous materials and products on offshore installations, as well as authorizing the Norwegian Petroleum Directorate to establish specific conditions for the use or manufacture of a material.

On the basis of the experiences made in the light of industrial medicine through exposure to asbestos fibre materials, the Norwegian Petroleum Directorate on 27 March 1980, pursuant to Section 11 of the Working Environment Act, issued a general prohibition against the use of asbestos and materials containing asbestos.

In certain instances, however, as for example with respect to major maintenance work involving previously installed asbestos materials (ceiling panels, pipe insulation materials) the Norwegian Petroleum Directorate will have to provide dispensation from the prohibition.

On this background, the Norwegian Petroleum Directorate has prepared guidelines (ISBN-82-7257-127-7) which give an account of the Directorate's requirements with respect to the proper handling of asbestos and materials containing asbestos in those cases where the Norwegian Petroleum Directorate finds it possible to give dispensation for the use of such asbestos materials.

Polymer fever

The Norwegian Petroleum Directorate is under the impression that within the industry generally there is an increased activity with respect to research involving illness symptoms which may be caused by the handling of certain products.

In this connection it may be mentioned that one operating company has identified cases involving polymer fever with the handling of communications cables. In addition, the operating company has established a correlation between increased risks of polymer fever and

persons who smoke.

This tends to indicate that polymer may get transferred from the cables, via the fingers, to the tobacco and the paper which thus becomes contaminated. The temperature of the cigarette glow changes the polymer into components which produces symptoms of polymer fever on inhalation.

Information has been received concerning corresponding cases, both on other installations and from electricians working in ship yards on shore.

In the electrical industry a manufacturing name is used as the generic name for all cables, regardless of who the manufacturer in fact may be, but the operating company has identified a type of fabrication which, with great probability may be related to these symptoms. Samples of the cable are now being analysed. A possible explanation may exist by virtue of the teflon contents which, according to the supplier, is used as top-coating between the electrical conductors of the cable.

Information relating to such problem areas which have become identified gets distributed through internal safety notices on the fields involved. To the extent it may be of general value to everyone, such information may also form the basis for safety bulletins issued by the Norwegian Petroleum Directorate to the petroleum industry.

FIRE DAMAGE

Below is a summary of instances of fire damage on fixed production installations in 1983, based upon reports submitted to the Norwegian Petroleum Directorate by the operating companies:

Damage resulting from fire	Construction Phase	Operating Phase A	B	C
Personal injuries and great material damage				
Personal injuries and minor or no material damage				
No personal injuries, but major material damage		1		
No personal injuries and minimal or no material damage		19	10	
TOTAL FIRES		20	10	

A - Cause of fire: Result of operation/operating accident
B - Cause of fire: Construction work
C - Cause of fire: Other causes

The Norwegian Petroleum Directorate has registered a total of 30 fires in 1983, against 31 in 1982.

None of the fires caused substantial damage to the installations.

WORK ACCIDENTS

The Norwegian Petroleum Directorate's summaries of personal injuries embrace injuries which have occurred on production installations, as well as in connection with diving activities on the Norwegian continental shelf.

The Norwegian Petroleum Directorate's registration system for accidents is based upon the use of electronic data processing. The registration system was altered in 1982 in order to provide the best possible presentation of the risks connected with technology and operation. The new system provides greater possibilities for the identification of the connection between cause and contributing factors in the occurrence of an accident.

The Norwegian Petroleum Directorate has conducted an audit of the operating companies's registration of injuries for the years 1980 to 1983. This audit revealed an over-reporting of injuries, i.e. the Norwegian Petroleum Directorate received injury reports which did not meet the established criteria for reporting of injuries. The extent of such over-reporting amounted to approximately 10 per cent of the overall number of injuries. These reported injuries have now been removed from the registers. The reason this has not reduced the number of injuries per year in a corresponding degree is that during the audit it was developed that some injuries had not been reported as they should have. The total reduction of injuries for the period in question, therefore, amounts to 1.3 per cent.

The Norwegian Petroleum Directorate is aware that some uncertainty remains as to the statistical material involved. This is due to several factors, including the fact that the operating companies appear to have certain problems in controlling the accuracy of reporting by the contractor companies. In addition, there appear to be different conceptions as to how the reporting rules are to be carried out in practice. This results in the receipt by the Norwegian Petroleum Directorate of insufficiently prepared reports in some cases, which are difficult to classify, in addition to which non-systematic errors sometimes occur in the registration of injuries.

Work is continuous with respect to the control and correction of the statistical base materials, and with respect to the improvement of the reporting system, in order to eliminate the above mentioned sources of uncertainty.

Corresponding uncertainty is a general problem connected with most injury registrations and is thus not typical for the activities on the continental shelf. Nevertheless, it is the Norwegian Petroleum Directorate's impression that its injury statistics present a reliable picture of the injury frequency insofar as production installations on the Continmental Shelf are concerned.

ACCIDENT STATISTICS FOR 1983

The Norwegian Petroleum Directorate's statistics of personal injuries are based on reported injuries which satisfy the following criteria: Death, absence from work during the succeeding 12-hour work shift, or injuries which have resulted in medical treatment. By medical treatment is meant that a medical doctor, directly or indirectly, has participated in the trteatment of the injury.

These criteria for the reporting of occupational injuries entail that the statistical material cannot directly be compared with corresponding reports from other activities, inasmuch as continental shelf activities are subjected to different and partly more stringent reporting requirements.

Table 3.a. shows among other things a summary of occupational injuries and deaths per 1000 man labour years during the period 1976-83 on production installations, exclusive of diving operations.

The table reveals a marked reduction of work accidents in 1983 as compared with 1982.

Injuries which occurred on the installations outside working hours (leisure time injuries) are not included in the Tables 3.a to f. For the period 1979-83, the leisure time injuries amount to 2.9 per cent, against 3.8 per cent for the single year 1983. The Norwegian Petroleum Directorate does not believe that this means an increase in the number of leisure time injuries, but rather that the reporting of injuries has improved.

The Norwegian Petroleum Directorate has furthermore had reason to question the reliability of the number of reported working hours for particular years (cf. the Norwegian Petroleum Directorate's Annual Report for 1982). In connection with the alteration of the registration system in 1982, the Norwegian Petroleum Directorate obtained reports on the number of working hours distributed over the different activities during the period 1979-82. Table 3.b shows how the the injury frequencies are distributed in accordance with the different functions of the employees. Drilling activities generally have shown a high injury frequency, but show a positive trend towards lower values. This is the result of the interaction of several factors. A probable contributing factor is the ever increasing positive attitude and follow-up by the involved parties.

It is also interesting to note the reduction within the construction and maintenance activities, which amounts to a substantial contribution to the overall reduction.

Table 3.c compares injury occurrence and occupation for the period 1982-83.

Table 3.d compares injury occurrence and injured parts of the body for 1982-83.

Table 3.e compares injury occurrences and contributing factors surrounding these occurrences, i.e. it provides further information on factors connected with the work situation which may have contributed to or been the trigger for an accident. The table embraces the years 1982-83.

Table 3.f gives a summary for the years 1979-83, based on the same arrangement as in Table 3.c.

Figure 3.a provides a summary of the distribution of injuries for 1983, within the categories designated "unspecified", "less serious", "serious" and "dead". This categorization is based upon a consideration of the nature of the injury, not upon the length of the absence from work. Within the category "serious", for example, are included amputations, major skeletal injuries and mutilation, second and third degree burns/ frostbite, and other injuries which may result in longer periods of convalescence and permanent injury.

The new classification system provides greater opportunity for setting up comparisons which may provide valuable information on possible causal relations behind work accidents.

Examples of this are shown in Figures 3.b and 3.c.

Figure 3.b shows a summary of the distribution of work accidents per hour on work shifts which commence at different hours during a 24-hour period. As shown by the diagram, the greatest variations are found in the work shift commencing at 0600 hours, where most of the injuries are found between the fourth and sixth hours of the work shift, and between the eighth and eleventh hours of the shift. Figure 3.c shows a summary of the number of accidents per day, during offshore work periods of different lengths.

These summaries are only meant to be presented as examples and the numbers behind the diagrams will be examined more closely in order to, if possible, obtain any explanations for the variations.

Diving

Figure 3.d provides a summary with respect to the number of personal injuries reported to the Norwegian Petroleum Directorate for the years 1978-83, in connection with diving activities on the Norwegian continental shelf. The summary embraces the number of cases of decompression sickness, other injuries, number of fatalities, and number of man-hours in saturation. "Man-hours in saturation" has been selected as the basis for the expression "activity".

From Figure 3.d it appears that despite a large increase in activity, there has been a marked reduction in the total number of personal injuries. This is a positive tendency which it will sought to improve still further through active efforts.

In 1983, a total of six deaths occurred in connection with diving.

In one accident, five experienced divers lost their lives through an explosion-like drop in the gas pressure of the pressure chamber complex in which they were located. The locking mechanism between the diving bell and the chamber complex probably opened too early resulting in an explosion-like release of gas which, amongst other things, forced the diving bell away from the chamber complex. Four divers in the chamber system died immediately. Two divers who assisted from the outside were thrown down and seriously injured. One of them later died as the result of his injuries.

The other accident cost one diver his life when he was carrying out surface-oriented diving and got his hose (umbilical), which supplies breathing gas, heat and communication, sucked into one of the ship's side propellers.

Summary

Serious accidents and accidental deaths occurred in connection with the petroleum activities in 1983.

A total of six fatalities occurred in two accidents connected with diving operations. In addition, the following accidental deaths occurred:

One person was killed on a flotel, in connection with maintenance work on a lifeboat which fell down.

Another person was killed on a drilling platform, in connection with the hoisting of pipes onto the drill floor.

As regards work accidents involving personal injury on production installations, there has been a marked reduction in the intensity of injuries from 1982 to 1983.

Despite two accidents involving deaths in 1983, with an aggregate of six fatalities, insofar as diving is concerned there has been a marked reduction in the number of personal injuries compared to the level of activity for the period 1978-83.

The Norwegian Petroleum Directorate is of the opinion that this positive tendency in the form of a reduction in the incidence of injuries is the result of a valuable contribution from the involved parties in the petroleum activity.

4. PETROLEUM ECONOMY

4.1 COSTS CONNECTED WITH ACTIVITY ON THE NORWEGIAN CONTINENTAL SHELF

Investment in field development and production drilling.

The Norwegian Petroleum Directorate has calculated annual costs of field development including production drilling for the period 1970-83. Costs apply to developed fields, fields under development and fields with approved development plans as of 31 December 1983. In addition, similar estimates have been worked out for the remainder of the century. Figures are based on operator reports.

Only the Norwegian parts of fields lying on both sides of the dividing line between Norway and Great Britain are included. The following fields are included in the calculations (Norwegian share):

- The Ekofisk area (including five fields and Tor, Albuskjell, the Norpipe pipeline and the water injection project).
- Valhall
- Ula
- Frigg (including pipeline)(60.82 %)
- North East Frigg
- Odin
- Statfjord (84.09 %)
- Murchison (25.06 %)
- Heimdal
- Gullfaks Phase I
- Statpipe.

All figures are in Norwegian kroner. Figure 4.1.a shows total costs for field development including production drilling, indicated in current value and fixed 1983-value. The reason for presenting the years from 1970-83 in fixed 1983-kroner is to show activity levels during the entire period using comparable figures. Petroleum activity investment price indexes from the national accounts have been used.

In 1983, a total of some NOK 19.5 billion were invested in field development, including production drilling and pipeline laying. The investment level will reach a peak in 1984, thereafter declining rapidly. The investment level of 1984 is especially high due to great activity in the construction of Gullfaks Phase I and Statpipe.

Figure 4.1.a shows total investments including production drilling for developed fields and fields decided on for development at 31 December 1983.

Total costs for production drilling for developed fields and fields decided on for development at 31 December 1983 are given in Figure 4.1.b.

Figure 4.1.c shows the Norwegian companies' share of total investments (including pipeline projects) in developed fields, fields under development and fields decided on for development by 31 December 1983. The Norwegian companies' share in 1983 was some 56 per cent. Statoil's share in 1983 was about 47 per cent.

Operating Costs

Total costs for operating and maintaining fields including transport and terminal expenditures amounted to some NOK 9.5 billion in 1983.

Figure 4.1.d shows annual operating costs for developed fields, fields under development, and fields decided on for development by 31 December 1983 in current kroner and fixed 1983-kroner. Figures are based on operators' reports. Figures from 1984 have been estimated. Conversion of figures from 1974-82 to fixed 1983-kroner, is based on the wholesale price index.

4.2 EXPLORATION DRILLING AND SUPPLY OF GOODS AND SERVICES

The exploration market has grown substantially both in volume and value since it started in 1966. Figure 2.2.2.a shows the number of wells started per year in the period 1966-83. Figure 4.2.a presents growth in value on the market in both current kroner and fixed 1983-kroner. In 1966, goods and services to the value of NOK 65 million were consumed. Ten years later, deliveries made up NOK 860 million, reaching a temporary peak in 1982 of about NOK 4.9 billion current. In 1983, deliveries were approximately NOK 3,700 million current.

Figure 4.2.b shows how the NOK 3.7 billion may roughly be divided between a number of goods and service groups. Table 4.2 shows a further subdivision of the main groups of goods and services.

The "miscellaneous" group may seem unduly large: It has proved difficult to define the items under this heading accurately. It may be mentioned that a relatively large share of miscellaneous services consist of well-heads and diving services.

The figures presented are based on data reported by the oil companies and reflect costs for all wells spudded in 1983. For wells started towards the end of the year, total cost and cost distribution have been calculated by the Norwegian Petroleum Directorate.

It should be pointed out that the above figures are somewhat uncertain. Nevertheless, they give a good idea of the level of individual goods and service categories in relation to total costs.

4.3 ROYALTIES

Royalties are calculated on the basis of the value of petroleum quantities produced. In 1983, royalties amounted to some 25 per cent of total taxes and duties procured from the petroleum activities on the Norwegian continental shelf.

The Norwegian Petroleum Directorate is responsible for the collection of royalties.

Interpretation and implementation of existing laws and regulations regarding assessment of royalties involves legal and economic, as well as measurement-technology questions.

The first regulations in this area were presented in King's Resolution of 9 April 1965. Of the fields in production today, production licences for Ekofisk, Frigg, North East Frigg and Valhall were awarded

in accordance with these regulations. King's Resolution of 9 April 1965 was superseded by King's Resolution of 8 December 1972. Of fields in production, production licences for Statfjord and Murchison were awarded in accordance with the 1972 resolution.

4.3.1 Total royalties

In 1983, a total of NOK 7,663,945,116 were paid in royalties.

Table 4.3.1 shows the distribution of royalties by petroleum product paid in 1982 and 1983.

4.3.2 Royalties on oil

In 1983, the Norwegian Petroleum Directorate received the amount of NOK 5,484,196,548 in royalties on oil from Ekofisk, Statfjord and Murchison.

Settlements with regard to crude oil were based in 1983 on the standard price. Royalties were paid quarterly as shown in Table 4.3.2.

4.3.3 Royalties on gas

In 1983, the Norwegian Petroleum Directorate received NOK 2,048,095,253 in gas royalties. Table 4.3.3 shows royalties paid by company/group each quarter.

Gas royalties have been settled on the basis of contract price. This is different from group to group.

The payment made by Methanor is settlement for that part of the oil royalty which was taken out in the form of produced oil. In addition to the tabulated quarterly payments, Methanor paid NOK 11,743,318 for the fourth quarter of 1983.

The refund of some NOK 5.7 million is a payment to Phillips Petroleum Company Norway to cover costs at Ekofisk which accrued on that part of the state's royalty which was taken out in the form of produced crude.

The Petronord group royalties for the Frigg area for the period 1977-83 were settled in accordance with temporary guidelines. However, agreement has been reached between the Norwegian Frigg-group and the authorities on a distribution between deductible and non-deductible installations in the royalty accounts for the Frigg field based on the "Ekofisk Model" used as the basis for the 1965 concessions.

Gas transport from Murchison began on 15 July 1983. The dry gas is taken out at St. Fergus and sold to the British Gas Corporation.

In accordance with King's Resolution of 1972, royalties on propane and butane landed from Murchison together with crude should be calculated according to the same excise rate as Murchison oil, i.e. 8 per cent.

Royalty on NGL which is landed with the gas is to be taxed at a rate of 12.5 per cent. NGL transported together with the gas to St Fergus is sold for the time being to Shell and Esso at the Peterhead Power Station and to British Petroleum Gas at Cruden Bay. When the plant at

Mossmorran is completed (about August 1984), NGL will be sent there for treatment and storage. Shipment of NGL will be made from Brayfoot Bay.

4.3.4 Royalties on NGL

In 1983, NOK 131,653,315 were paid in NGL royalties. Table 4.3.4 shows royalty payments made by companies and groups each quarter.

4.4 Acreage fees on licence areas

The Norwegian Petroleum Directorate collected NOK 94,913,508 in acreage fees in 1983. The amount is distributed among the concessions as follows:

Concessions announced in 1965:	NOK 55,184,578
Concessions announced in 1969:	NOK 24,150,000
Concessions announced in 1971:	NOK 1,703,000
Concessions announced in 1973:	NOK 2,423,600
Concessions announced in 1975:	NOK 3,183,282
Concessions announced in 1976:	NOK 5,021,705
Concessions announced in 1977:	NOK 1,170,473
Concessions announced in 1982:	NOK 936,000
Concessions announced in 1983:	NOK 1,140,870
	NOK 94,913,508

As of 10 November 1983, the Norwegian Petroleum Directorate has refunded NOK 20,281,248 in acreage fees. This represents the deductible portion of the acreage fees for Production Licences 006, 018 and 037 for the period 1 October 1982 to 1 November 1983.

4.5 PETROLEUM MARKETS

4.5.1. The oil market

The price of oil from the Norwegian continental shelf is determined by supply and demand on the markets for crude oil. Due to a change-over to other types of energy, energy savings, lower economic activity and changes in storage methods, the consumption and therefore the demand for crude oil has declined in recent years. After a continuous period of crude oil price rises from 1973 on, market developments from 1980 to 1983 have produced a substantial decrease in crude oil prices.

Figure 4.5.1.a shows current and real price developments on the Norwegian continental shelf from 1976 to 1983. In terms of 1983 prices, the real price of oil from the Norwegian continental shelf reached a temporary high during the fourth quarter of 1980, when it was more than USD 48 per barrel. From this time until the second quarter of 1983, the real price of Norwegian oil sank by some 37 per cent. One has to go all the way back to 1979 to find a lower real dollar rate on crude. Yet, a considerable part of this decline in real price is due to an increase in the dollar exchange rate. The actual real price decline on crude oil in Norwegian kroner was about 8 per cent.

The low demand of the last three years continued into 1983. Because of a mild winter in 1982-83, demand increases on the oil market traditionally connected with the winter season did not take place. In addition, with OPEC's problems in establishing common pricing and production policies, which raised expectations of price drops, a further decline in oil demand resulted during the first quarter of 1983. These factors led to OPEC's having a capacity utilization of only 51 per cent at the beginning of 1983. During the first quarter, OPEC production dropped further so that production in February was below 15 million barrels per day, representing a capacity utilization of about 45 per cent. Low demand caused by price expectations further depressed the market. This is illustrated by the fact that the spot price of Ekofisk crude dropped from USD 31.56 per barrel in January to USD 28.75 per barrel in March.

At the OPEC conference of March 1983, a production ceiling of 17.5 million barrels per day was agreed upon, representing a capacity utilization of about 53 per cent. A crude oil reference price of USD 29 per barrel was established. This price, all of 5 dollars lower than the reference price at the beginning of the year, has remained unchanged since April.

During last year, the spot market price was useful as an index for the market value of oil. This was due to an increasingly larger share of oil companies' needs being met by this market. It is estimated that 30-40 per cent of the large multinational oil companies' crude oil needs are satisfied by the spot markets.

After the OPEC meeting in March, the price decline of the first quarter was followed by a price increase on the spot markets, reaching a peak in August with a price on Ekofisk crude of USD 31.31 per barrel. In the same period, OPEC production rose from 15.2 to 18.9 million barrels per day.

The OPEC production rise, which continued into September at the rate of 19 million barrels per day, together with stable oil production in the remaining producing countries, resulted in a downward pressure on market prices which continued throughout the entire fourth quarter of 1983. This brought the spot prices down, so that the spot price on Ekofisk crude was USD 28.85 per barrel in December, some 10 per cent lower in dollars than in December 1982. Still, it is to be noted that throughout 1982, and especially during the last quarter, the dollar exchange rate rose substantially in relation to most countries' currencies, so that the price of oil as seen in currencies different from dollars did not declined as much as it would seem from the drop in the spot price. In Norwegian kroner, the spot price for Ekofisk crude rose during the last quarter, and at the beginning of 1983 it was about the same as the average price in December. Considering 1983 as a whole, it may be claimed that the real oil price drop which took place corresponds to inflation when measured in Norwegian kroner.

Figure 4.5.1.b illustrates developments in spot and standard prices for oil from the Norwegian continental shelf in 1983 in Norwegian kroner and US dollars. For comparison, price development in the spot market for Arab Light are shown. This is a crude oil type which, because of its great market share, serves as a crude oil market index. Figure 4.5.1.c shows capital utilization in OPEC for the same period.

Price changes throughout the year as compared with OPEC production indicate that price stability is still sensitive to changes in supply. Even limited rises in supply affect prices, and it appears there is a continued downward pressure on market rates. Beginning upsurges in economic activity in the US and later in Western Europe still appear not to have affected the oil market through price increases. Nonetheless, some observers are of the opinion that bottom was reached during the second half of 1983. The total shipment of crude oil from Ekofisk (via Teesside), Statfjord and Murchison (via Sullum Voe) was 29.2 million tons in 1983, cf. Figure 4.5.1.d. This is a growth of 26.8 per cent compared with the previous year. About 20 per cent of these shipments went to refineries in Norway. In 1982, the US was the largest receiver of Norwegian oil. In 1983, Great Britain took over as the major receiving country.

Of the licensees on the Norwegian continental shelf, Statoil sold the most crude oil.

4.5.2 The gas market

The market for Norwegian dry gas is limited to Great Britain and the Continent, including West Germany, the Netherlands, Belgium and France. Total gas export in 1983, as shown in Figure 4.5.1.d, was 24.4 billion Sm3. This is approximately the same export volume as in 1982. There were exported 11.6 billion Sm3 to Great Britain and 12.8 billion Sm3 to the Continent.

Gas deliveries from the Ekofisk area and Frigg will be made for the duration of field lifetimes, according to long-term contracts already entered into. The most important clauses, besides pricing, deal with delivery quantities -- among other things, how much gas the buyer may receive in winter as opposed to summer.

In 1981, for the first time, there was a decline in gas consumption in Western Europe. The decline was connected, not least, with low economic activity during the period 1980-83, and the fact that coal and nuclear power have replaced gas as a fuel in industry and electricity generating stations. In the same way, extensive energy saving measures have reduced energy consumption in general.

Prices in contracts made until now have been determined by two factors: a basic rate, and an escalation formula. The basic rate is determined by negotiations between buyer and seller, and is set at a level which is considered to reflect the competitive situation on the gas market, as well as the parties' needs for capital yield at the time the contract is made. The escalation formula is designed to link the contract price to various indexes covering, among other factors: price changes in competitive oil products, price changes on crude oil, general inflation, and currency fluctuations.

Figure 4.5.2.a shows how the average contract price for Norwegian gas developed in comparison with the market price for Ekofisk crude.

Because of contractual regulations with regard to price adjustments, the diagram shows that there has been a certain displacement in time between price changes on crude oil and the esclation of the gas rate. The reason for the non-parallel development is that the gas rate is connected to other factors in addition to the crude oil price.

It may be seen from the diagram that gas experienced had a lower percentage rise than crude oil, and that gas prices may rise even in periods with falling crude oil rates. These factors indicate that, in periods with unstable oil prices, the gas price may act to stabililize the total production income from continental shelf activity. This, however, is dependent on the two being out of phase, viz: that a decline in the gas price which results from a previous drop in the oil price does not arrive at the same time as a new drop in the oil price.

Figure 4.5.2.b shows, among other things, that Elf Aquitaine was one of the licensees on the Norwegian continental shelf who sold the greatest amount of dry gas in 1983, some 5.6 billion Sm3. Norsk Hydro sold about 4.5 billion Sm3 in 1983, whereof some 3.7 billion Sm3 went to British Gas Corporation, and 0.8 billion Sm3 to the continental buyer group.

5. FUTURE ACTIVITY

PERSPECTIVES FOR PETROLEUM ACTIVITIES ON THE CONTINENTAL SHELF

Background for the Petroleum Outlook 1983.

The analysis for the year was prepared as a continuation of the Petroleum Outlook issued for 1982. There have been incorporated some substantial alterations, as a result of decisions made and new information developed during the course of the year:

- The most optimistic of the expectations as regards gas discoveries off northern Norway have not materialized. As a result, it is probable that it will require a longer time to establish a sufficient reserves base for development than assumed in the 1982 analysis.

- The reserves expectations for the Troll field have been confirmed through drilling in the neighboring blocks to Block 31/2. The analysis is based upon expected recoverable gas reserves of the order of 600 billion Sm3.

- The sales negotiations with respect to the Sleipner field have been delayed with respect to earlier plans. The analysis presupposes that an application for field development will be considered during the spring session 1984.

- Saga has made an oil discovery in Block 34/4 which probably extends into Block 34/7 as well. New drillings of exploration wells have resulted in the up-grading of the reserves estimates in the Alpha and Beta structures of Block 34/10. These changes in the oil reserves picture have been decisive insofar as the preparation of an oil-based field development solution is concerned. In this connection, too, the specific plans for pipeline transport of oil from the northern North Sea, amongst other things in connection with planning for the Oseberg project, have been crucial.

- Insofar as the Petroleum Outlook is concerned, substantial elements have become firmly established inasmuch as the Ula project and the Ekofisk water injection project are being executed.

In addition to these circumstances, insofar as specific fields are concerned, regard has been taken in this year's Petroleum Outlook to the decision by the Norwegian parliament not to open up new areas for exploration for the time being, but rather to expand the activities for those already existing.

In addition, an attempt has been made in this year's analysis to consider the applicability of those guidance criteria which have been suggested by the recommendations of the Tempo Committee.

SCOPE OF THE ANALYSIS

The Norwegian Petroleum Directorate in its Petroleum Outlook has sought to analyse the consequences of variations amongst important external factors, such as price and market conditions. In addition, the consequences of applying different guidance criteria, such as total demand and the tax revenue's contribution to the gross national product, have been considered. This has been done through the

construction of different development paths. It is emphasized that these development paths are only meant as illustrations of different courses of development.

SUMMARY AND CONCLUSIONS

The most important conclusions of the Petroleum Outlook and the consideration of different development paths may be summarized under the following headings:

The reserves base

The basis for future activity is an expected reserves potential of approximately 4.7 billion toe. More than 70 per cent of these reserves are located between 60 degrees and 62 degrees North.

The proven gas reserves of Troms I and Haltenbanken are not presently sufficient to form the basis for economic operations. Substantial gas production from the northern areas does not appear to be possible before the turn of the century, owing to the time one assumes will be required to establish a sufficient resource base and to build the production installations.

The oil discovery on Haltenbanken and the many indications of oil formations in the northern areas generally, increase the hopes for a major oil discovery in the future. Should this hope materialize rapidly, by drilling on blocks allocated during the eighth round, there will be a possibility of starting production towards the end of the 1990s.

The proven reserves which form the basis for future development, are expected to be markedly more expensive to recover than those developed so far, amongst other things by reason of greater ocean depths and increasing distance to the markets. The average sizes of the structures also become smaller as the largest gradually come onstream.

The increasing costs connected with future developments are placing ever increasing demands on technological innovation and the increased effectiveness of operations. The emphasis on technological research and development ought to be given higher priority.

There is a considerable potential saving in the use of idle capacity in the existing and planned production and transport installations.

The decisions which must be made in the near future, will involve the most profitable as well as the most extensive parts of the total potential reserves in the North Sea. This applies, inter alia, to decisions concerning the development of Sleipner, Oseberg, Troll, Gullfaks II and Tommeliten. The manner in which these reserves are managed will to a large extent control the shape of activities for the next 30 years.

Concern for the long-term planning of resource management makes it desirable to have an overview of the total resources on the continental shelf, before the long-term development strategy is firmly settled upon. Such a strategy, however, would involve too much of an investment in the exploration phase and, thereby, tie up means which might more profitably have been devoted to field development. A

gradual expansion of opened-up areas, coupled with limited but frequent allocations, is considered to be an important basis for obtaining a broad resource base for the intermediate as well as long term.

Future oil prices are of the greatest importance when planning future activities. Uncertainty in the development of oil prices underlines the requirement for an alert monitoring of the oil markets.

Owing to a lower growth in the consumption of gas than previously assumed, there may at times arise difficulties in marketing Norwegian gas. A certain measure of flexibility, therefore, appears necessary on the part of Norway to so arrange things that the European gas markets can make use of the Norwegian gas.

The Troll field today represents by far the greatest part of those reserves which are identifiable for future development. The size of the field demands that ample time be taken to arrive at satisfactory solutions to the many challenges which the field represents. When, in addition, such solutions are of great importance to the development of the rest of the continental shelf, with similar or even deeper ocean depths, there can be no doubt that Troll represents a mighty motivation to achieve technological advances and utilize them in the optimum manner.

The enormous resources of both gas and oil in the Troll field, at the same time places big demands for an optimum solution which gives the best overall results. A series of circumstances makes it necessary to evaluate the entire field, viewing the four relevant blocks involved as one, before any decision on development is made.

Calculations which have been made indicate that it is sound economics to transport future oil production from the area between 60 and 62 degrees North, through a pipeline to a shore terminal, rather than through buoy-loading. Such a joint transport system is now being considered in connection with the planned development of the Oseberg field.

Other factors

Amongst other factors which are important for the selection of a development strategy, one has to consider the regards for safety; the availability of qualified personnel; the availability of capital; and an optimum use of the mechanical engineering industry. None of the first three factors have become identified as a preventive factor insofar as concerns increasing the activity level above that of today's. Problems of temporary character may arise, however, if the increase is introduced too rapidly. On the other hand, considerably greater problems may arise through major fluctuations in the activity. As regards concern for the capacity of the mechanical engineering industry, it is difficult to define a definite level which may be of decisive importance in the selection of levels for the overall activity.

Profit and loss analysis

The planned allocation of blocks is an important control mechanism for the authorities. Analysis emphasizes, however, that there is a demand for planning in order to so guide the development activity that social objectives may be accomplished.

Even with a considerable amount of failure of the assumed market conditions, through planning it will nevertheless be possible to avoid drastic negative consequences on the investment or production sides. The tax revenues will vary greatly, in pace with the development of petroleum prices. Large deviations from an expected price development might result in great problems as regards income.

One important aspect which is clearly demonstrated by the analysis is that the time interval between the decision and result stages is a relatively long one. Ten years may elapse between the time a discovery is declared commercial until the regular production level is reached. In addition, it may take up to 20 years from the time of licence allocation until regular production is achieved. This means that the consequences of today's block allocations, licence conditions and the decisions concerning development which are scheduled to be made during the next couple of years, will dominate the activities of the present century.

These long time intervals also entail that we will be little able to influence the level of activity within the different phases of the petroleum activity during the years immediately ahead.

The decisions which were made in 1983 concerning the further development strategy will, at the earliest, be able to exert any noticeable influence starting in the year 1987 as regards investments; in 1992, insofar as operating expenses are concerned; and in 1995, with respect to production and the tax revenues.

Statoil's share of the activity is expected to increase in pace with the expansion of the total activity. The Norwegian operating companies will be responsible for most of the development tasks up to the middle of the 1990s.

The level of investments in 1984 and 1985 will, probably, be somewhat lower than in 1983. The investments further ahead can be maintained at the same level as in the past year. Without active guidance, however, they may well display the same types of variations as those which have been experienced so far.

The accumulated operating and maintenance expenses of an individual field may be larger than the total investments. This leads to the result that the operating phase's proportion of the total activity will increase over time and be larger than that of the investment phase, starting with the mid-1990s. This slide effect will, to a certain degree, be able to alter the pattern of Norwegian industry's participation on the continental shelf.

The tax revenues from offshore activities since 1980 have amounted to some 10 per cent of the overall mainland economy. Assuming a moderate price trend, this will remain the future level for those development alternatives which have been analysed. A low price development will cut this level in half, while a high rate of inflation might double the proportional contribution of tax revenues to the economy.

If the petroleum activities were to be scaled in accordance with the long-term objectives for the petroleum revenues, there is great danger that the price fluctuations in practice would lead to considerable instability on the investments side, unless one were able to adhere strictly to stable price expectations. The latter can be difficult to accomplish in practice. A reasonable interpretation of the Tempo Committee's criteria, therefore, will involve the planning of activities in such a manner that, in the short term, they provide a relatively stable investments level and uniform employment. The long-term consquences of plans, as well as individual decisions insofar as incomes are concerned, ought to remain in a satisfactory relationship with the mainland economy.

6. SPECIAL REPORTS AND PROJECTS

In 1983, the Norwegian Petroleum Directorate granted a total sum of NOK 11.7 million for special projects. This amount is distributed on the basis of NOK 2.5 million for the Safety Control Department; NOK 4.0 million to projects under the auspices of the Resource Management Department; NOK 1.0 million to projects of the Legal and Economic Department. In addition, there has been granted the sum of NOK 4.2 million for the project North Sea Ocean Bed Clean-up, which project has been administered by the Administration Department.

Safety Control Department

PROJECT TITLE	PROJECT EXECUTION AGENCY
Membership, Welding Institute	NPD
Updating E & P Data Regulations	NPD, with external assistance
Updating Construction Regulations	NPD, with external assistance
Updating Safety Guidelines for the Evaluation of Platform Concepts	NPD, with external assistance
Hydrogen Induced Stress Corrosion and Hardness of Welded Structural and Pipelines Steels	Welding Institute
Participation in Fatigue Program	DnV/SINTEF
Pipeline Regulations	NPD, with external assistance
Pitting of Structures and Pipelines	DnV
Corrosion Control in Seawater at Depths down to 500 m	DnV
Membership in CIRIA - UEG	
Mooring and Fender Systems Offshore	NTH
Sacrificial anodes - Design Procedures, Fabrication and Installation	DnV
Preparation of Revised Guidance on Underwater Inspection	CIRIA-UEG
Chemicals in the Offshore Industry	Several institutions
Filmproject: The Organized Safety and Environmental Work on fixed installations	Informasjonsfilm og Video A/S
Possible Long-Term Effects of Deep Diving on Divers' Central Nervous System	EUBS/NPD

Code of Safety for Diving Systems	IMO
Code of Practice for the Operation of Manned Submersible Craft	AODC/UK Dept of Trade/NPD
Guidelines for Specification and Operation of Dynamic Positioned Diving Vessels	UK Dept of Energy/NPD
Guidelines for Preparedness	NPD
Advanced Development of Drilling Data Bank	Rogalandsforskning
Revision of Drilling Regulations	NPD
Evaluation of New Equipment and New Technology for Drilling and Completion	NPD
Safeguards for Electrical Motors in Explosion Hazard Areas	EFI
Area Classification Regulations and Guidelines	NVE/SSI/NPD
Support to NEC for Participation in International Standardization Work regarding Regulations for Electrical Installations and Area Classification	Norwegian Electronic Committee
Registration and Location of Lightning Discharges	Electrical Association's Research Institute (Norway)
Acceptance Criteria for Hydrocarbon Walls	NPD
Acceptance Criteria for Subsea Production Systems	DnV
Guidelines for Approval of Flexible Hoses and Tubes in Hydrocarbon Systems	DnV

Film Project "The Organized Safety and Environmental Work on Fixed Installations"

Because there had not previously been made any informational films relating to the organized safety and environmental work in the North Sea production fields, the Norwegian Petroleum Directorate decided it was timely to give high priority to such a project in 1983.

It was felt desirable to make an educational and informational film which might demonstrate adequately how questions relating to the environment might be solved in a correct manner. In addition, it was felt right to contribute to a better understanding of those utilitarian values which exist in sound-working safety and environmental work.

On this basis, the Norwegian Petroleum Directorate invited the oil companies to participate in a financial cooperative project for the making of this film, to which the Norwegian Petroleum Directorate contributed one half of the costs.

In order to complete the project in a professionally sound manner, there was established a resource group, comprized of two chief safety delegates as representatives from the employees, and two staff members from the companies' safety departments. The total expenses for the project amounted to NOK 360,000, and the project was completed in June 1983.

Today the film is used in connection with safety training, by employer/ employee organizations, companies and different educational institutions. Even though there have been different reactions to the film, the Norwegian Petroleum Directorate believes it will function in accordance with intentions, viz. creating a basis for an extensive and constructive debate concerning the organized safety and environmental work within the offshore petroleum industry.

Provisional regulations concerning littering and contamination from petroleum activities on the Norwegian continental shelf

In accordance with instructions from the Ministry of Petroleum and Energy, the Norwegian Petroleum Directorate is charged with the responsibility of controlling that exploration for and exploitation of petroleum resources do not needlessly damage or inconvenience other activities, as for example fisheries. For this and other reasons, the Norwegian Petroleum Directorate has intensified its control in this area through meetings with the operating companies, perusal of documents, site inspections and cooperation with other authorities and institutions. As a result of this work various problems have become identified, as regards the recording and reporting of scrap materials, storing, transport, labeling and use of occupational hygiene data sheets and the dumping of hazardous waste on shore.

In addition, the Norwegian Petroleum Directorate in cooperation with the Norwegian Hydrographic Office, has developed a system for the recording and reporting of the presence of scrap materials on the sea bed resulting from the petroleum activities. The objective is to improve information to the commercial fishermen concerning scrap material obstructions, in order to prevent loss of or damage to fishing gear. It is expected that this system may be put into effect early in 1984.

In addition, the Norwegian Petroleum Directorate and the Labour Inspectorate are cooperating with a view towards solving problems connected with the transport, identification labels and dumping, amongst other things, of problematic waste materials from the petroleum activities.

Resource Management Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
Reservoir simulation of Statfjord Field	Institute for Energy Technology
Evaluation of Ekofisk Water Injection	Franlab Consultant
Reservoir Simulation of Horizontal Wells, Troll	Franlab Consultant
Chemical Water Flooding, Oseberg	Institut Francais du Petrole
Leasing of Reservoir Simulation Models	Rogalandsforskning
Marine Geo-Physical Research	Institute for Geology, Univ. of Oslo
Sedimentological Studies of Mesozoic Rock Specimens from the Danish-Norwegian Basin of the North Sea	Institute for Geology, Univ. of Oslo
Diagenetical Examination of the Statfjord Formation, Statfjord & Gullfaks Fields	Intitute for Geology, Univ. of Oslo
Paleontological and Sedimentological Examination of the Jurassic Strata Series in the Northern North Sea	Institute for Geology Univ. of Oslo
Catalogue, Dinoflagellatecysts	Institute for Geology Univ. of Oslo
Workup of Marine Geo-Physical Data etc., Warm-Current Measurements at Svalbard Margin	Earthquake Station, University of Bergen
Examination of Continental Margin in the Lofoten and Jan Mayen Areas	Earthquake Station, University of Bergen
Bedrock Tectonics on the Norwegian Continental Shelf	Institute for Petroleum Technology and Applied Geophysics, Norwegian Institute of Technology, Trondheim
Basement Projects, Core Dating	Univ. of Oslo
Rock Species Studies and Geo-Chemical Analyses	Inst. for Cont. Shelf Surveys, Univ. of Aarhus
Petrographical Analysis of Ekofisk and Tor Formations in Ekofisk Area	Inst. for Cont. Shelf Surveys, Univ. of Aarhus
Jurassic Slate Sedimentation	Univ. of Oslo
Geology of Statfjord Field	Lab. for Applied Palynology

Possibilities for Utilization of Existing Installations on Cont. Shelf	Aker Engineering/DnV
Cost studies for Ekofisk 2/4 K	Aker Engineering A/S

Legal and Economic Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
Water Contents of Oil Stream	Rogaland Research
NEL-Automatic Sampling of Crude Oil	National Engineering Laboratory, Scotland
Decision Analysis Related to Field Evaluation	Chr. Michelsens Institute
Financial Analysis of Project Portfolio on the Continental Shelf, Maintenance and Further Development	SINTEF
Maintenance and Further Development of the Company Model	Chr. Michelsens Institute
Transport Model TARIFF	Kvam Data A/S
Calculation System for Royalty (PABS)	Kvam Data A/S

Transport Costs Model TARIFF

In order to be able to calculate and prognosticate transport costs and the demand for transportation capacity for oil and gas products, Kvam Data A/S, based on an assignment from the Norwegian Petroleum Directorate, has developed the analysis model TARIFF. The Model, which has been developed in close cooperation with the Norwegian Petroleum Directorate, provides possibilities for making economic analyses of existing and developing transport systems which have been decided upon as well as with respect to planned future systems. In addition, it provides the opportunity to evaluate different alternative transport solutions, viewed in isolation and in conjunction with others. The model will be an important tool for planning, field evaluations and the Petroleum Outlook.

Decision analysis related to field evaluation

The selection of strategy for a search for petroleum resources is dependent upon a series of circumstances. In a financial context, it is especially costs and time spent in connection with explorations and the uncertainty tied to the value of possible discoveries which are important.

In order to conduct a systematic processing and evaluation of relevant data, there has in this connection been established a project at Chr. Michelsens Institute to develop a value indicator for fields which have not yet been explored. This value indicator is intended to

summarize all economic distinguishing features connected with the field and the uncertainties tied to them. Simultaneously, the value indicator or price is intended to provide the correct rankings as between the different fields. The field which is assigned the highest price is the best exploration alternative. If the prices on the whole are low, this is supposed to indicate that exploration had best be postponed. Before starting the analysis, the following information must be provided for each field:

- Costs of exploration
- Time interval until start-up of field production
- Distribution of probabilities for the economic value of the field at the moment of production start-up.

Administration Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
Clearing up the Sea Bed of the North Sea	NPD

Clearing up the sea bed of the North Sea

Again in 1983, the Norwegian Petroleum Directorate was assigned the responsibility for implementation of the clearing up project.

The clearing up of scrap materials was conducted during the period 30 May through 3 August. The fishing industry organizations had this year assigned priority to clearing the Egersund banks. Portions of Blocks 10/1, 10/2, 18/11, 18/12 and 19/10 were cleared.

Two stern trawlers were hired for the clearing work, using two types of clearing equipment were used:

- Specially constructed trawl
- Trawling gear with sweeping chain. Onto the chain and wire were mounted 5 anchors.

It was chiefly the specially constructed trawl which was used during this year's project.

In all, somewhere between 200-300 tons of scrap were recovered from the seabed. For the most part, the scrap consisted of old wire.

The Egersund Fishermen's Association by letter to the Norwegian Petroleum Directorate expressed the opinion that this year's clearing up work had been very successfully executed.

The clearing up project is guided by a committee on which the Norwegian Petroleum Directorate, the Fisheries Directorate, the Norwegian Hydrographic Office, the Norwegian Fishermen's Association and the Norwegian Industry Association for Operating Companies are represented. The committee has prepared a final report for the project, in which the various factors relating to the clearance work have been described.

7. INTERNATIONAL COOPERATION

7.1 The European Economic Community (EEC)

The Norwegian Petroleum Directorate still continues to follow the work of the EEC as it relates to the harmonization of safety requirements etc. with respect to the offshore petroleum industry. Norway has observer status in those meetings arranged under EEC auspices under the designation "Safety and Health in the Oil and Gas Extractive Industries". A status of this work was provided through an extensive symposium in Luxembourg on 19 and 20 April of this year, at which the Norwegian Petroleum Directorate was also represented.

In addition, the Norwegian Petroleum Directorate has participated in a working group whose task it has been to look at the possibilities for finding gas in prospects located at greater depths than where exploration is customarily done.

7.2 The International Maritime Organization, IMO

The Norwegian Petroleum Directorate has been represented in a working group for IMO, the International Maritime Organization, which has prepared a code for diving systems onboard ships and mobile installations. This "Code of Safety for Diving Systems" has now been adopted and the material requirements will form the basis for the new diving system regulations of both the Norwegian Petroleum Directorate and the Maritime Directorate.

7.3 EDTC/AODC

The Norwegian Petroleum Directorate's participation in the international organizations EDTC, the European Diving Technology Committee, and AODC, the Association of Diving Contractors, provides opportunities for influencing the ongoing developments. Under the auspices of AODC, the Norwegian Petroleum Directorate has participated in the preparation of the "Code of Practice for the Operation of Manned Submersible Craft".

7.4 Aid to foreign countries

The Norwegian Petroleum Directorate's aid to foreign countries, through NORAD, was continued in 1983 and in accordance with the pattern for 1982. The main thrust of the work has been connected with the two principal cooperating countries, Tanzania and Mocambique.

The tasks in Tanzania have been to provide general advice in connection with the surveying of the continental shelf. In addition, the Norwegian Petroleum Directorate has been involved in the build-up and training of a bio-stratigraphic staff at the National Tanzanian Production and Development Company (TPDC). In connection with the surveying activities bio-stratigraphic studies of drilling wells from both Tanzania and Mocambique have been made.

The assignments in Mocambique have been chiefly tied to the preparations in connection with the allocation of production licences. An evaluation of 17 offshore blocks has been carried out, as a basis for the approaching allocation negotiations. In addition, work has

been done in connection with the further exploration of the Mocambique continental shelf, as well as the training of a research fellow at the Norwegian Petroleum Directorate.

In Burma, Kongsberg Våpenfabrikk has considered the possibilities for increased petroleum extraction from an old oil field, through the aid of steam injection. For the time being, a pilot project is planned and the Norwegian Petroleum Directorate has become engaged through its reservoir technological expertise.

In 1983, the Norwegian Petroleum Directorate completed its "Project Pakistan", through which it has assisted NORAD with the planning and implementation of seismic surveys on the Pakistani continental shelf and recommended the strategy for the allocation of licences and the drafting of petroleum laws.

The Norwegian Petroleum Directorate, in addition, has made some evaluations in connection with new suggested projects in Burma and Bangladesh.

7.5 The International Standardization Organization, ISO

The Norwegian Petroleum Directorate participates in the technological work of measurements standardization carried out by the International Standardization Organization, ISO. International standards form the basis for the measurement of oil and gas. In order to make a contribution to the further development of international standards, the Norwegian Petroleum Directorate participates on the technical committees dealing with standards for the measurement of oil and gas. To make the national work in this area more effective, there has been formed a Norwegian Measurement Technology Forum in which the Norwegian Petroleum Directorate participates.

7.6 Jan Mayen

The border agreement between Norway and Iceland pertaining to the Jan Mayen ridge entails that the countries reach agreement on the carrying out of joint investigations within a more precisely defined area and for which the Norwegian Petroleum Directorate is charged with responsibility for implementation.

The collection of approximately 3,000 km seismic surveys is planned in order to better define the main geological features. The investigations were originally planned for completion in 1984 but, for budgetary reasons, they have been postponed until 1985 (Storting Proposition No. 1, 1983-84).

Preparations for the surveys were started in 1982 and carried further in 1983, amongst other things by transferring the Norwegian Petroleum Directorate's seismic data base for the area to the responsible authorities on Iceland. The preliminary investigations will continue in 1984 through a close collaboration between the Norwegian Petroleum Directorate and the Icelandic authorities.

8. STATISTICS AND SUMMARIES

8.1 Units of measurement

The Norwegian Petroleum Directorate will normally use the units of the International System of Units, the SI system. This system is also recommended for use by the oil companies operating on the continental shelf. However, other units than those whose use is allowed in the SI-system have a very strong position in the petroleum industry for traditional reasons.

Measurement - oil

An exact measurement of an oil quantity by volume must refer to a more closely defined measuring state, characterized by pressure and temperature. This is necessary because the volume of an oil quantity varies with its pressure and temperature. The pressure and temperature which the measured oil volume refers to, is normally its "reference state". The two most common reference states are a) 60 degrees F, 0 psig and b) 15 degrees C, 1.01325 bar.

Pressure and temperature standards other than these may also occur. One should note that expressions like "standard state", "barrels at standard conditions", etc are ambiguous unless the pressure and temperature referred to are defined.

Reference condition (b) is recommended for use by the International Standardization Organization, ISO. Moreover, this reference condition was introduced as a Norsk Standard in 1979, NS 5024 (see Section 8.2). The Norwegian Petroleum Directorate is working to have this reference condition established in the petroleum industry.

Exact conversion of an oil volume from one condition to another requires the use of special tables. For estimated values, however, the volume at 60 degrees F, 0 psig corresponds approximately to the volume at 15 degrees C, 1.01325 bar.

Normal units/ abbreviations:

Sm3 = standard cubic meter. Temperature and pressure references must be given for the unit to have an unambiguous meaning.

Barrels at standard conditions = Traditional American unit. Reference condition normally 60 degrees F and 0 psig.

Conversion

1 Sm3 corresponds to approx. 6.29 barrels at standard conditions.

Measurement - gas

To an even greater extent than for oil volumes, the numerical value of a gas volume will depend on the pressure and temperature to which it is referred. Four reference states are normally employed: a) (60 degrees F, 14.73 psia), b) (60 degrees F, 14.696 psia), c) (15 degrees C, 1.01325 bar), d) (0 degrees C, 1.01325 bar). Reference states a), b) and c) are usually termed "standard conditions", d) "normal conditions".

A volume cannot be converted exactly from one state to another without knowing the physical properties of the gas. For estimates, however, the volume of the same quantity of gas can be assumed to be approximately equal in states (a), (b) and (c), and the volume of this quantity is 5 per cent less in state (d).

Common abbreviations:

SCM or Sm3 = Standard cubic meter
Nm3 = Normal cubic meter
Scf (Scuft) = Standard cubic feet

Temperature and pressure references must be given for the unit to be unambigious.

Conversion

1 Sm3 corresponds to approximately 0.95 Nm3
1 Sm3 corresponds to approximately 35.3 Scf.

Quality measurement - oil and gas

Density or relative density is often used to describe the composition of an oil or gas. A low density value indicates that the hydrocarbon is made up of light components.

Oil:

(a) **Specific Gravity 60/60 degrees F**
The relative density of oil in relation to water. Oil and water at temperature 60 degrees F and pressure corresponding to atmospheric at the place of measurement. The figure is undenominated.

(b) **API-Gravity at 60 degrees F**
Specific Gravity 60/60 degrees F expressed on an enlarged scale. Units are degrees API. Conversion by this formula:

$$\text{API-gravity at 60 degrees F} = \frac{141.5}{\text{Spec. Grav. 60/60 deg. F}} - 131.5$$

(c) **Density at 15 degrees C**
Absolute density at temperature 15 degrees C and pressure corresponding to atmospheric at the place of measurement.

Gas:

(a) **Specific Gravity**
The relative density of gas in relation to air. The content of this concept is not exactly defined unless the temperature and pressure are given. Very often however, no temperature or pressure references are given for specific gravity. For rough calculations this is not very important, as the differences between the values which may be measured/ calculated for the most often used reference states are very small.

Registration of oil and gas in oil equivalents

Oil and gas are often measured in tons oil equivalent in contexts where an exact registration of amount or quality is not required. Conversion is based on the amount of energy liberated in the combustion of the oil or gas. In many cases, the amount of energy in a ton of oil will be close to the amount of energy in 1000 Sm3 gas. This conversion factor is very easy to employ, at the same time as the difference in quality between oil and gas is so large - during processing, storage, distribution and application - that it would not be correct to note the conversion factor more accurately. Normal practice is therefore that:

1 ton oil equivalent (toe) corresponds to 1 ton oil or 1000 Sm3 gas

8.2 Standard reference conditions

Here follows the Norsk Standard NS 4900 - ISO 5024, Standard Reference Conditions, prepared by the Norwegian Standardization Organization (NSF) and reproduced by agreement with the NSF:

- Petroleum, liquid and gas
- Measurement
- Standard reference conditions

The standard contains the English version of the International Standard ISO 5024-1976 and a Norwegian translation. If not otherwise agreed the Norwegian text is binding.

0) Introduction

For many years the results from measurements carried out on petroleum and petroleum products in international trade have been corrected to atmospheric pressure and 60 degrees F.

The global tendency to exclusively use the international system for units of measurement (SI) requires that pressure and temperature are stated in these units. At the same time one is trying to retain the habitual values as far as this is possible.

The hope is that the stipulation of one set of common standard reference conditions will simplify the requirements set by world trade.

1) Orientation and validity

The standard stipulates standard reference conditions for pressure and temperature for measurements carried out on both liquid and gaseous petroleum and its products.

2) Standard reference conditions

The standard reference conditions for pressure and temperature for use in connection with measurements of both liquid and gaseous petroleum and its products shall be 101.325 kPa (*) and 15 degrees C except for liquid hydrocarbons with a vapour pressure higher than atmospheric pressure at 15 degrees C. In this case the standard pressure should be the equilibrium pressure at 15 degrees C.

(*) 101.325 kPa = 1.01325 bar = 1013.25 mbar = 1 atmosphere

8.3 Exploration and appraisal drilling on the Norwegian continental shelf

Since exploratory activities for petroleum started in 1966 in the Norwegian sector of the North Sea, a total of 400 exploration and appraisal wells had been spudded as of 31 December 1983. Of these, 390 had been completed by the same date.

Information from these wells is presented statistically to illustrate some features of the activities.

A total of 1,267,019 meters was drilled in the wells which are included here, of which 135,801 meters in 1983.

The average penetration of the 40 wells drilled to total depth (TD) in 1983 was 3155 meters. Forty wells were spudded during the year.

To drill the wells for which data are given in the table, 53 different drilling rigs were employed, five of them under two different names. Of these, 38 were of the semi-submersible type, ten were jack-ups, three were drill ships and two were fixed installations. In 1983, a total of 16 drilling rigs operated on the Norwegian continental shelf.

The deepest well in the Norwegian part of the North Sea is the British Petroleum operated Well 30/4-1. Drilling started here in November 1978, and was completed in March 1979 at a depth of 5430 meters.

The greatest depth of water drilled in so far is 388 meters. The well was 34/2-3, drilled in 1981 with Amoco as operator.

8.4 Production of oil and gas in 1983

The production of oil and gas on the Norwegian contintental shelf in 1983 was 55 million tons oil equivalent, compared with 48.9 million toe in 1982. In Table 8.4.a and Figures 8.4.a and 8.4.b, the production on the Norwegian continental shelf is presented in more detail.

8.5 Publications by the Norwegian Petroleum Directorate in 1983

Regulations

- Regulations compendium: "Kontinentalsokkelen" ("The Continental Shelf"): An up-to-date compendium of the laws, regulations and guidelines stipulated by the Norwegian Petroleum Directorate and other regulatory agencies. Up-dated to 1 January 1983.

- Regulations on drilling personnel qualifications. Stipulated by the Norwegian Petroleum Directorate on 22 February 1983.

- Guidelines for the specification and operation of dynamically positioned diving vessels. Stipulated by the Norwegian Petroleum Directorate and Petroleum Engineering Division of the UK Department of Energy on 1 May 1983.

- Guidelines for area classification. Stipulated by the Norwegian Petroleum Directorate, the State Inspectorate of Explosives and the Norwegian Water and Electricity Board.

- Regulations for a fishery skilled person onboard seismic vessels on the Norwegian continental shelf. Stipulated by the Norwegian Petroleum Directorate on 28 October 1983.

Research reports

- SSB-Programmet 1978-81 (The SSB Program 1978-81) (SSB = Styringskomiteen for sokkelberedskap = the Executive Committee for Preparedness on the Continental Shelf. English edition).

- SPO-Programmet 1978-81 (The SPO Program 1978-81) (SPO = Styringskomiteen for sikkerhet, prosedyrer og overvåking = the Executive Committee for Safety, Procedures and Monitoring. English and Norwegian editions).

Geological publications

- NPD Paper No. 32, The Southernmost Part of the Norwegian Section of the Central Trough.

Other publications

- Environmental Conditions on Tromsøflaket 71 degrees 30 minutes N, 19 degrees 00 minutes E.

- Guidelines for the Handling of Asbestos and Products Containing Asbestos.

- Opprydding av havbunnen i Nordsjøen 1983. (Clearing up the seabed of the North Sea 1983).

- Oljedirektoratets årsberetning 1982 (the Norwegian Petroleum Directorate's Annual Report 1982)

- NPD Annual Report 1982 (English translation of the above annual report)

- The Norwegian Petroleum Directorate 1973-83, the NPD Anniversary Book.

- List of publications issued by the Norwegian Petroleum Directorate

- NPD Contribution No 1, Structural and Stratigraphic Evolution of the Barents Sea.

- NPD Contribution No 2, Basic Conditions for the Exploration and Exploitation of Mineral Resources in the Antarctic: Options and Precedents.

- NPD Contribution No 3, A Survey of Norwegian Marginal Petroleum Resources.

- NPD Contribution No 4, Olje- og gassressursene på norsk kontinentalsokkel. Status og perspektiver med særlig vekt på utenrikspolitiske spørsmål. (Oil and Gas Resources on the Norwegian Continental Shelf. Status and Perspectives with Special Emphasis on Matters Relating to Foreign Policy.)

- NPD Contribution No 5, Exploration of the Norwegian Shelf.

- NPD Contribution No 6, Petroleumsressursene i nord. (Petroleum Resources in the North).

- NPD Contribution No 7, Norsk gass og perspektivene for utbygging. (Norwegian Gas and Perspectives for Development).

- NPD Contribution No 8, Structures and Basins and the Margin from 60-69 degrees N and their Development.

- NPD Contribution No 9, Vedlikeholdsmarkedet som stimulans for produktutvikling i norsk industri. (The Maintenance Market as a Stimulus for Product Development in Norwegian Industry).

- NPD Contribution No 10, Ressursgrunnlaget og mulighetene for jevn aktivitet på norsk kontinentalsokkel. (The Resource Basis and Possibility of Uniform Activity on the Norwegian Continental Shelf).

- NPD Contribution No 11, Some Aspects of Kinematic Modelling of the Wave Pattern in the Upper Sediments.

- NPD Contribution No 12, A Method to Determine the Velocities in the Seafloor and Near-Surface Sediments.

- NPD Contribution No 13, Exploration Results, Production and Development Plans on the Norwegian Continental Shelf.

FIG 1.3.3.a
Stillinger 1973 - 1984.
Faste stillinger og overgangsstillinger.
Positions 1973 - 1984.
Permanent positions and engagements.

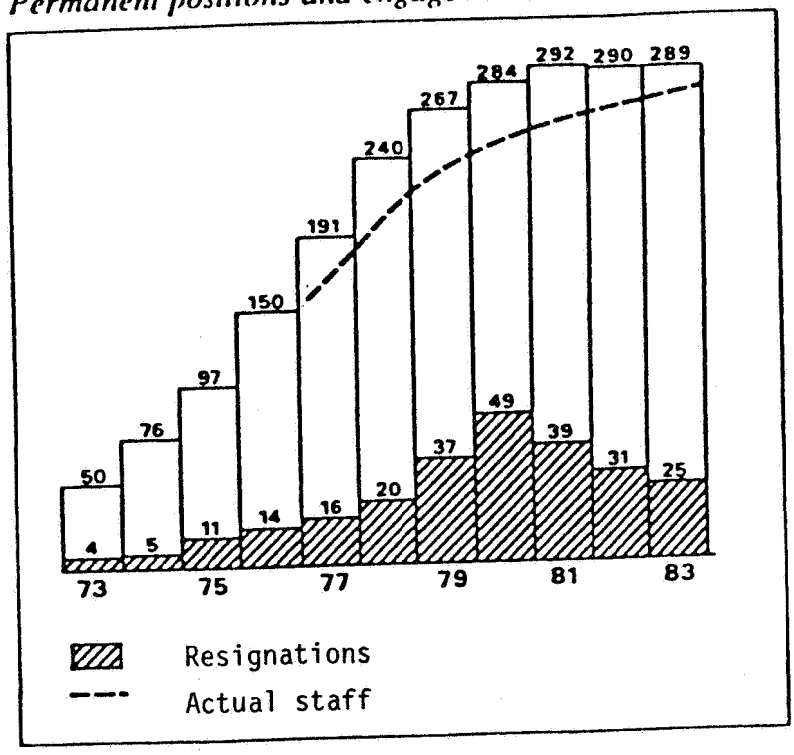
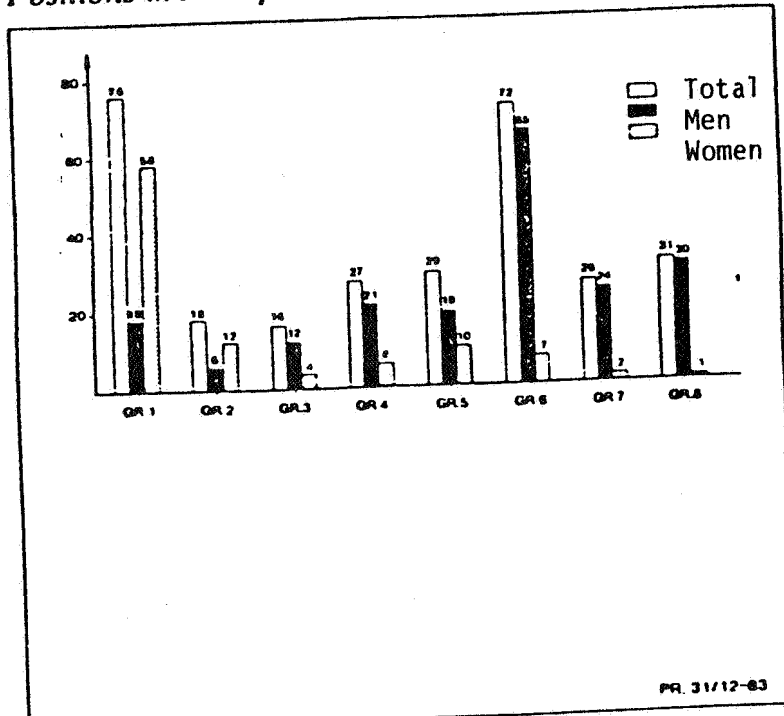


FIG 1.3.3.b
Stillingsgruppering i Oljedirektoratet pr 31.12.83
Positions in NPD per 31. December 1983.



Group 1
Office Assistent, Clerk, Laboratory Assistent, Draftsman, First Clerk, First Lab. Assistent

Group 2
First Secretary, Administration Secretary, Petroleum Draftsman, Typing Leader, File Leader, Petroleum Draftsman Leader, Librarian

Group 3
Engineer, Division Engineer (Wage Scale 14-21)

Group 4
Division Engineer (Wage Scale 18-24), Geologist, Geophysicist

Group 5
Consultant, First Consultant, Principle Librarian

Group 6
Senior Engineer, First Geologist, First Geophysicist, Chief Engineer

Group 7
Special Advisor, Senior Doctor

Group 8
Section Manager, Deputy Director, Divisional Director, Director General.

FIG 1.3.3.c
Personellovergang fra Oljedirektoratet til oljeselskapene i perioden 1973 – 1983.
Personnel who left the NPD for oil companies during the period 1973 – 1983.

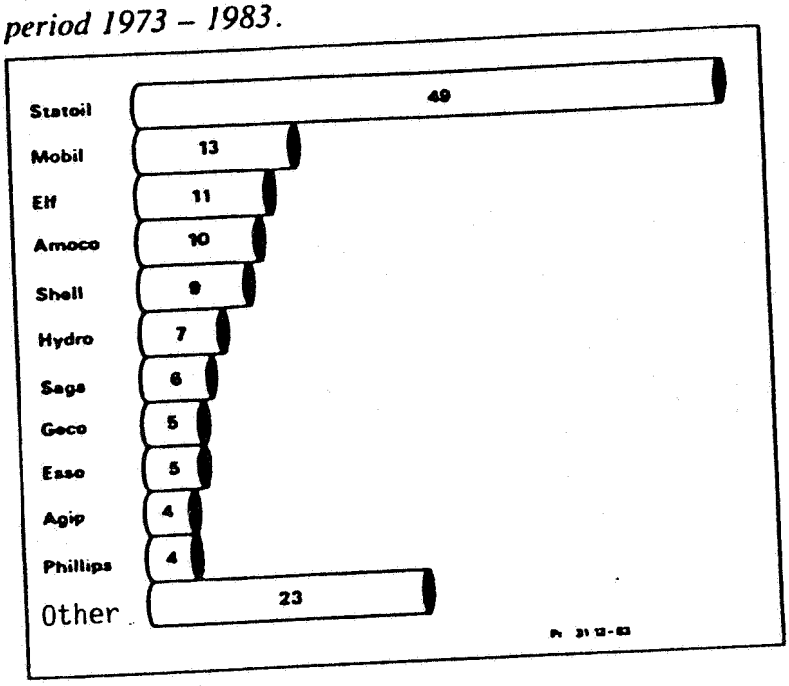


FIG 1.3.6
Ved jubileumsmarkeringen ble de 15 medarbeidere som hadde vært i direktoratets tjeneste siden etableringsåret 1973 hedret med Oljedirektoratets plakett. Bildet er fra utdelingen
During the marking of the anniversary, the 15 persons who had been employed by the Norwegian Petroleum Directorate since the founding year 1979 were presented with the NPD plaque. The photo was taken at the presentation.

FIG 1.3.11
Direktør Fredrik Hagemann markerer første spadestikk for nybygget den 17.11.83.
Director General Fredrik Hagemann is here seen breaking the ground for the NPD's new building.

FIG 2.2.1.a
Geofysiske undersøkelser nord for Stad i statlig regi
Govermentally conducted seismic surveys north of Stad

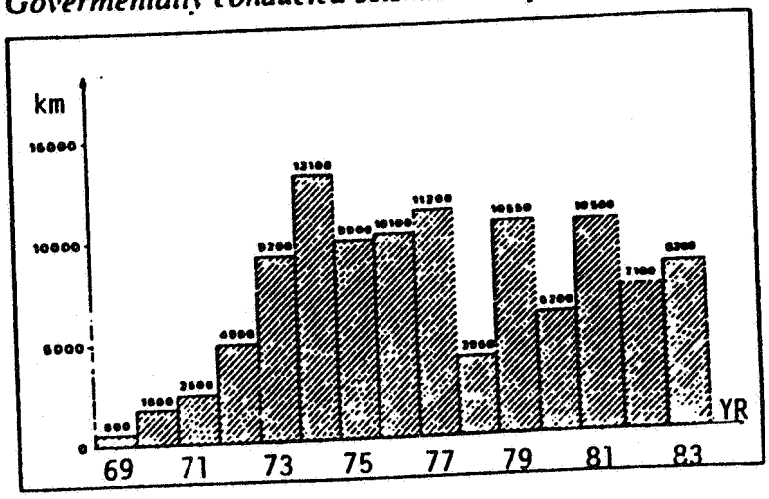


FIG 2.2.1.b
Geofysiske undersøkelser nord for Troms/Finnmark, 1983
Seismic surveys north of Troms/Finnmark, 1983

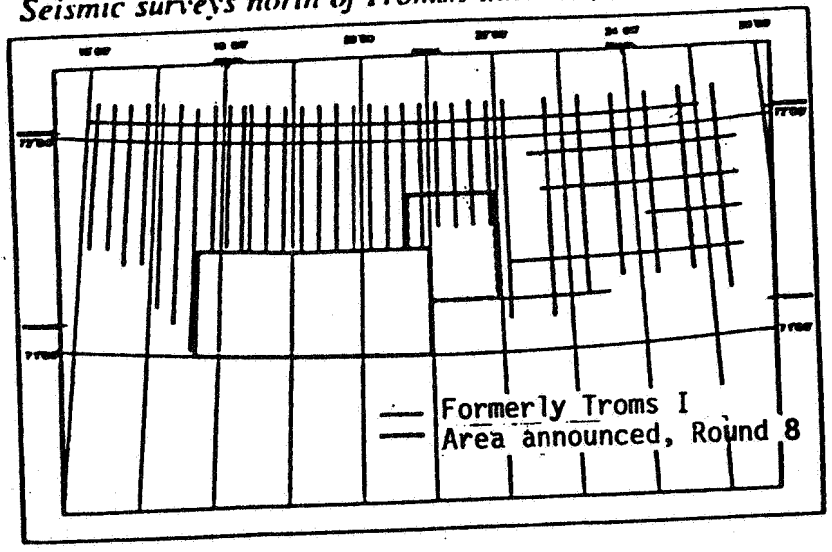


FIG 2.2.1.c
Områder åpnet for geofysiske undersøkelser i selskapenes regi utenfor Troms/Finnmark
Areas opened for company conducted seismic surveys outside Troms/Finnmark

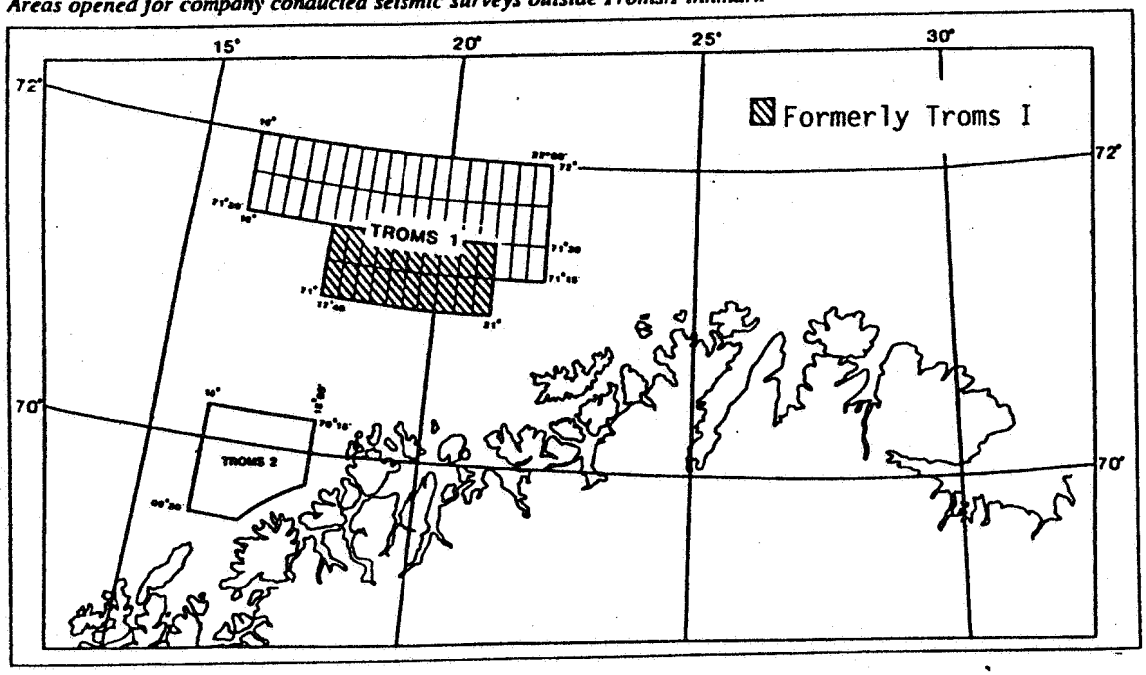


FIG 2.2.1.d
Geofysiske undersøkelser Nordland 2, 1983
Seismic surveys Nordland 2, 1983

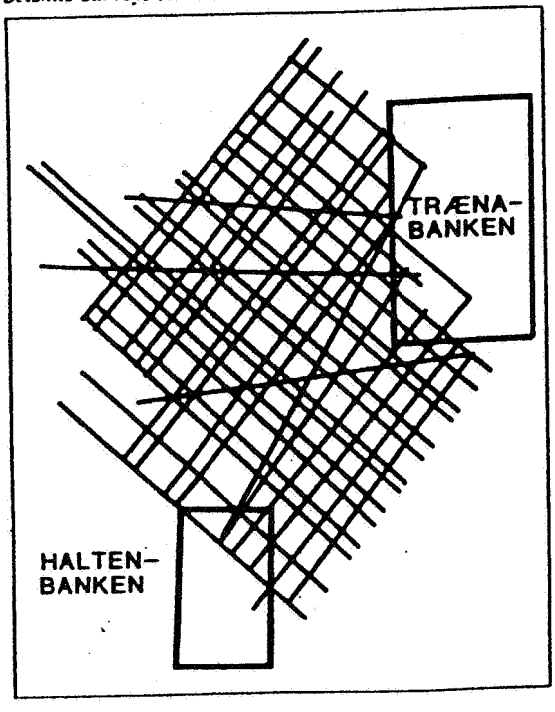


FIG 2.2.1.f
Geofysiske undersøkelser utført på hele den norske sokkel (inkl nord for Stad)
Seismic surveys carried out on the whole Norwegian Shelf (north of Stad included)

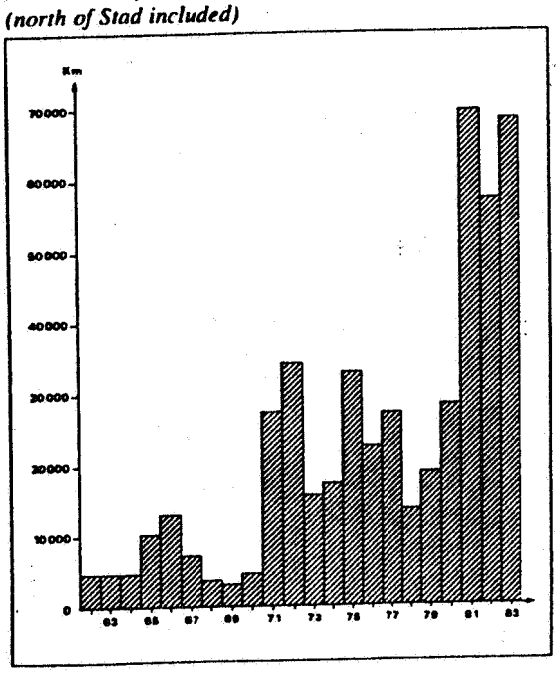


FIG 2.2.1.e
Områder åpnet for geofysiske undersøkelser i selskapenes regi mellom Stad og Troms
Areas opened for company conducted seismic surveys between Stad and Troms

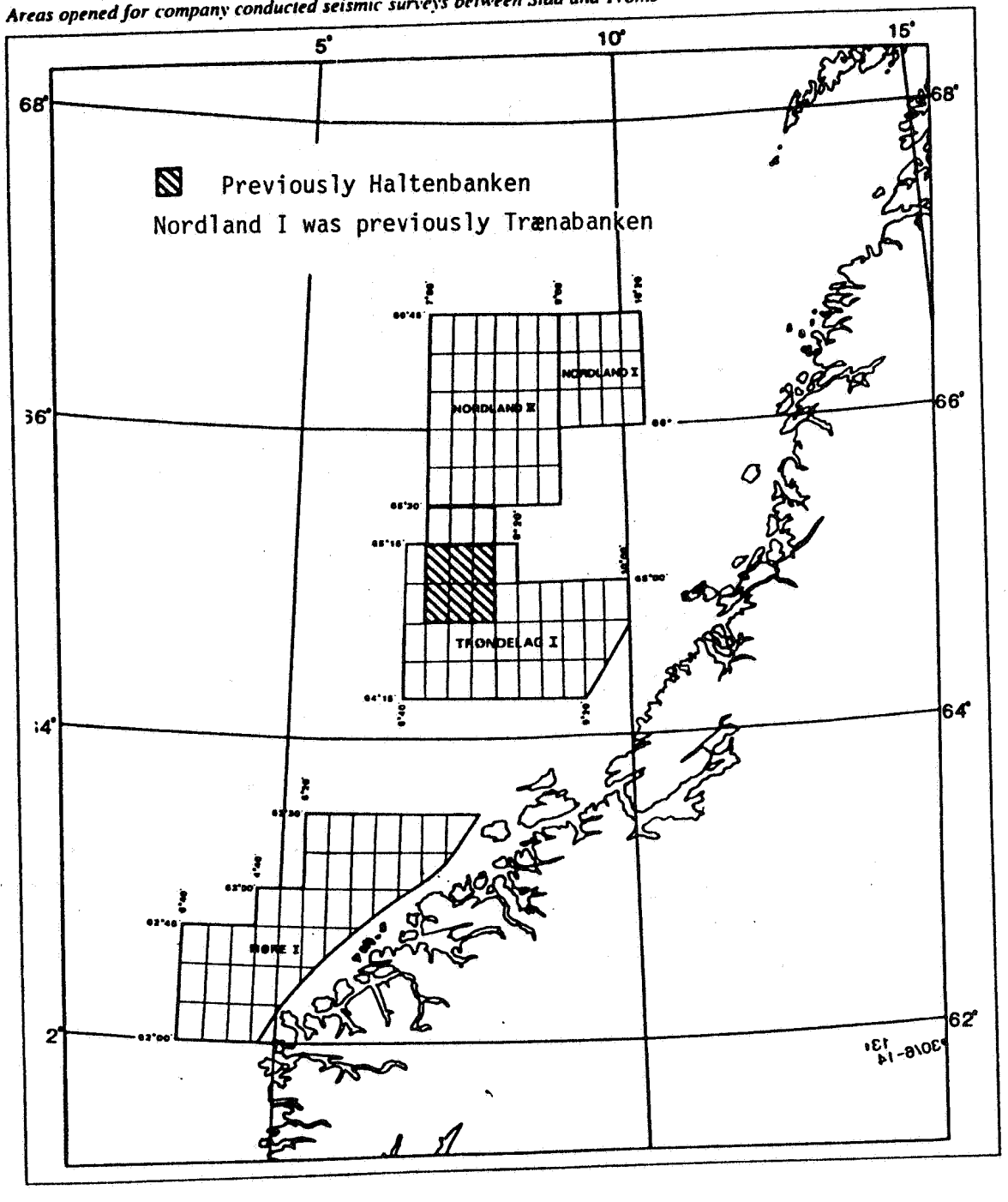


FIG 2.2.1.g
Blokker der seismiske data er frigitt
Blocks where seismic data have been released

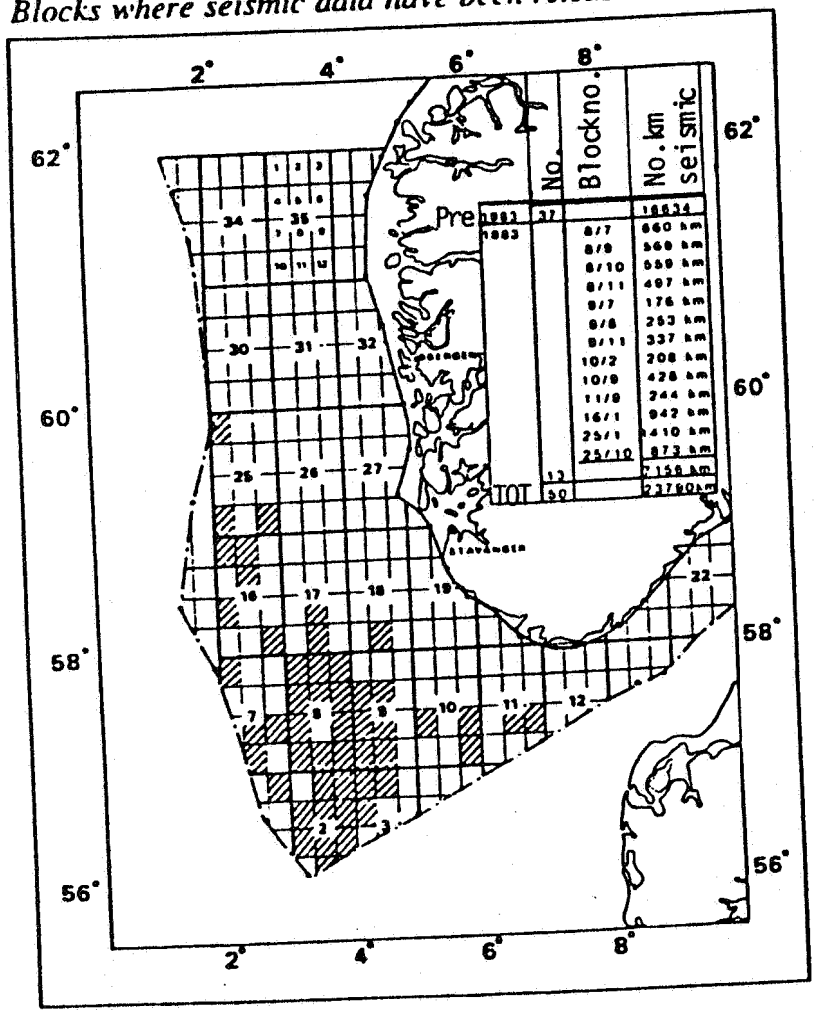


FIG 2.2.2.a
Boreaktiviteten på den norske kontinentalsokkel
(Antall borehull pr år)
Drilling activity on the Norwegian Continental Shelf
(Number of wells per year)

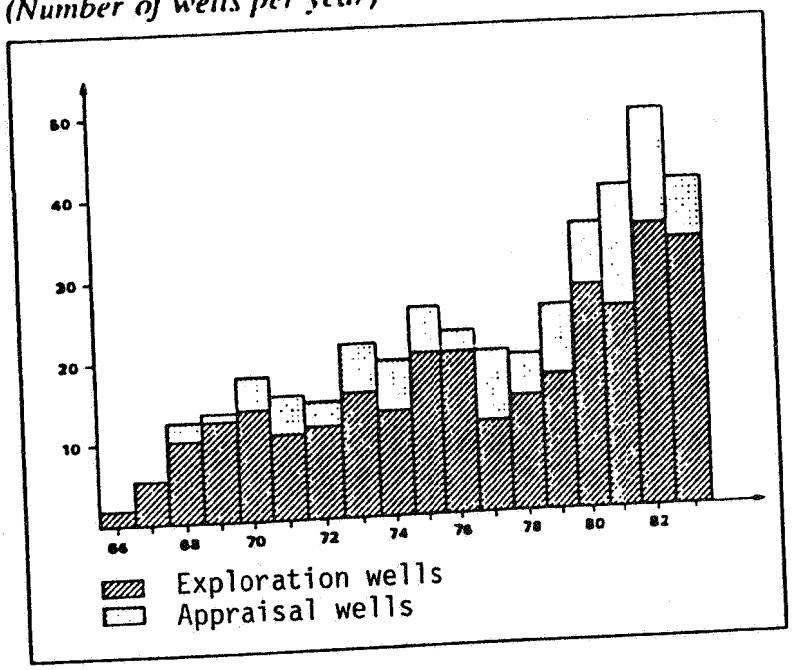


FIG 2.2.2.b
Borehull i 1983 i forhold til strukturelle hovedtrekk i Nordsjøen
Wells drilled in 1983 in relation to main structural elements in the North Sea

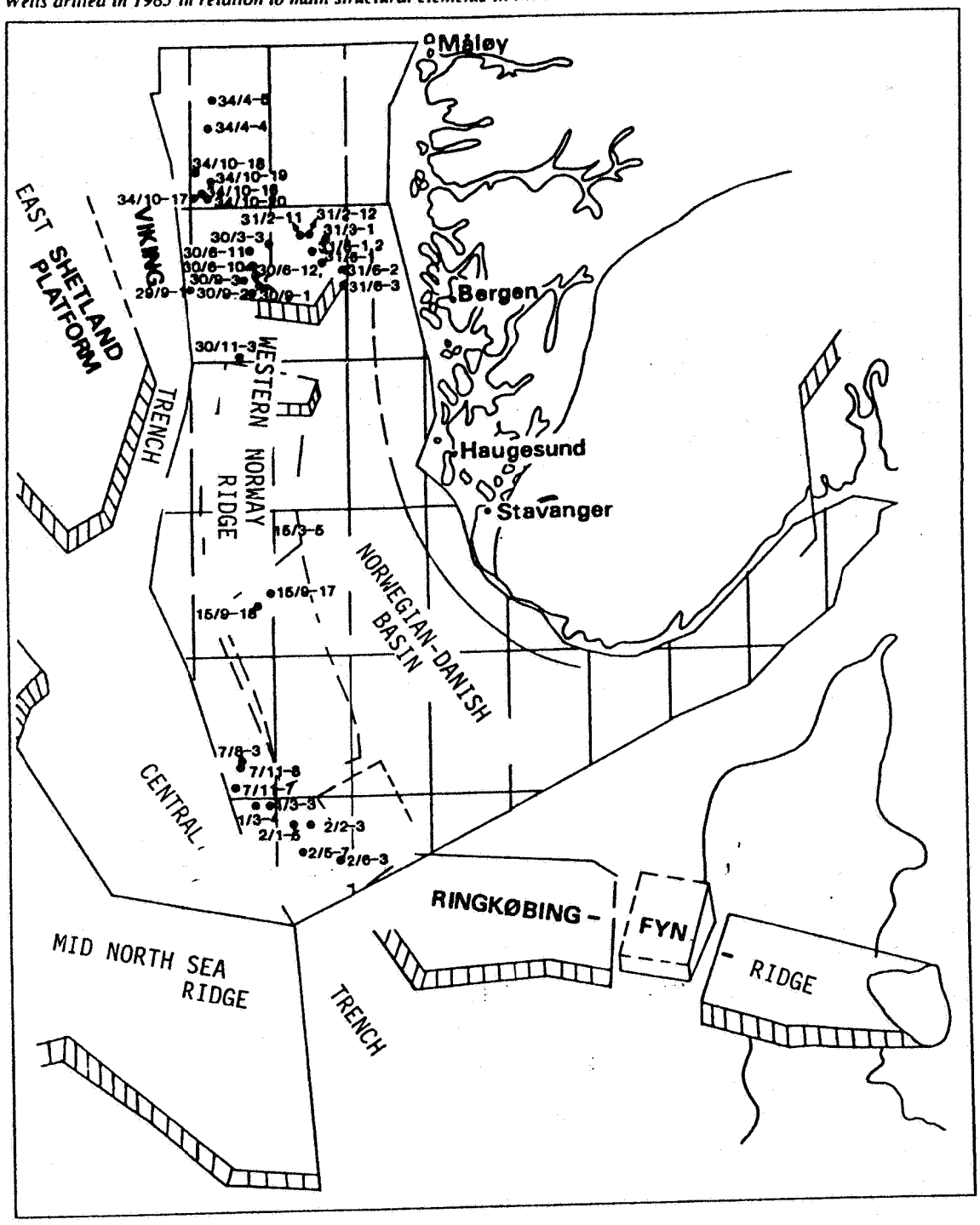


FIG 2.2.2.c
Borehull i 1983 i forhold til strukturelle hovedtrekk på Haltenbanken
Wells drilled in 1983 in relation to main structural elements on Haltenbanken

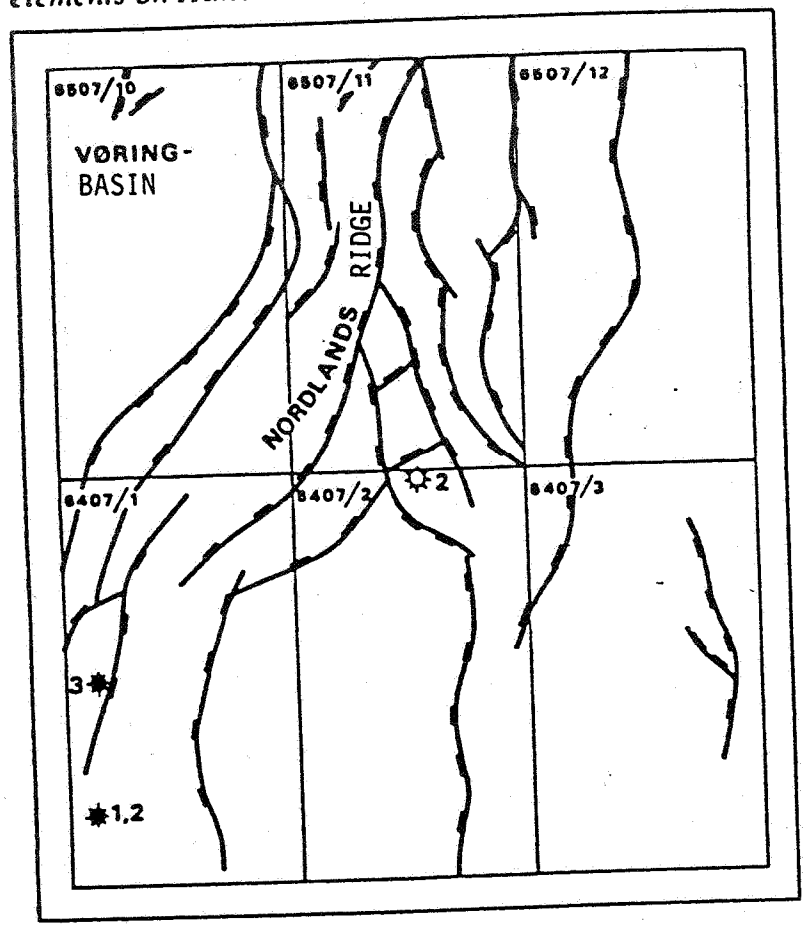
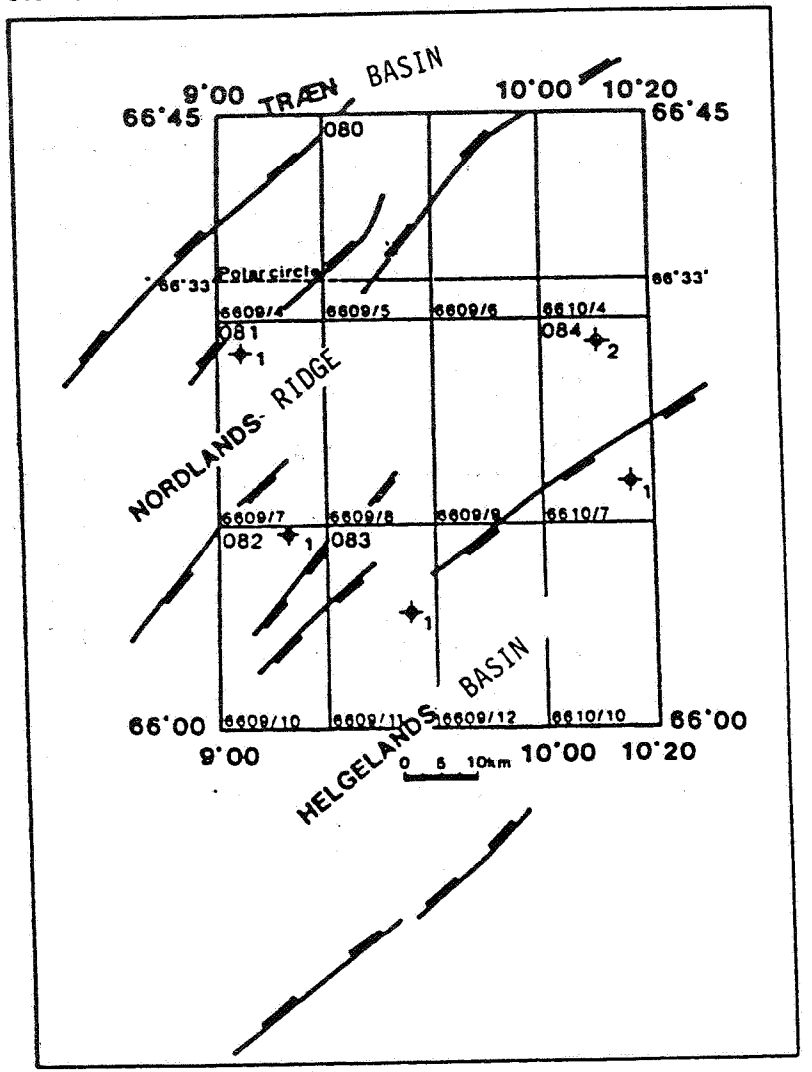


FIG 2.2.2.d
Borehull i 1983 i forhold til strukturelle hovedtrekk på Trænabanken
Wells drilled in 1983 in relation to main structural elements on Trænabanken



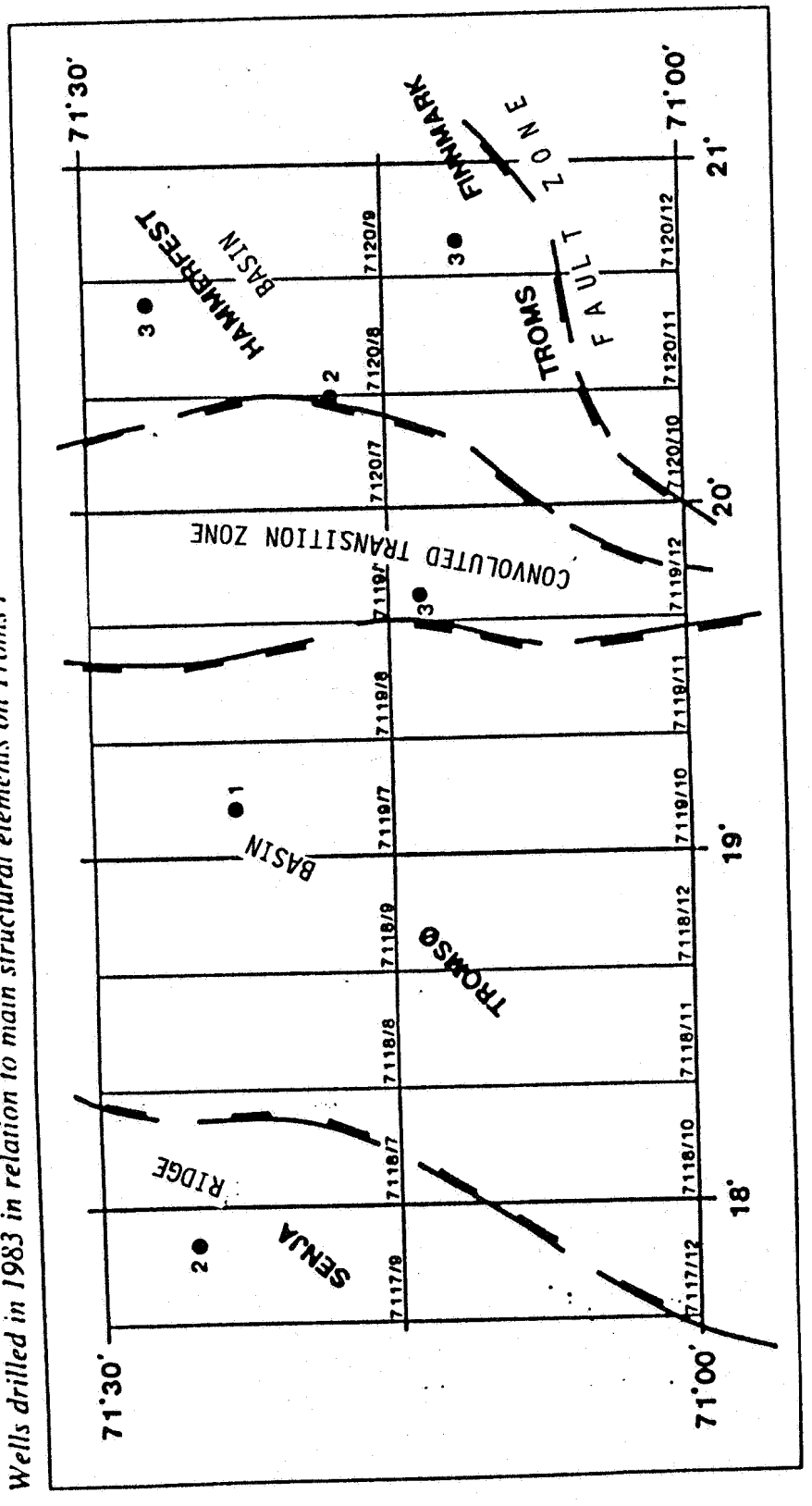


FIG 2.2.2.e
Borehull i 1983 i forhold til strukturelle hovedtrekk på Troms I
Wells drilled in 1983 in relation to main structural elements on Troms I

FIG 2.2.2.f
Borelokaliteter på Svalbard
Well locations on Svalbard

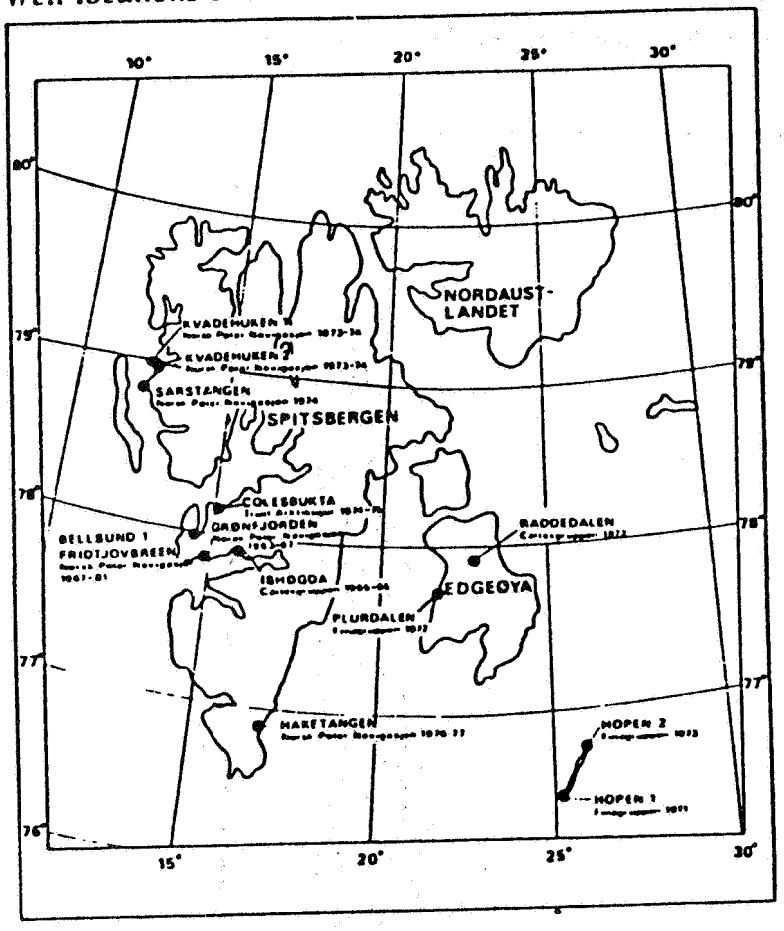


FIG 2.2.2.g
Årlige leteboringsutgifter i perioden 1966-1983 (løpende kroneverdi).
Annual expenditure 1966-1983 in exploration drilling (nominal value)

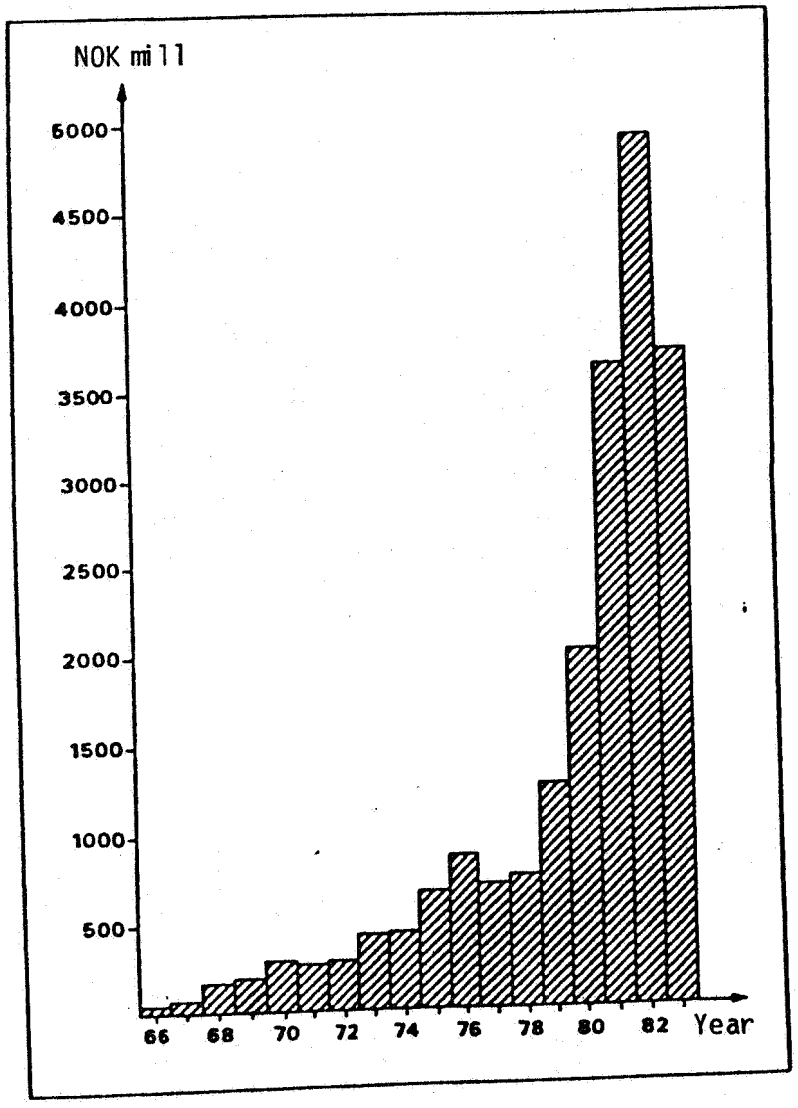


FIG 2.2.3
Haltenbanken-området
The Haltenbanken area

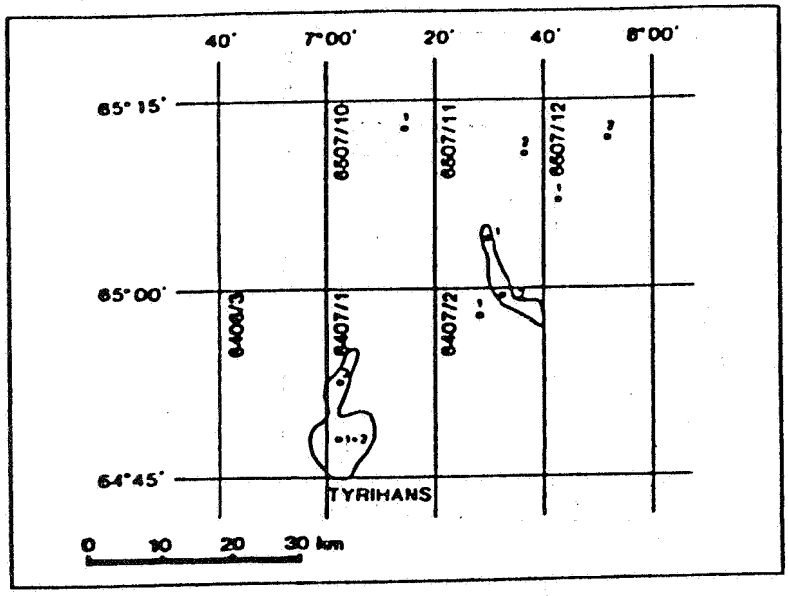


FIG 2.2.3.b
Sleipner-området
The Sleipner area

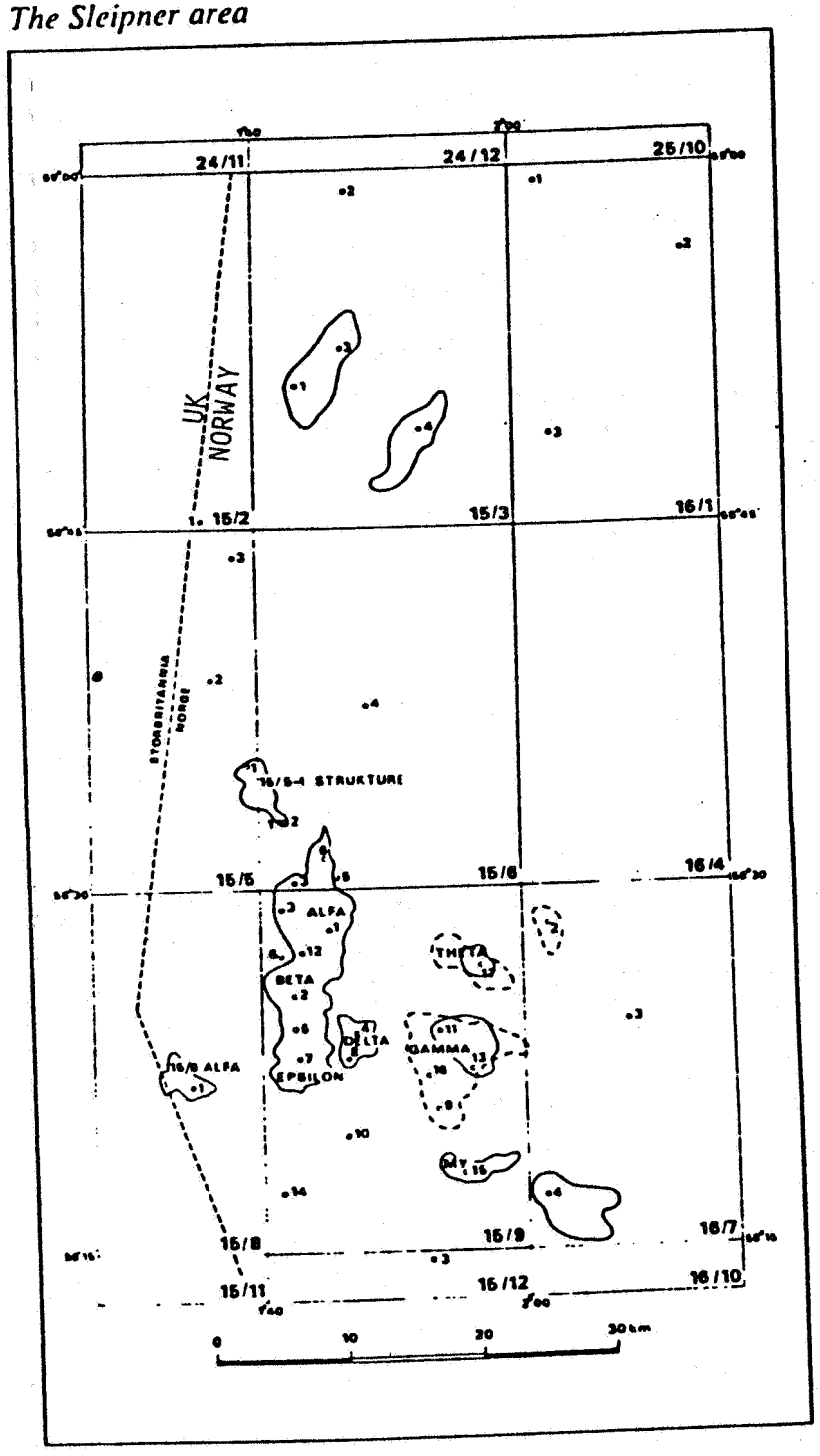


FIG 2.2.3.c
Oversikt over Oseberg-strukturene
View of the Oseberg structures

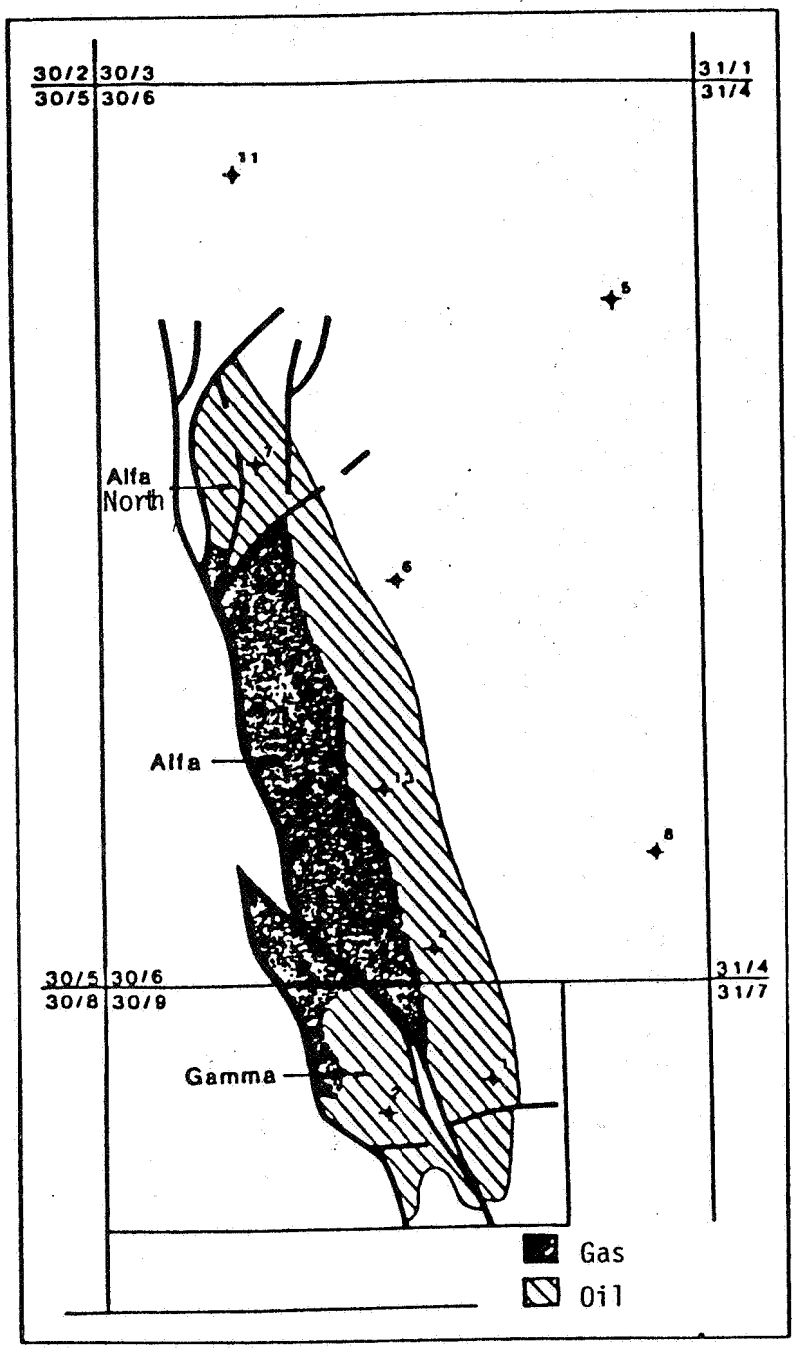


FIG 2.2.3.d
Troll-feltet
The Troll field

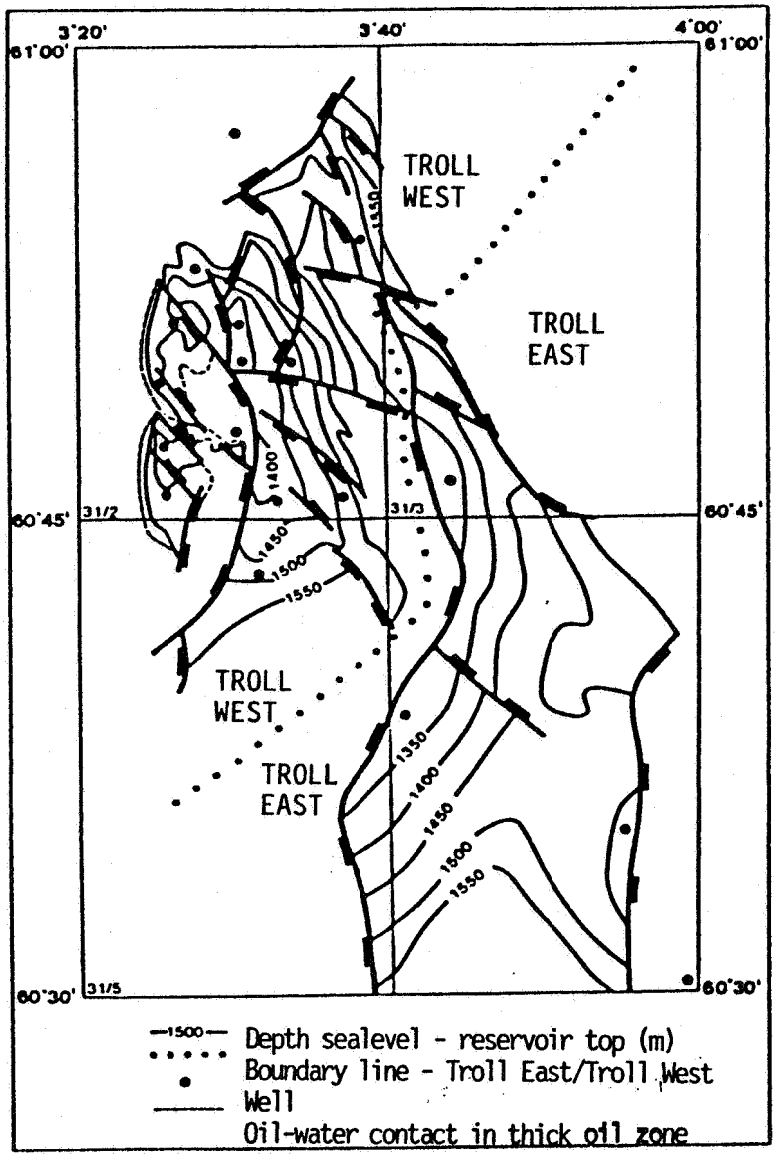
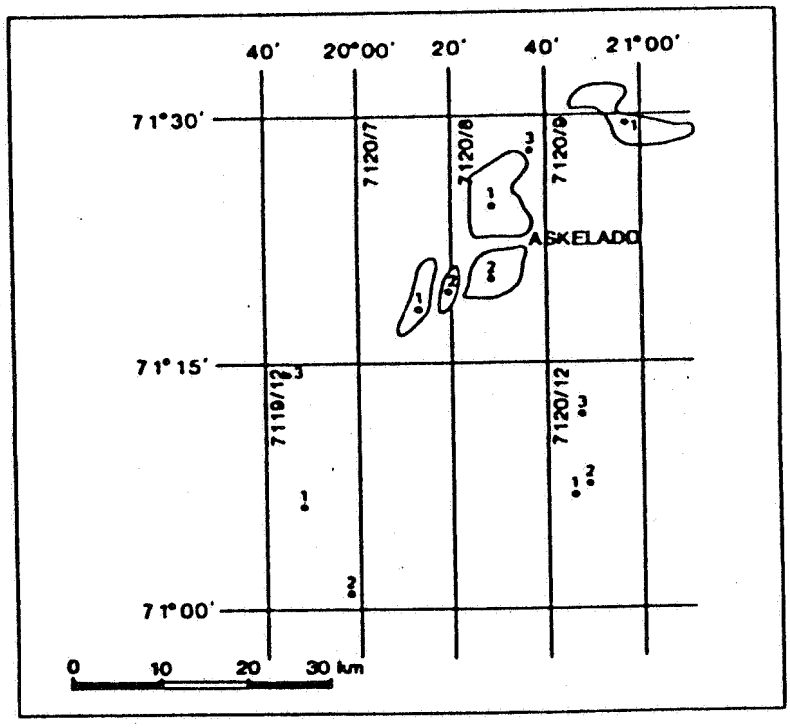


FIG 2.2.3.e
Askeladd-området
The Askeladd area



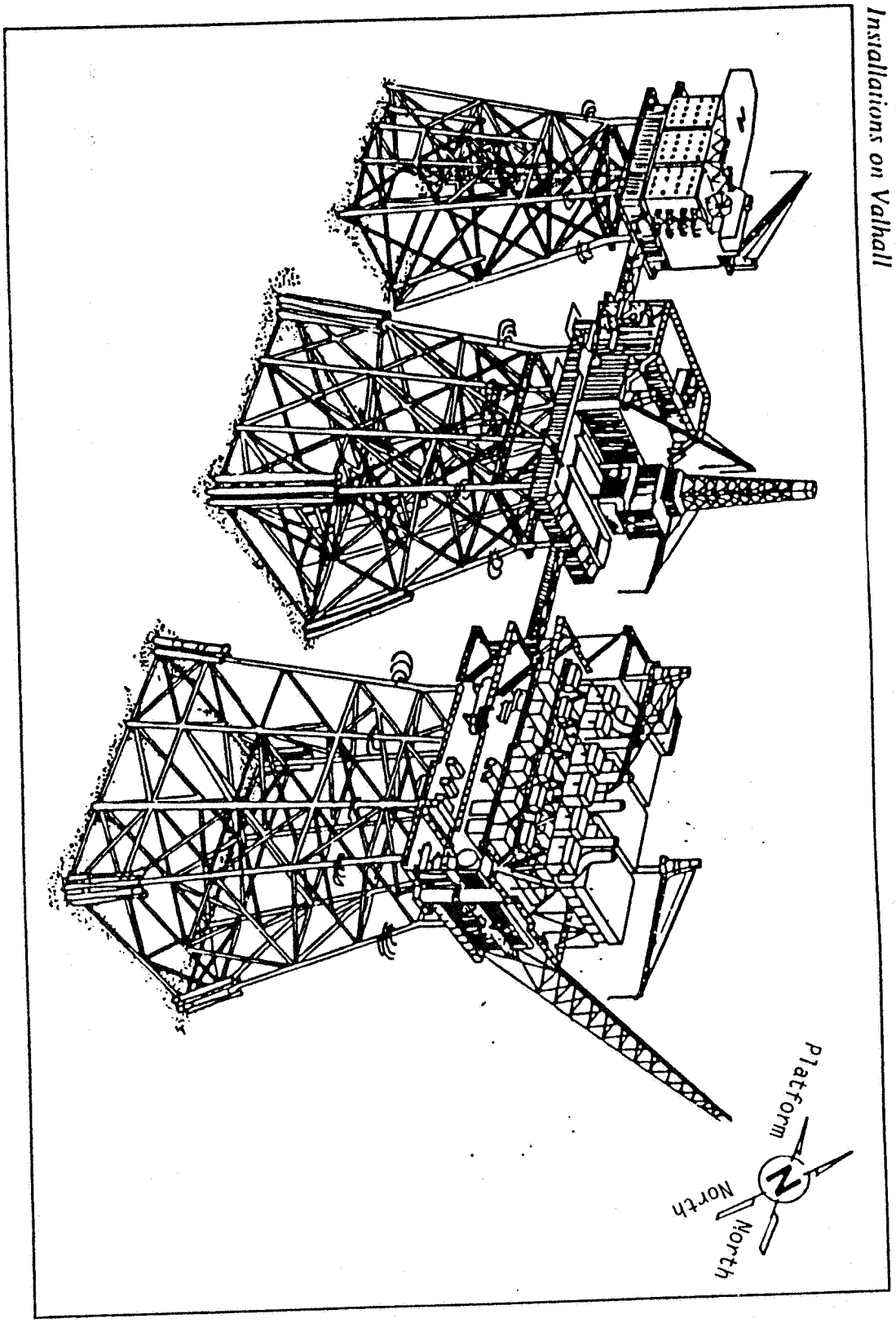


FIG 2.3.1.a
Installasjoner på Valhall
Installations on Valhall

FIG 2.3.1.b
Brenning av gass på Valhall
Gas flared on Valhall

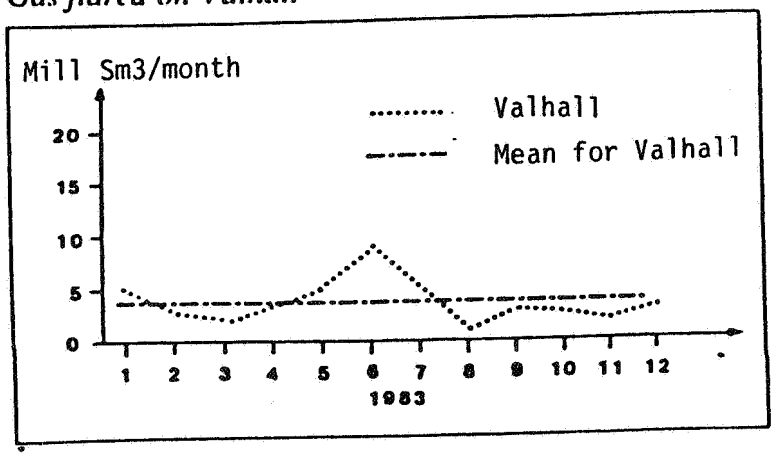


FIG 2.3.2.a
Ekofisk-området
The Ekofisk area

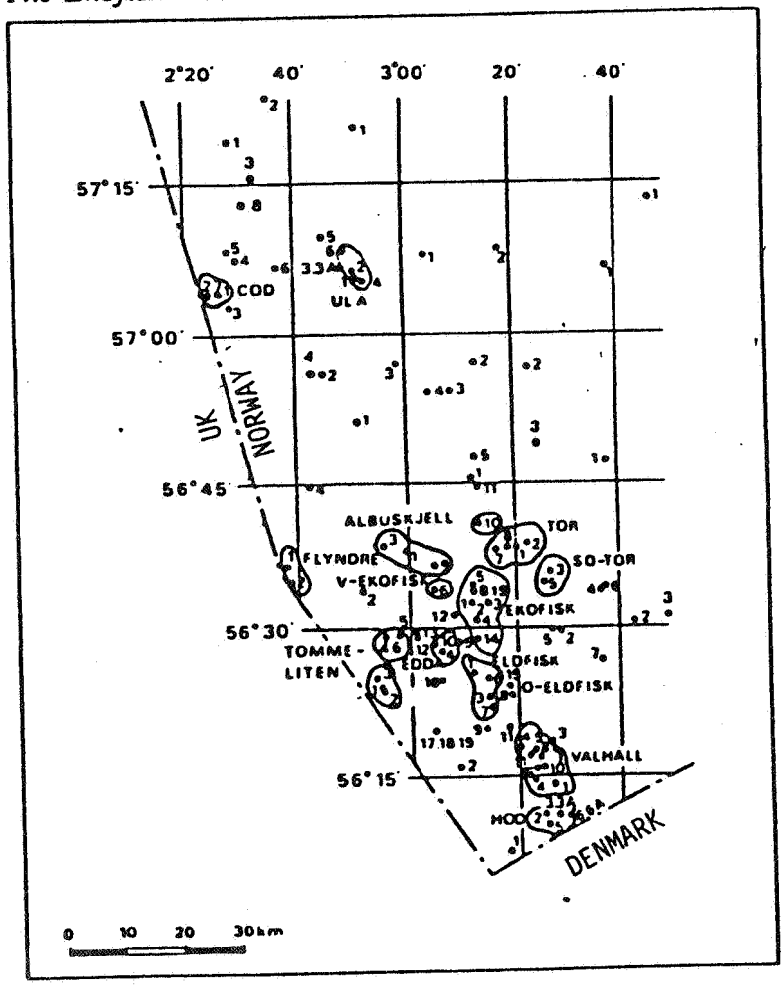
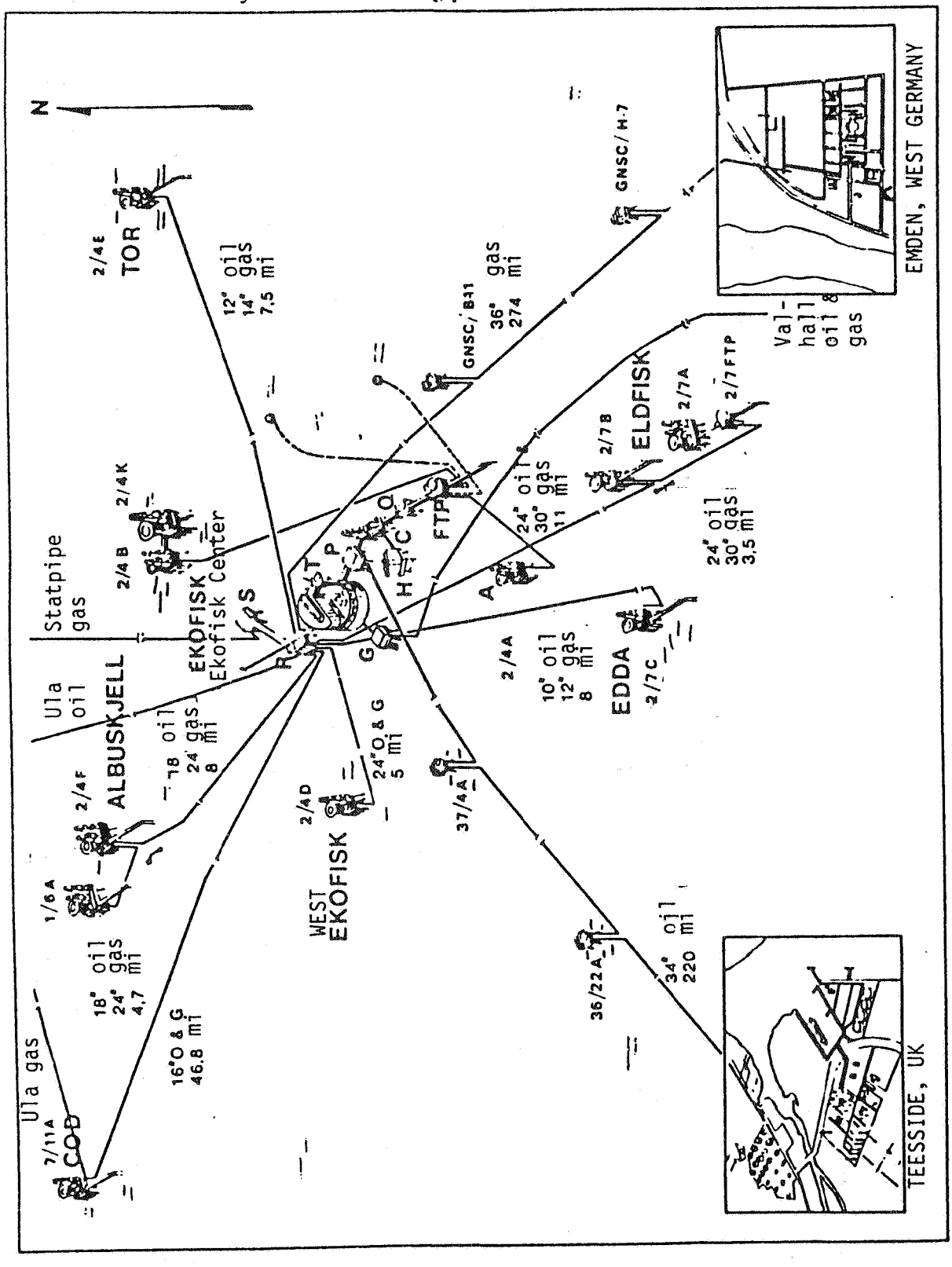


FIG 2.3.2.b

Anlegg for felt i Ekofisk-området med planlagt 2/4 K, tilknytning fra Ula og Statpipe

Installations in the Ekofisk area including planned 2/4 K, connections from Ula and Statpipe



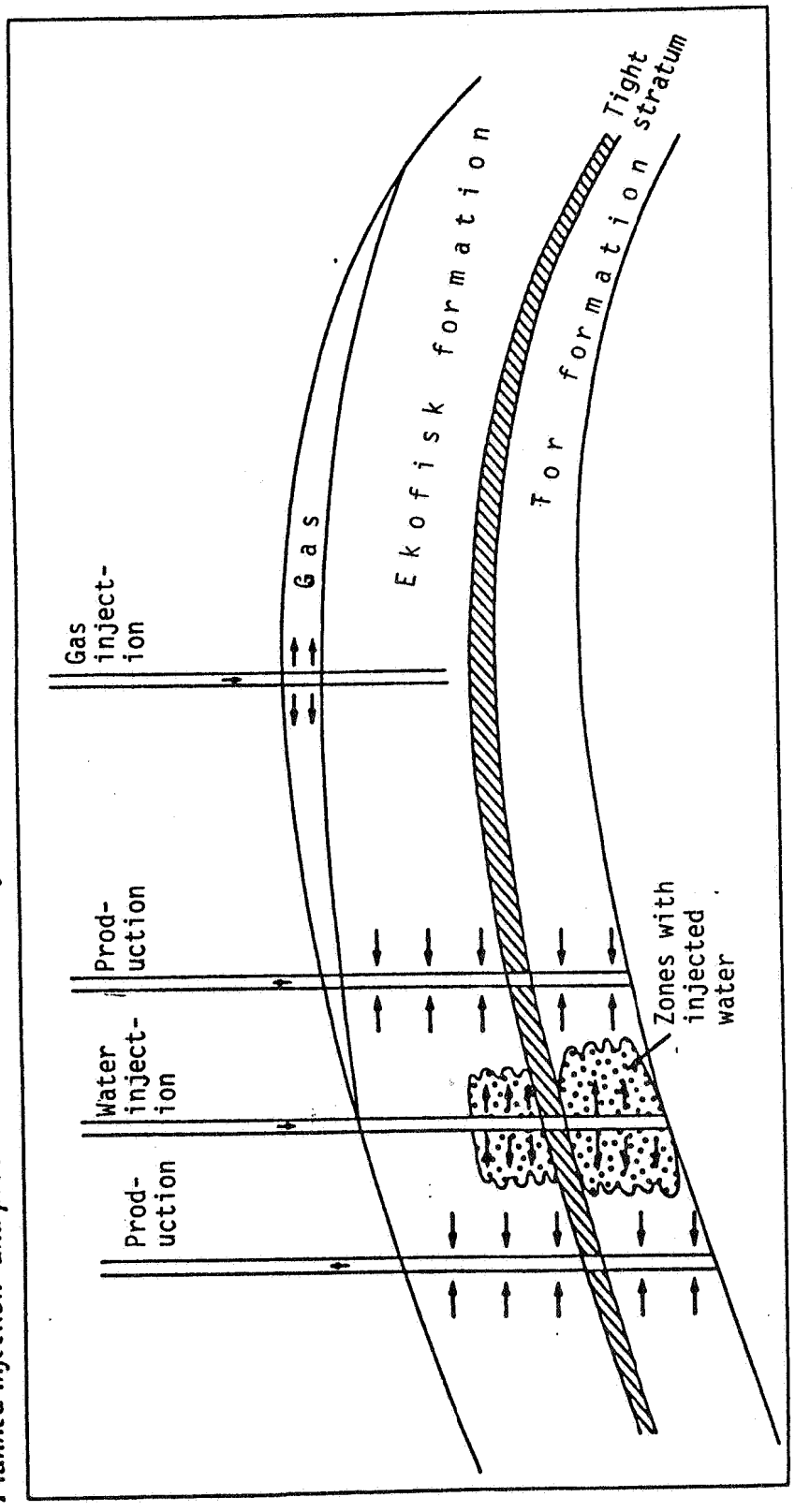
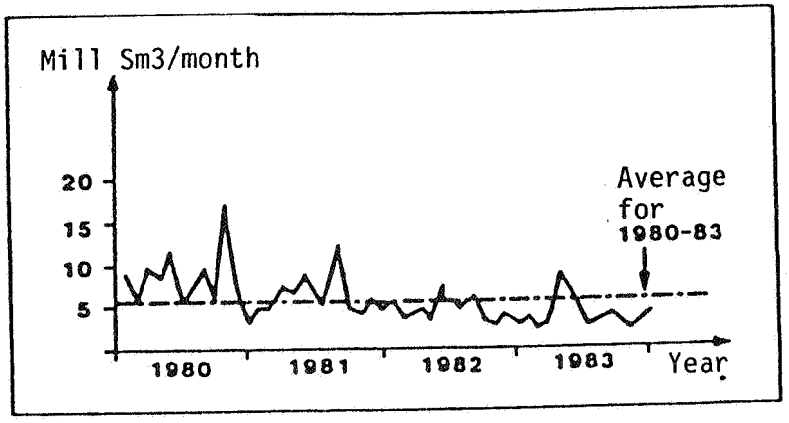


FIG 2.3.2.c
Planlagt injeksjons- og produksjonsmønster i Ekofisk
Planned injection- and production scheme in Ekofisk

FIG 2.3.2.d
Brenning av gass i Ekofisk-området
Gas flared in the Ekofisk area



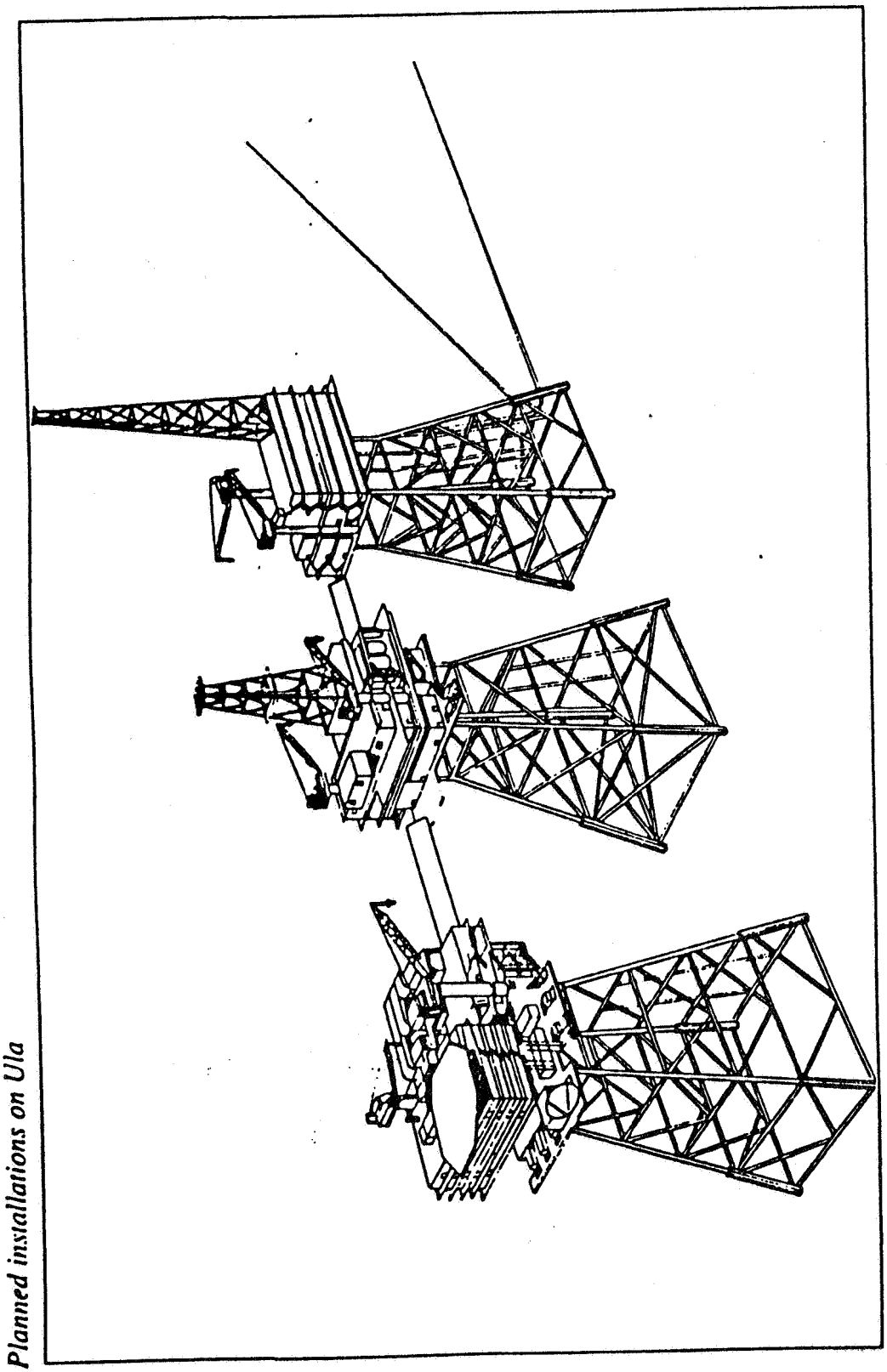


FIG 2.3.3
Planlagte installasjoner på Ula
Planned installations on Ula

FIG 2.3.4
Planlagt installasjon på Heimdal
Planned installation on Heimdal

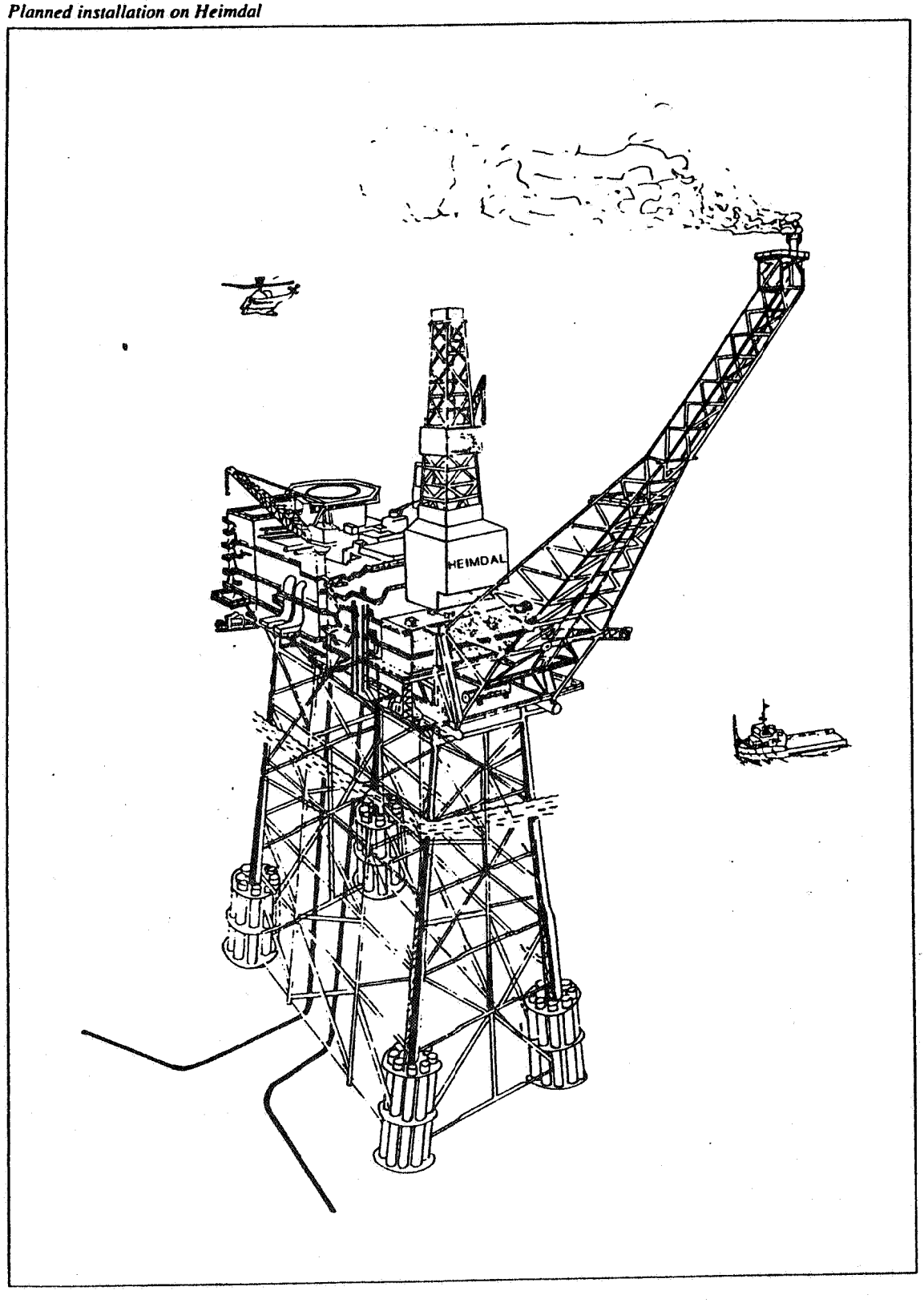


FIG 2.3.5.a
Frigg-området
The Frigg area

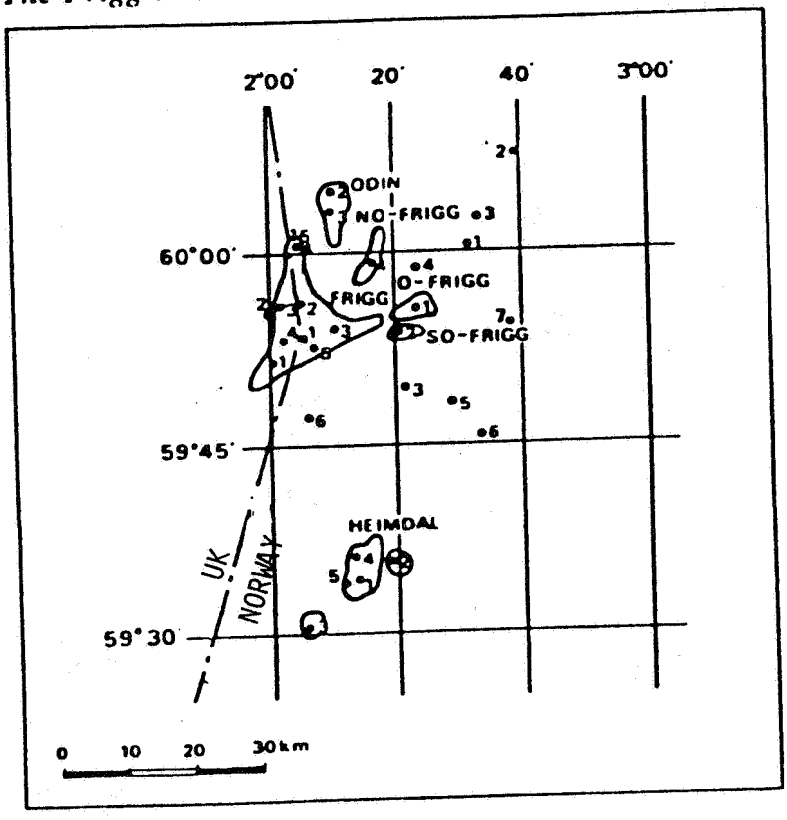


FIG 2.3.5.b
Installasjoner på Frigg
Installations on Frigg

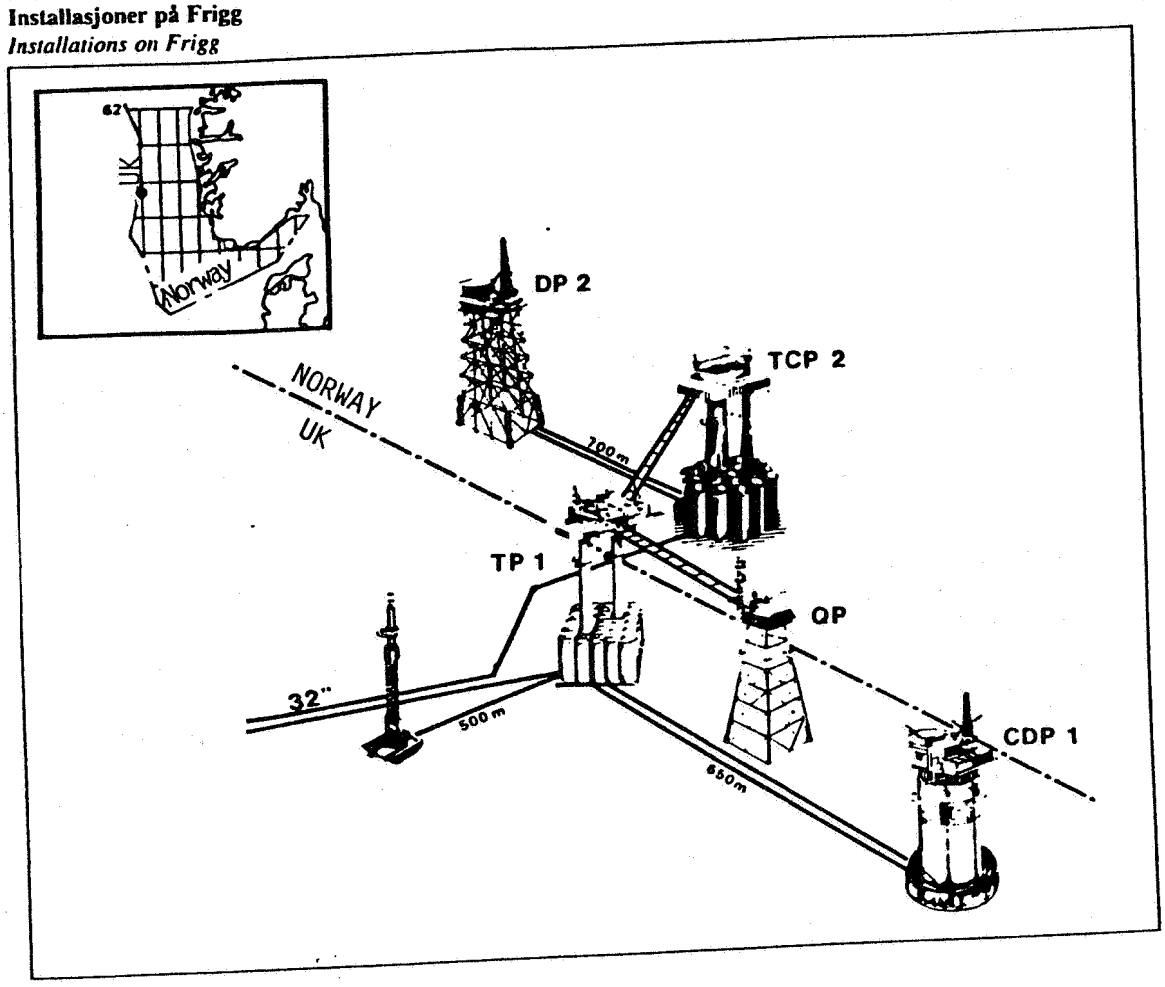


FIG 2.3.5.c
Installasjoner på NØ-Frigg
Installations on NE-Frigg

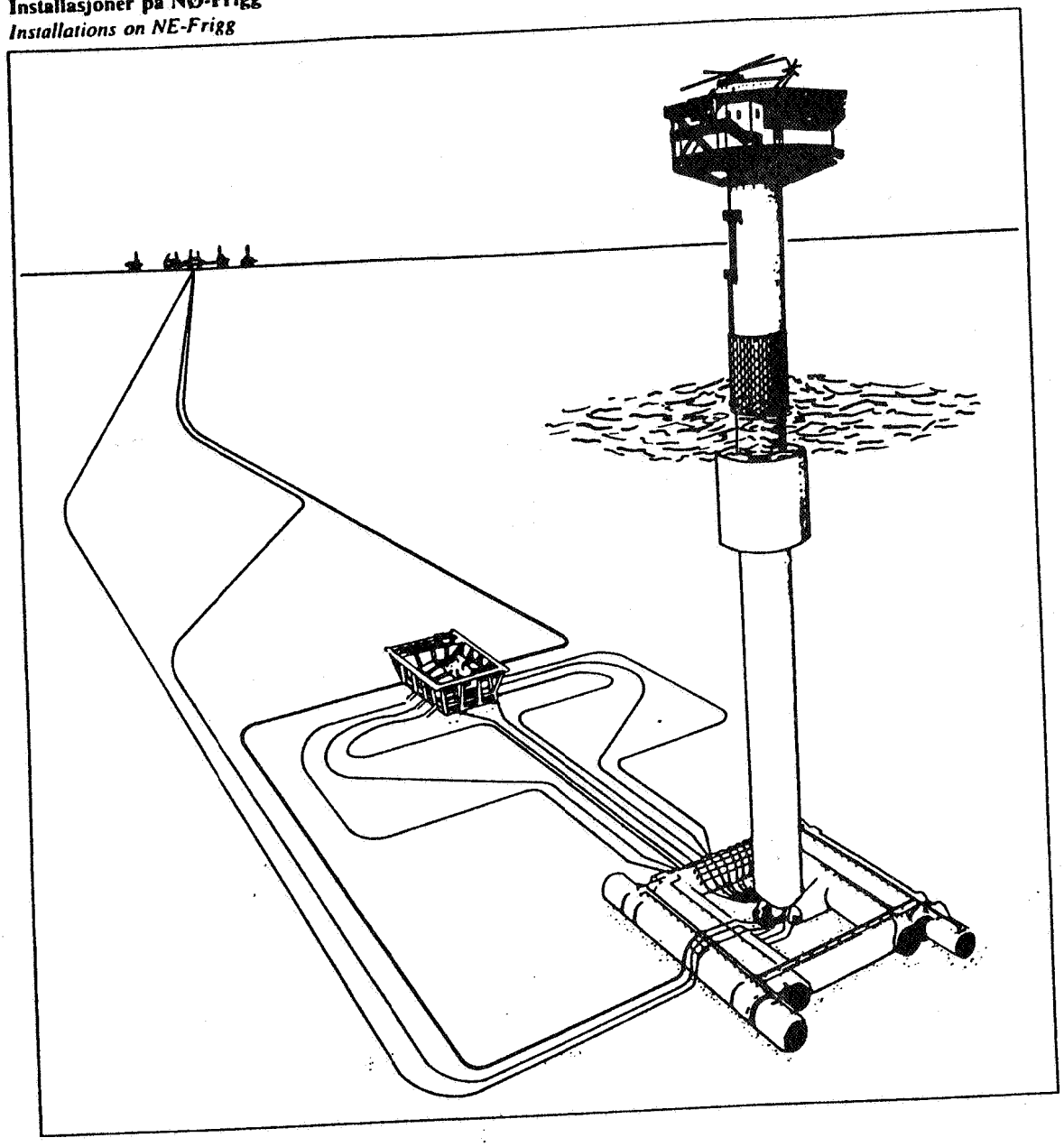
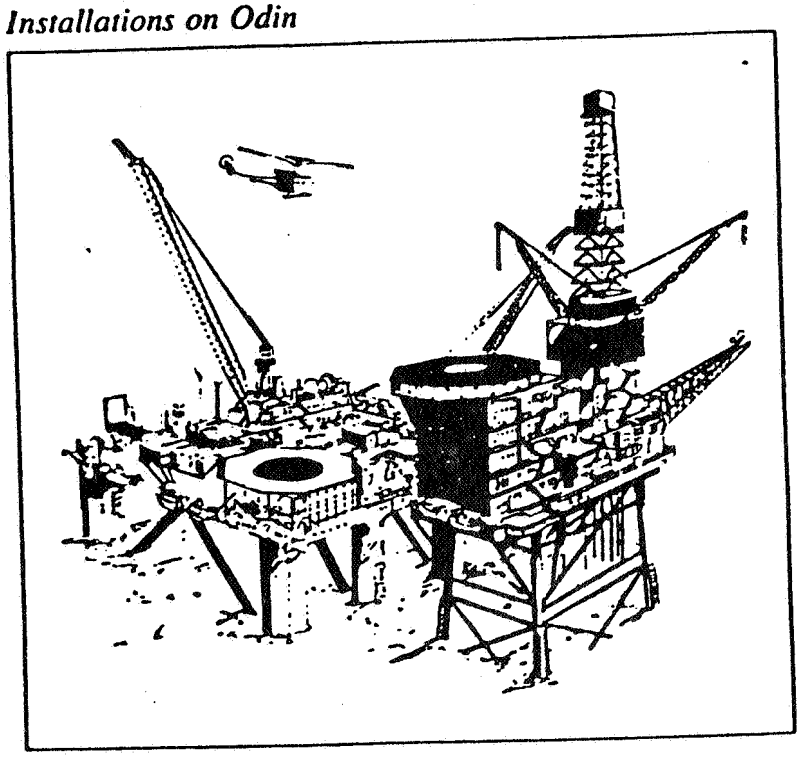


FIG 2.3.5.d
Installasjoner på Odin
Installations on Odin



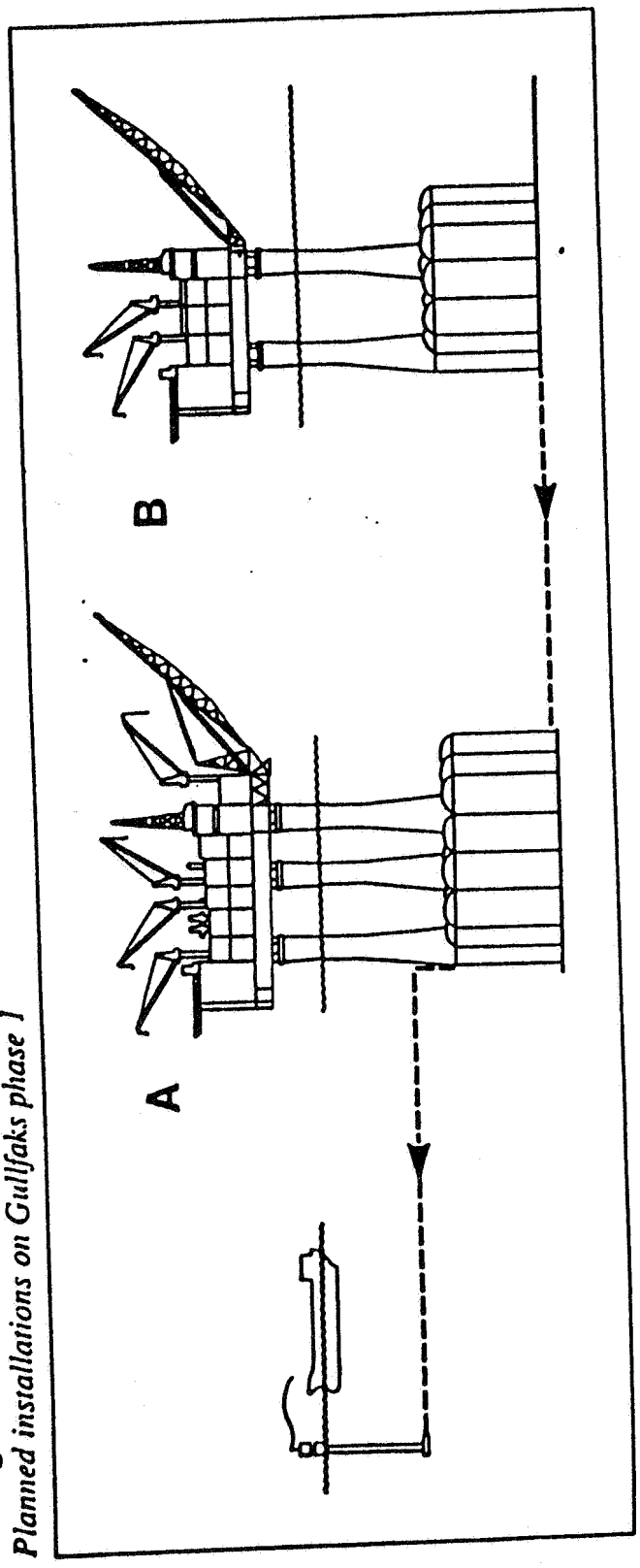
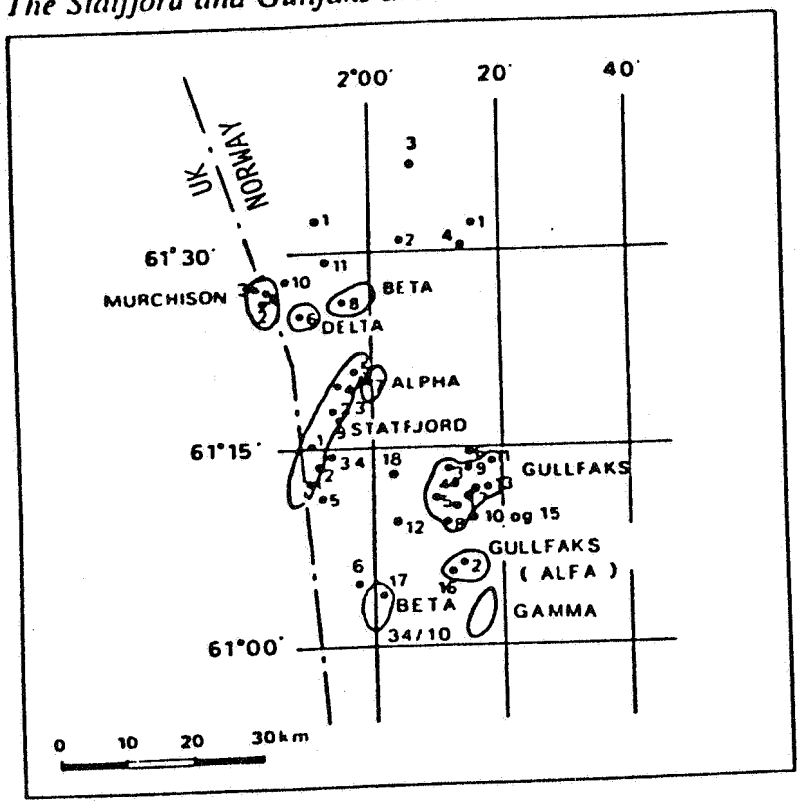


FIG 2.3.6
Planlagte installasjoner på Gullfaks fase I
Planned installations on Gullfaks phase I

FIG 2.3.7.a
Statfjord- og Gullfaks-området
The Statfjord and Gullfaks area



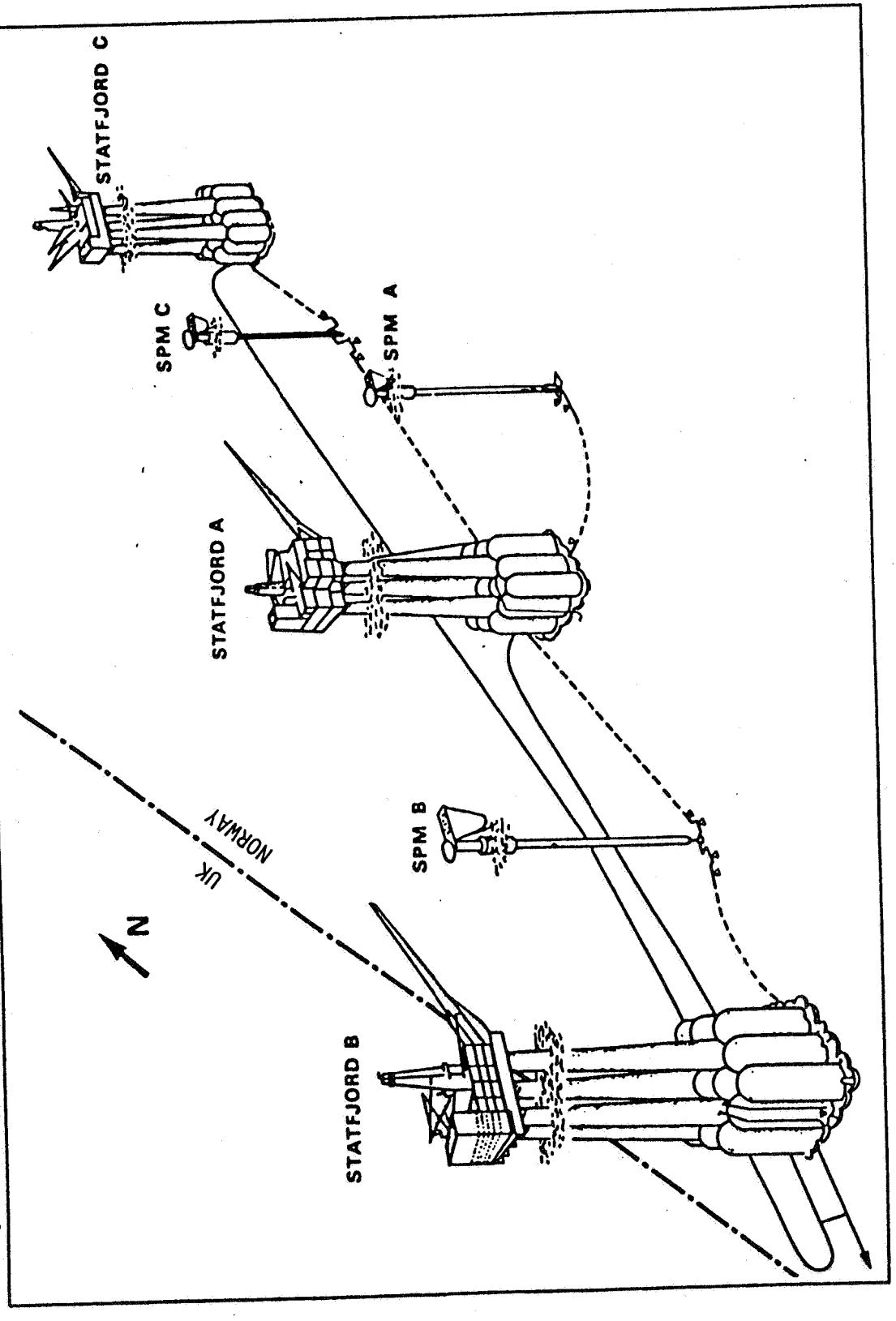


FIG 2.3.7.b
Eksisterende og planlagte installasjoner på Statfjord-feltet
Existing and planned installations on the Statfjord field

FIG 2.3.7.c
Brenning av gass i Statfjord-området
Gas flared in the Statfjord area.

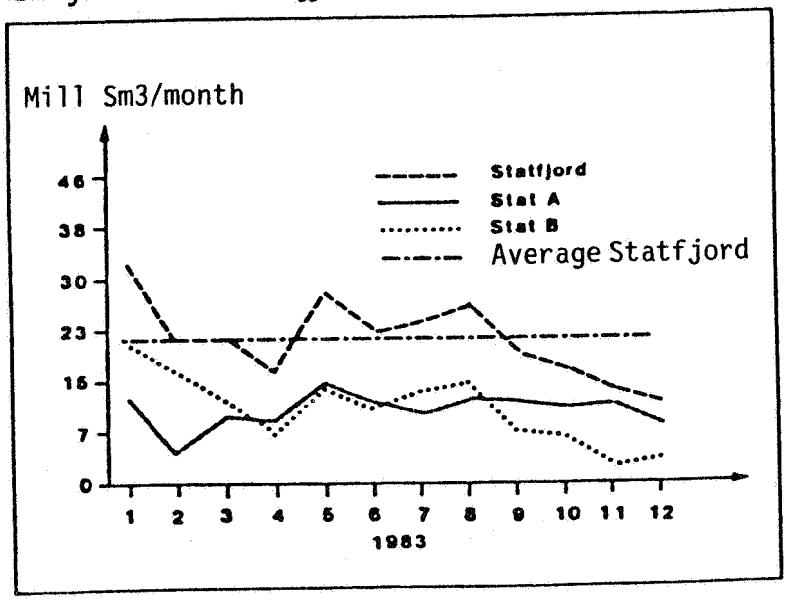


FIG 2.3.7.d
Statpipe-transportsystemet
The Statpipe transport system

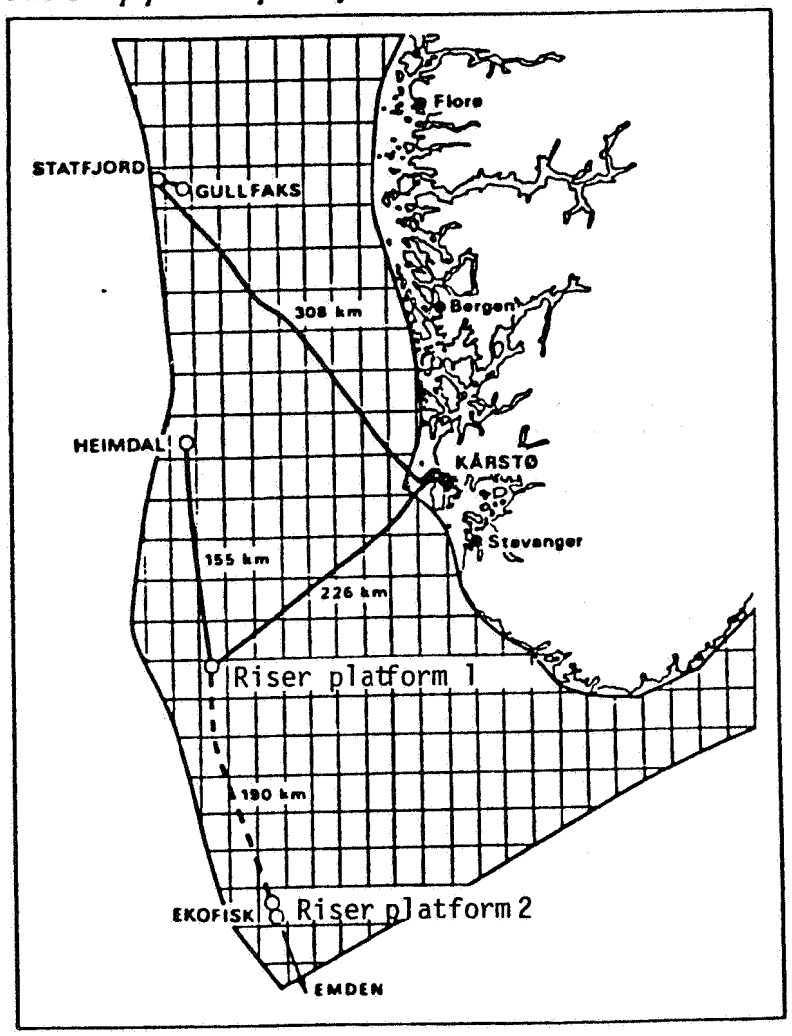


FIG 2.3.8.a
Installasjon på Murchison
Installation on Murchison

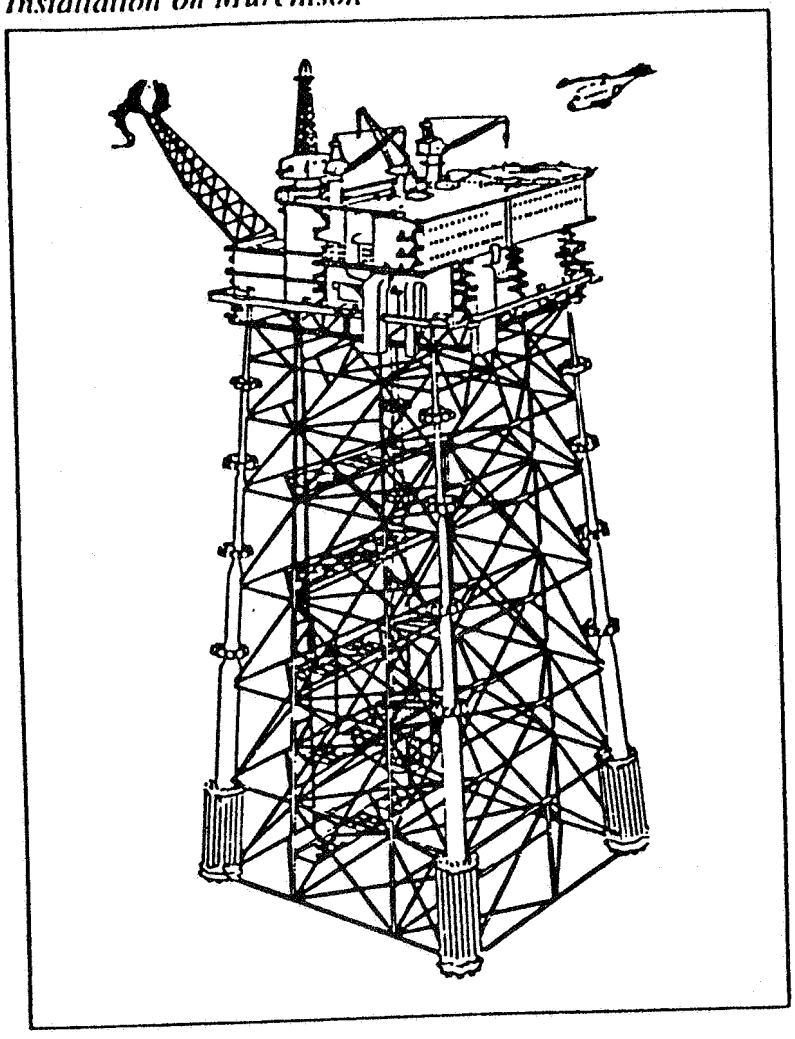


FIG 2.3.8.b
Brenning av gass på Murchison
Gas flared on Murchison

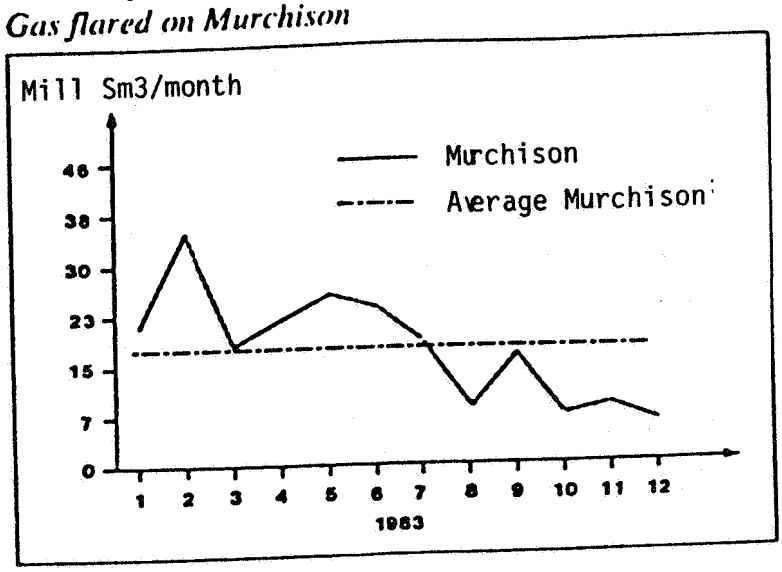


FIG 2.4.1.a
Klassifisering av petroleumsressurser
Classification of petroleum resources

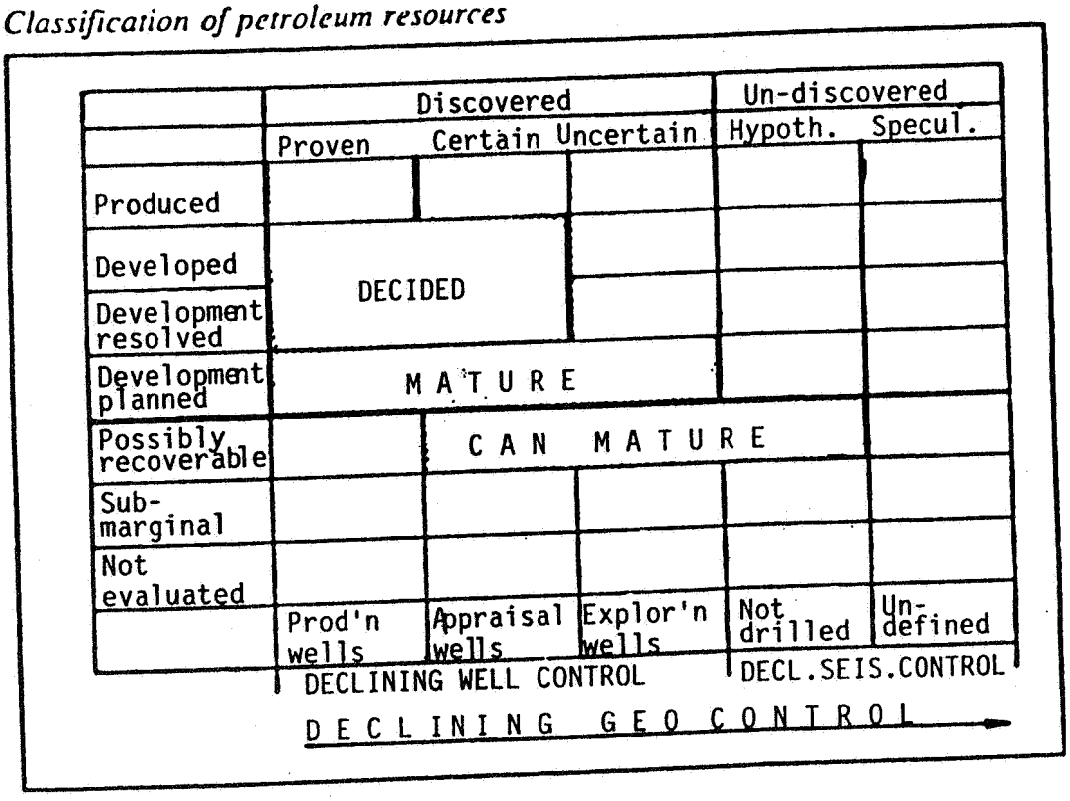


FIG 2.4.1.b
Ressursregnskap for området sør for Stad (10^9 t.o.e.)
Resource account related to the area south of Stad

	Discovered			Un-discovered	
	Proven	Certain	Uncertain	Hypoth.	Specul.
Produced	0.33				
Developed	0.66				
Development resolved		0.18			
Development planned		2.2			
Possibly recoverable			0.24	14	
Sub-marginal					
Not evaluated					
	Prod'n wells	Appraisal wells	Explor'n wells	Not drilled	Un-defined

FIG 2.4.6.c
Forventede totale utvinnbare ressurser sør for Stad
Proven and probable recoverable resourses south of Stad

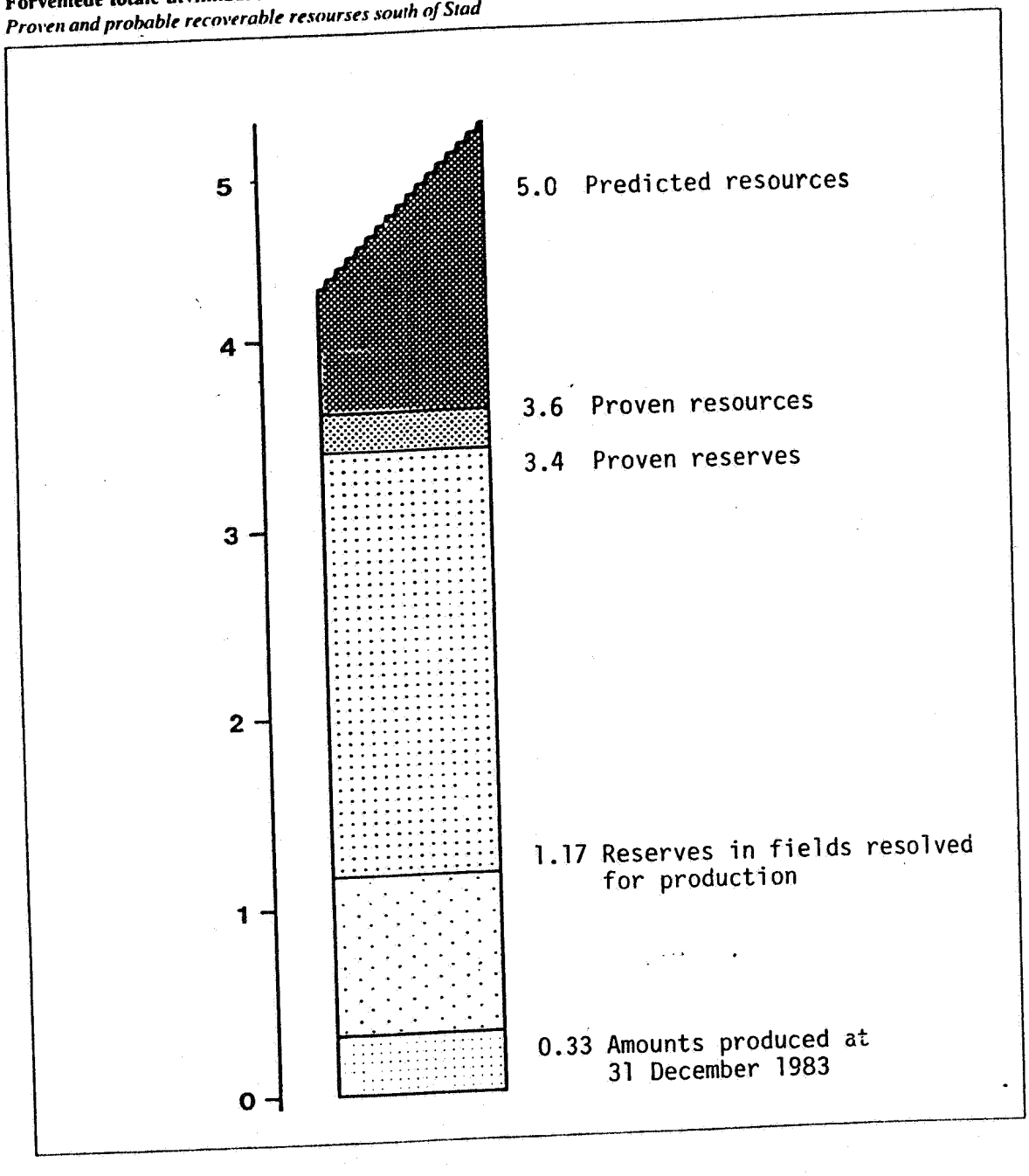


FIG 3.a Alvorlighet av skader i % av totalt, 1983
Severity of injuries in % of total, 1983.

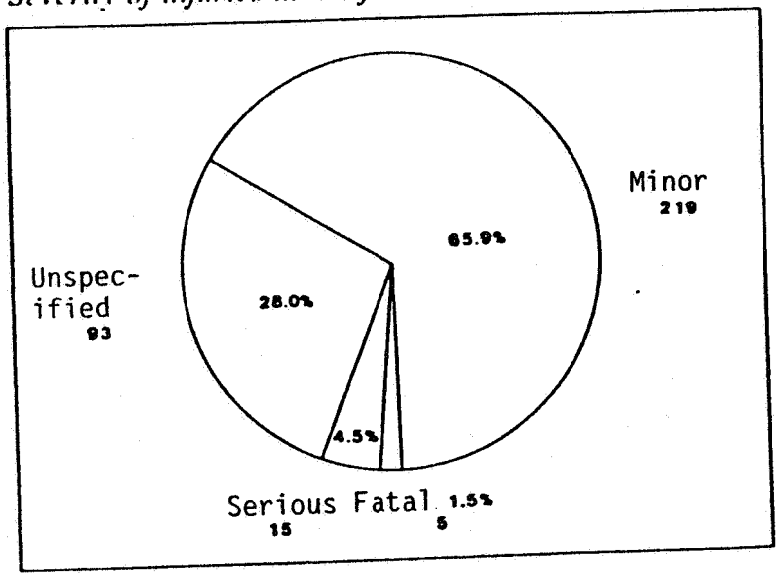


FIG 3.b Ulykkesfordeling i ulike skift, 1979–83
Accident distribution on shifts, 1979-83

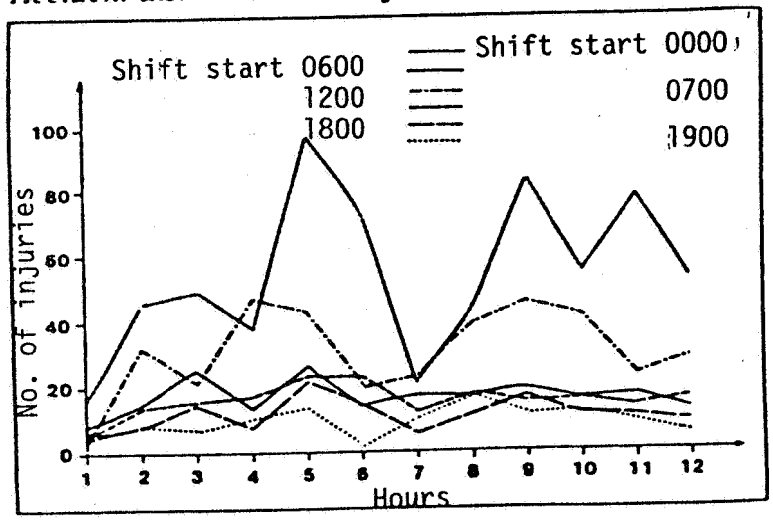


FIG 3.c Ulykkesfordeling, ulike offshore-perioder, 1979–83

Accident distribution on offshore periods, 1979-83

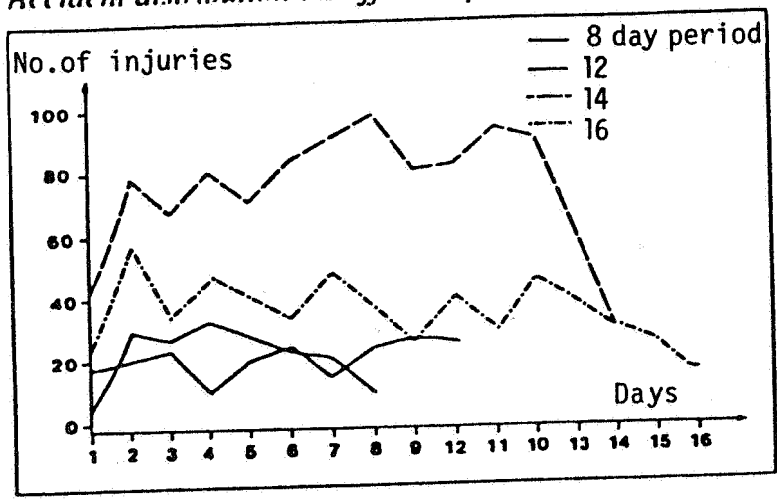


FIG 3.d Totalt antall personskader i forbindelse med dykking på den norske kontinentalsokkelen i perioden 1978–83

Total number of personal injuries connected to diving activities on the Norwegian continental shelf, 1978-83.

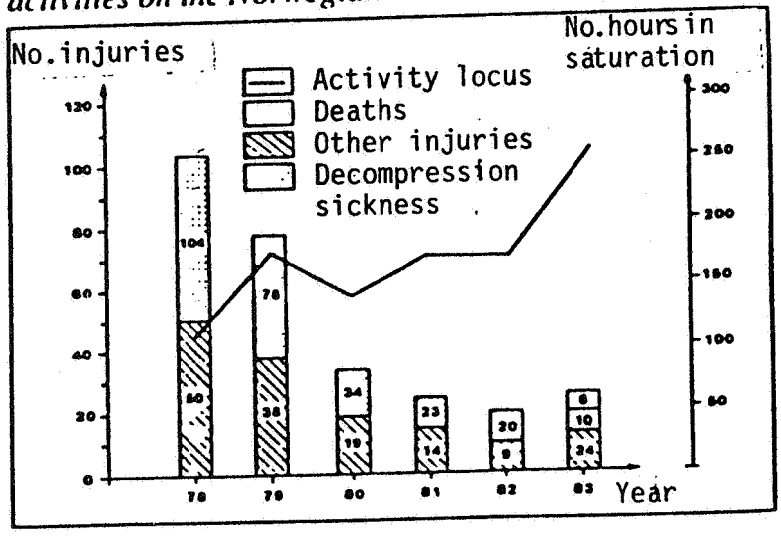


FIG 4.1.a
Investeringer i feltutbygging og produksjonsboring i perioden 1970 – 1996 i løpende kroneverdi og fast 1983-kroneverdi.
Field investments and production drilling costs 1970 – 1996. Nominal value and real 1983 value.

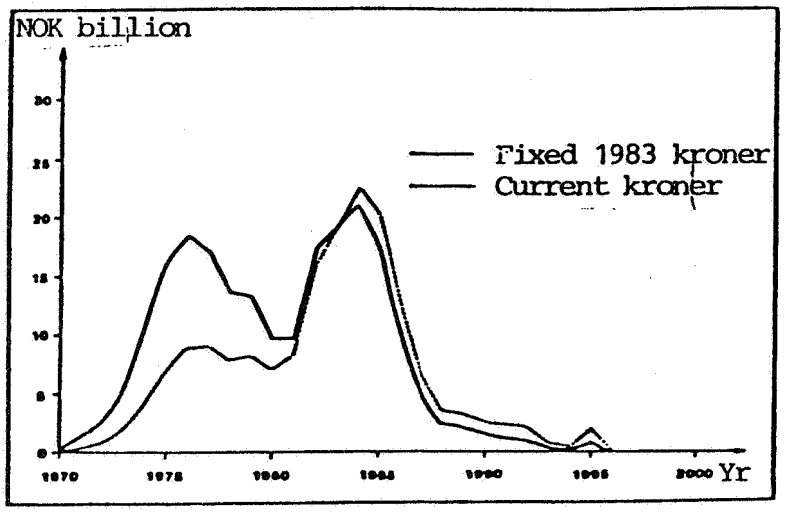


FIG 4.1.b
Kostnader for produksjonsboring 1970 – 1996 i løpende kroneverdi og fast 1983-kroneverdi
Production drilling costs 1970 – 1996. Nominal value and real 1983 value.

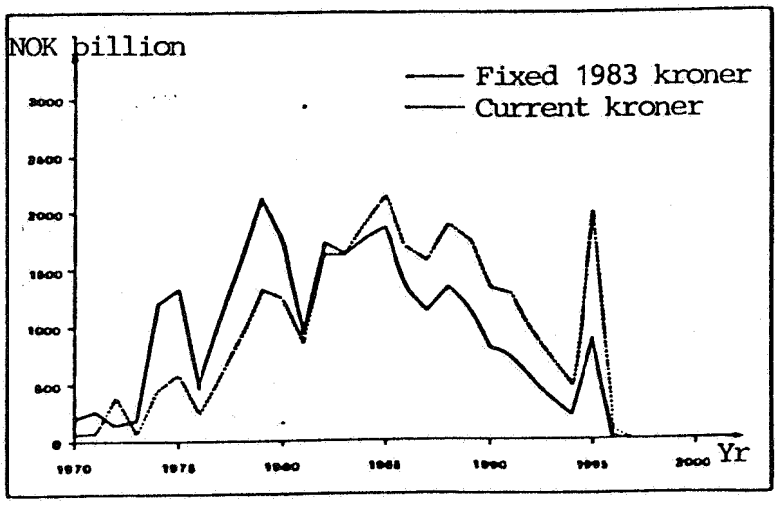


FIG 4.1.c
Norske selskapers andel av totale feltinvesteringer og produksjonsboring for perioden 1970 – 2000. Fast 1983-kroneverdi.
Norwegian companies' share of field investments and production drilling costs 1970 – 2000. Real 1983 value.

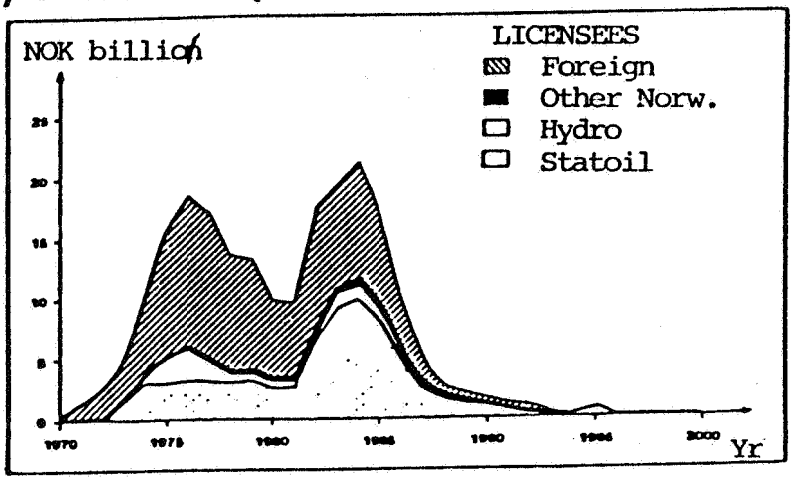


FIG 4.1.d
Totale driftskostnader. Løpende kroneverdi og fast 1983-kroneverdi.
Total operating cost. Nominal value and real 1983 value.

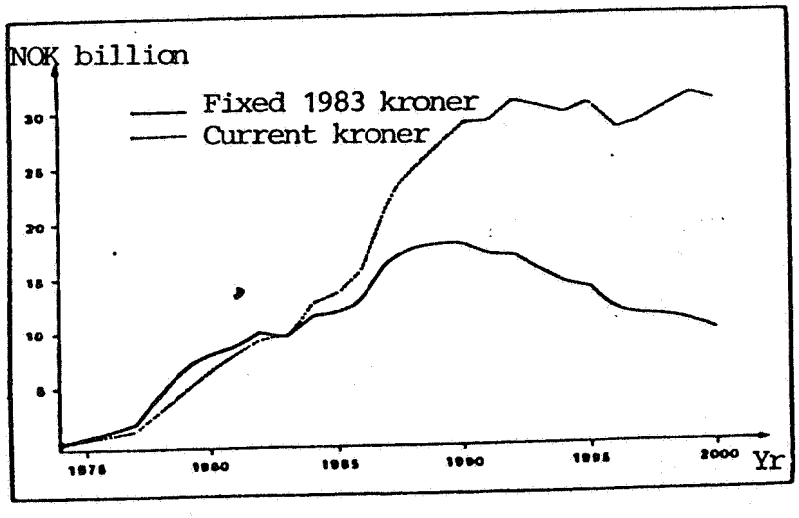


FIG 4.2.a
Årlige leteboringsutgifter. Løpende kroneverdi og fast 1983-kroneverdi.
Annual expenditures on exploration drilling. Nominal value and real 1983 value.

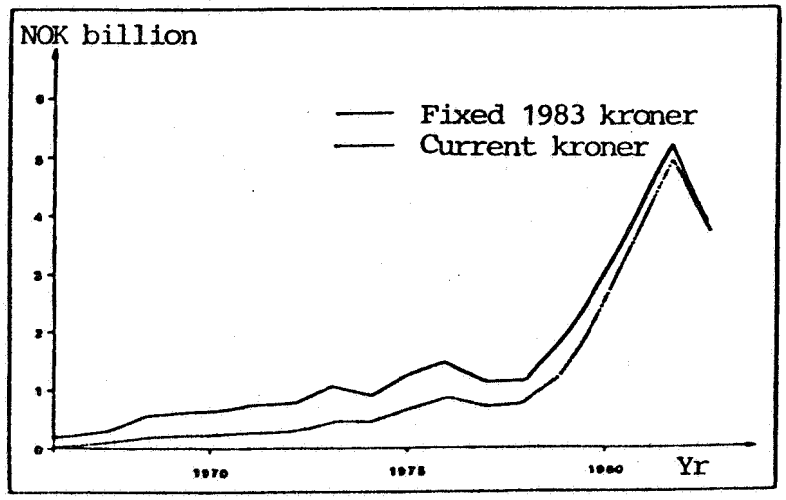


FIG 4.2.b
Utgifter til leteboring i 1983 fordelt på vare- og tjenestegrupper.
Exploration expenditures in 1983 per main cost categories.

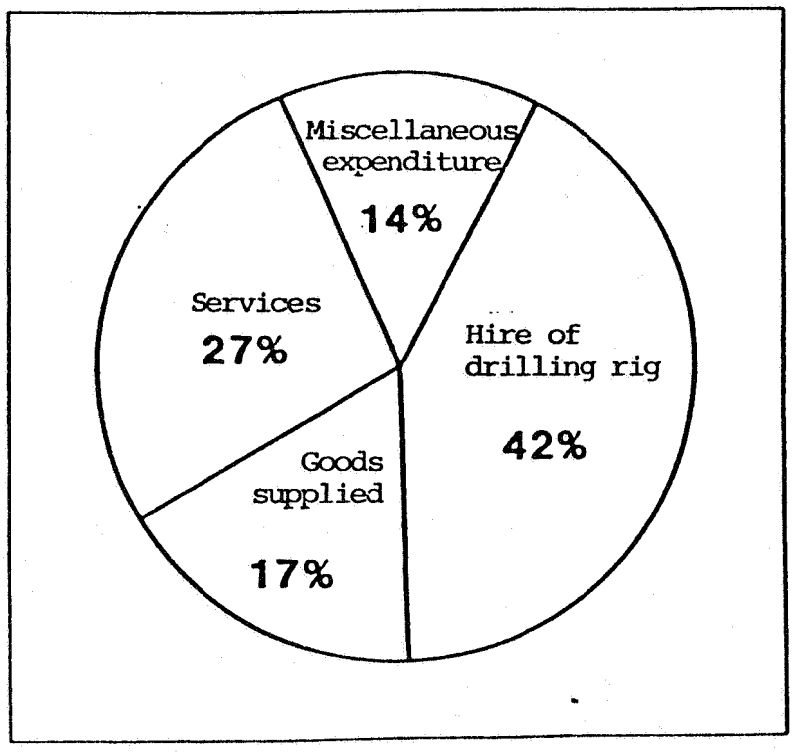


FIG 4.3.1.a
Innbetalt produksjonsavgift 1982-1983
Royalities 1982-1983

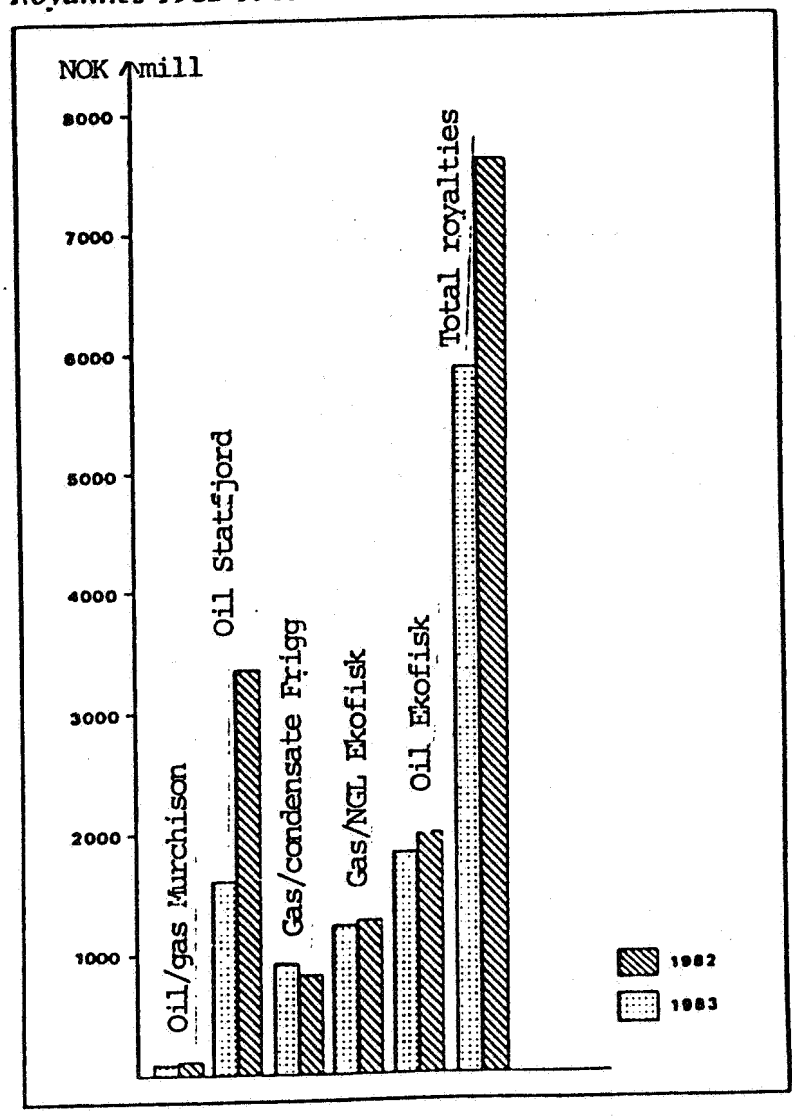


FIG 4.3.1.b
Innbetalt produksjonsavgift 1973-1983
Royalties 1973-1983

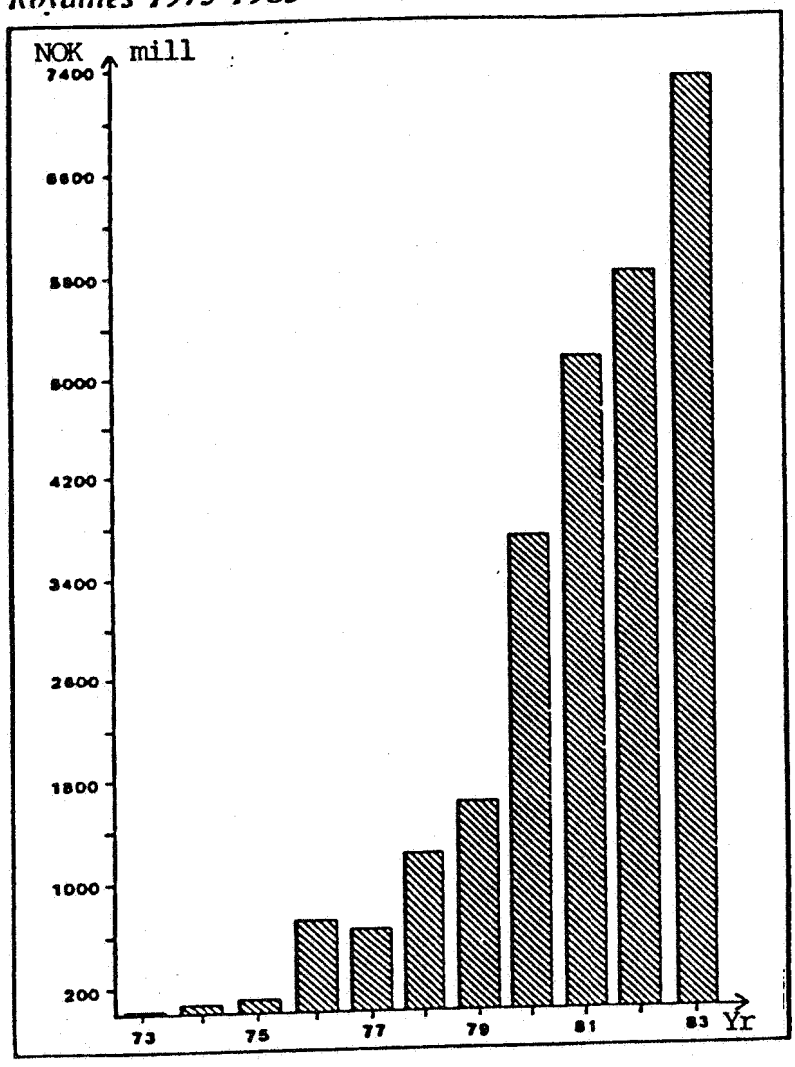
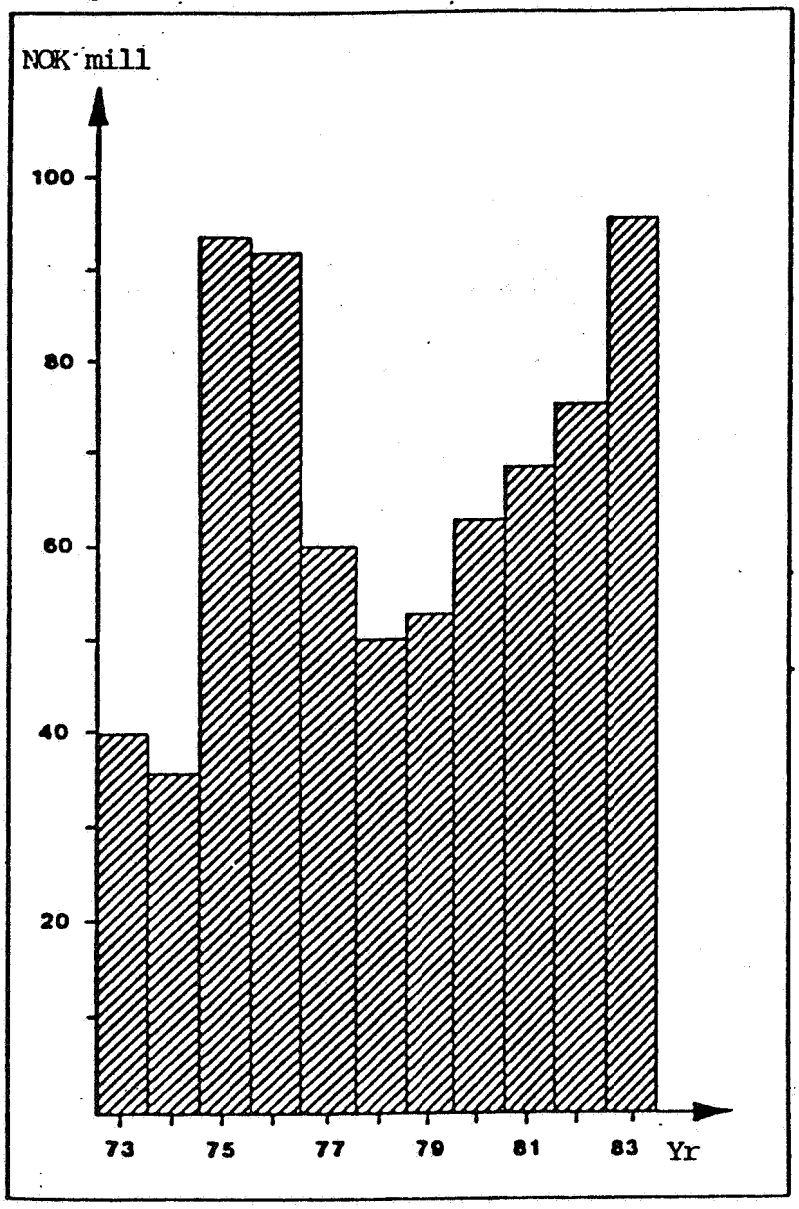


FIG 4.4
Innbetalt arealavgift 1973-83.
Areas fees 1973-83.



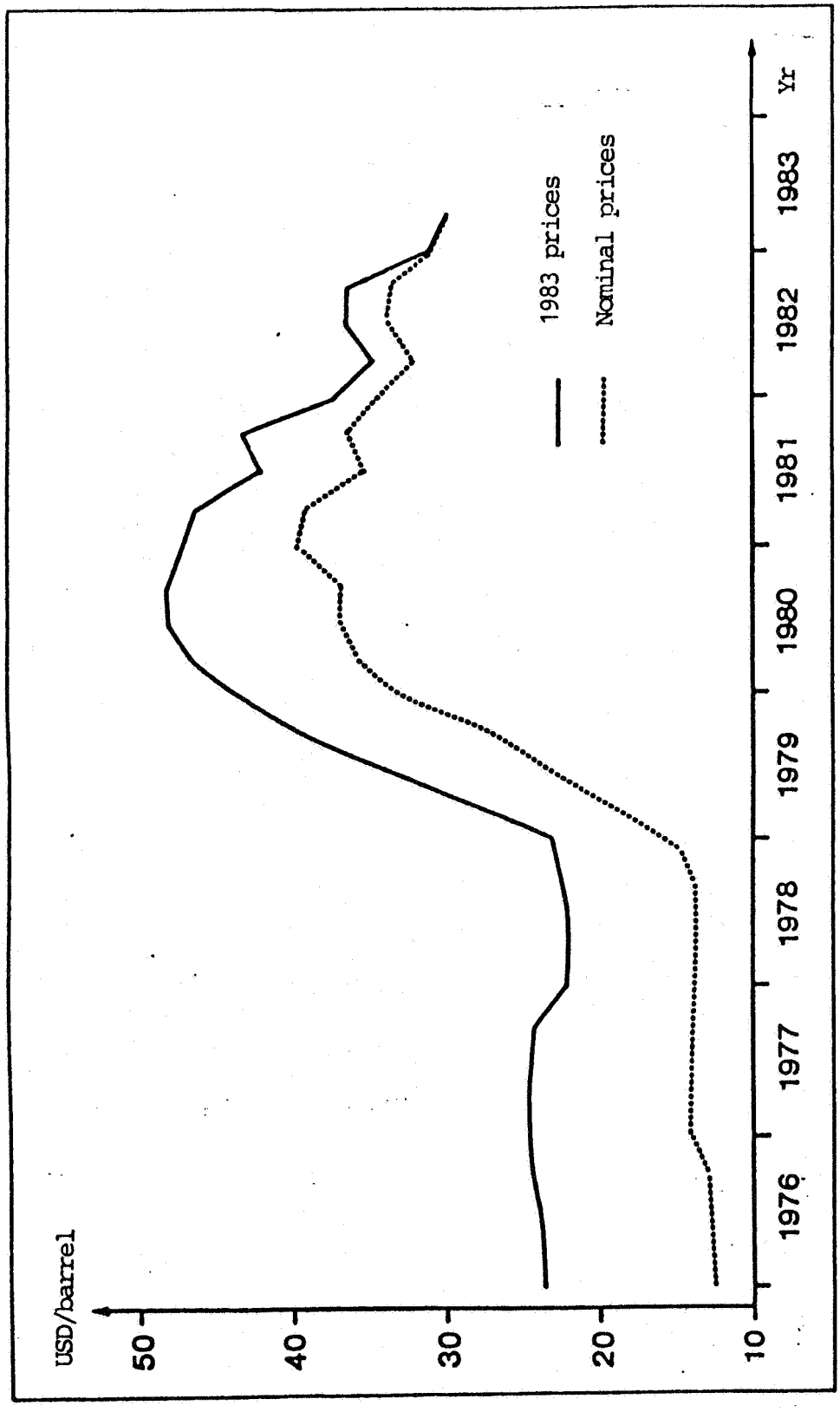


FIG 4.5.1.a
Prisutvikling for norsk olje.
Development of oil price.

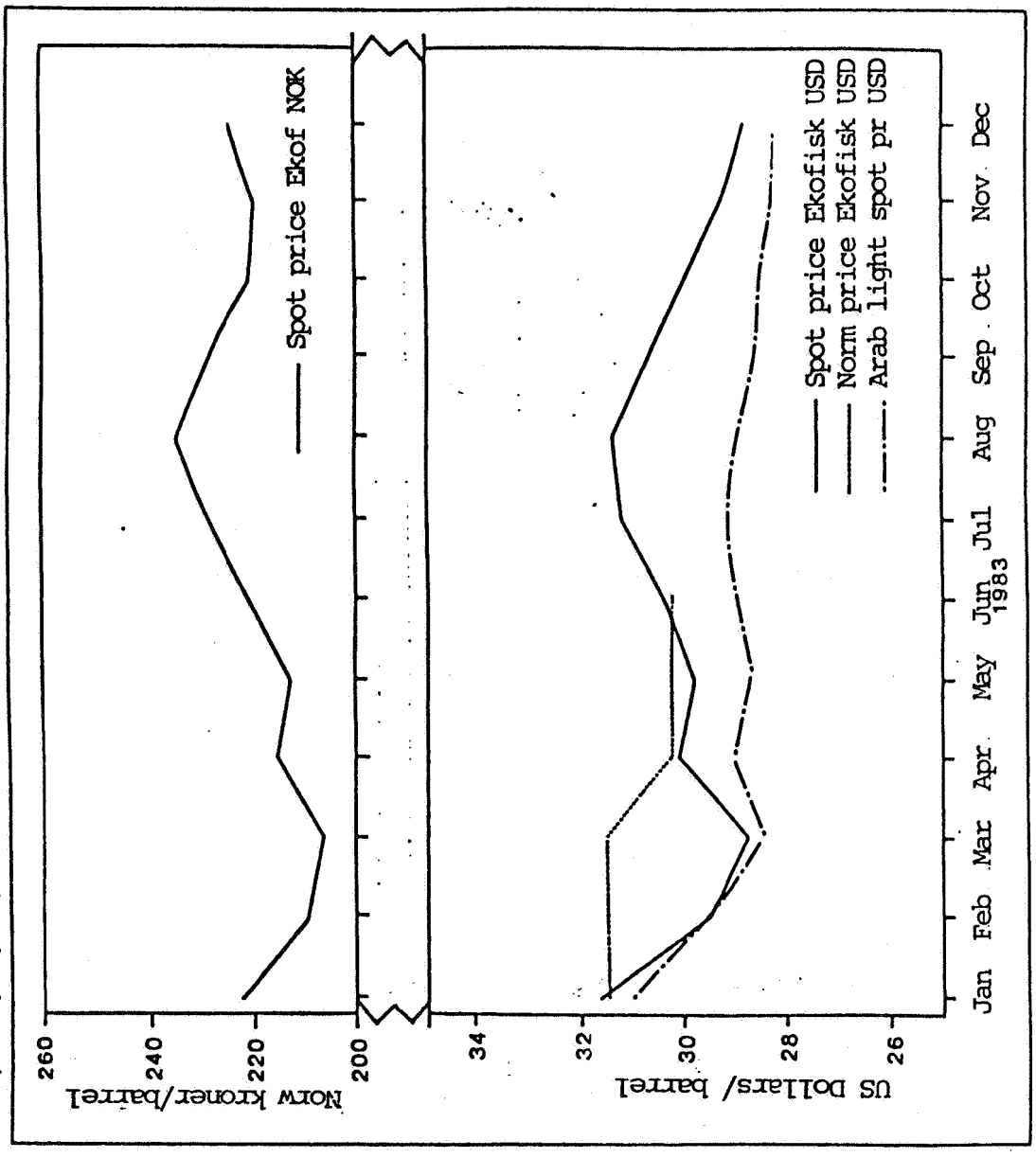


FIG 4.5.1.b
Prisutvikling for råolje for norsk sokkel – normpris og gjennomsnittlig spotpris.
Development of oil price from Norwegian Shelf – norm price and average spot price.

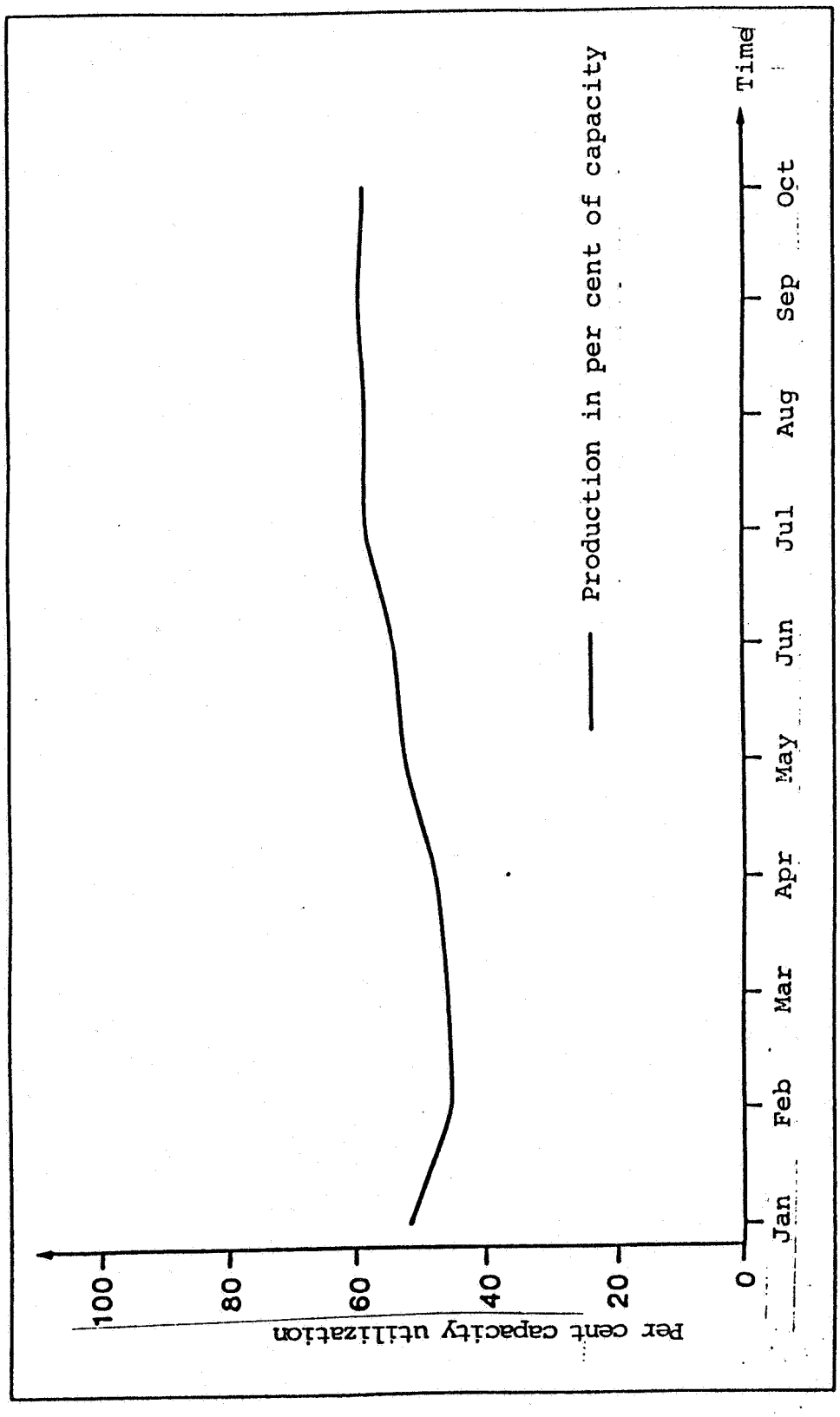


FIG 4.5.1.c
OPEC's kapasitetsutnyttelse i 1983.
Utilization of capacity within OPEC in 1983.

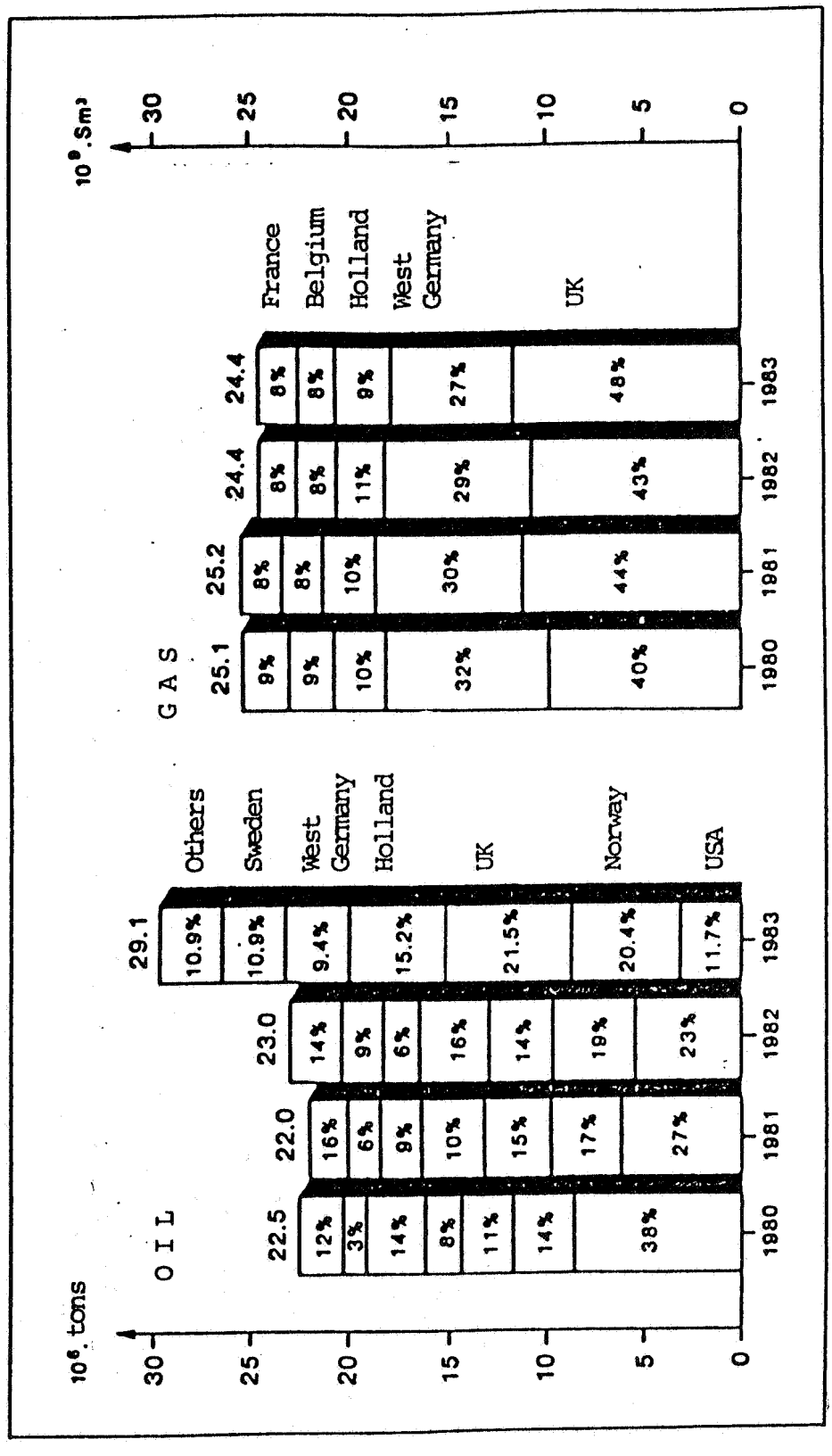


FIG 4.5.1.d
Salg av norsk råolje og gass fordelt pr land.
Sales quantities of oil and gas as per country.

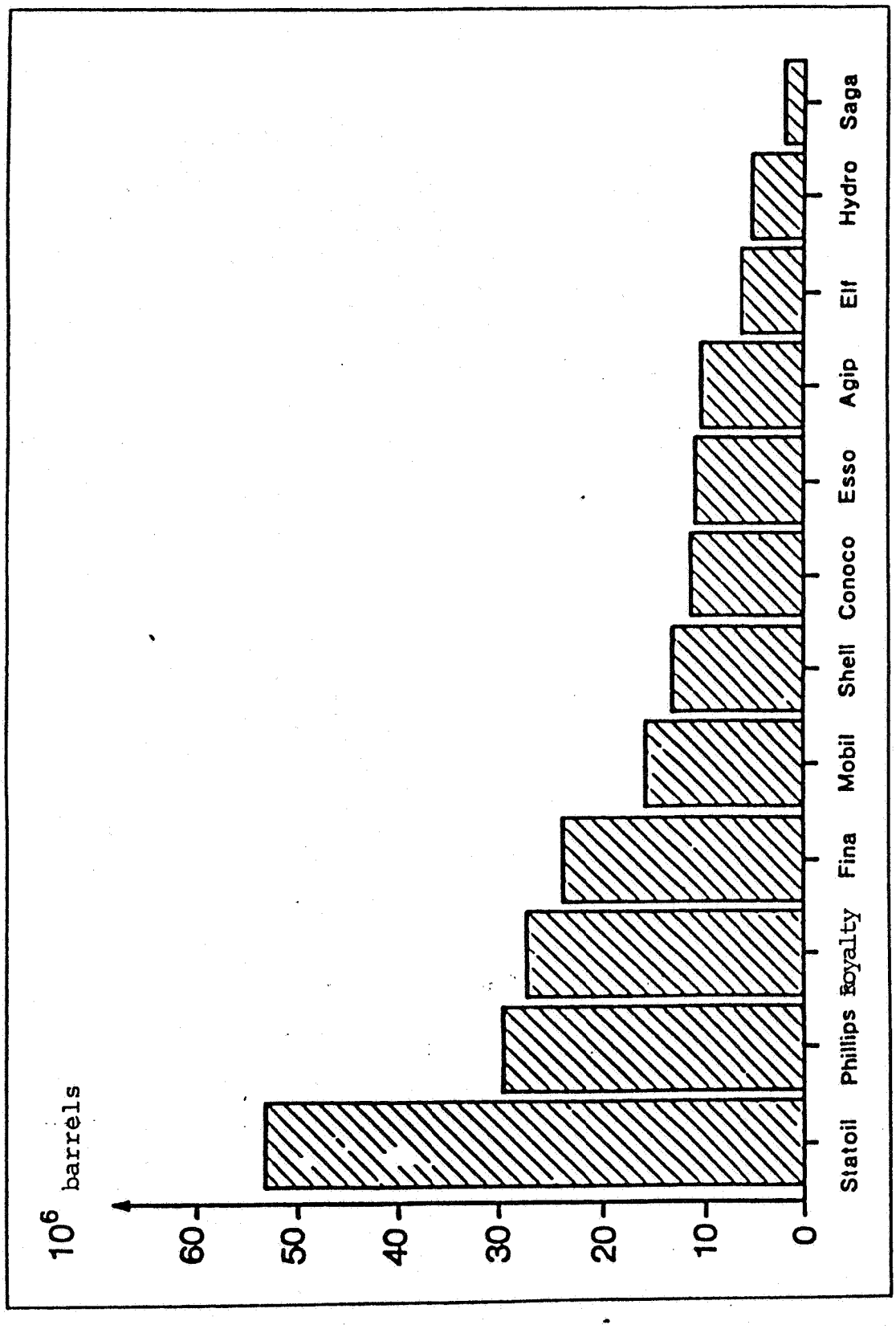


FIG 4.5.1.e
Solgt råolje pr rettighetshaver og produksjonsavgift i 1983.
Sales quantities of oil as per licensee and royalty in 1983.

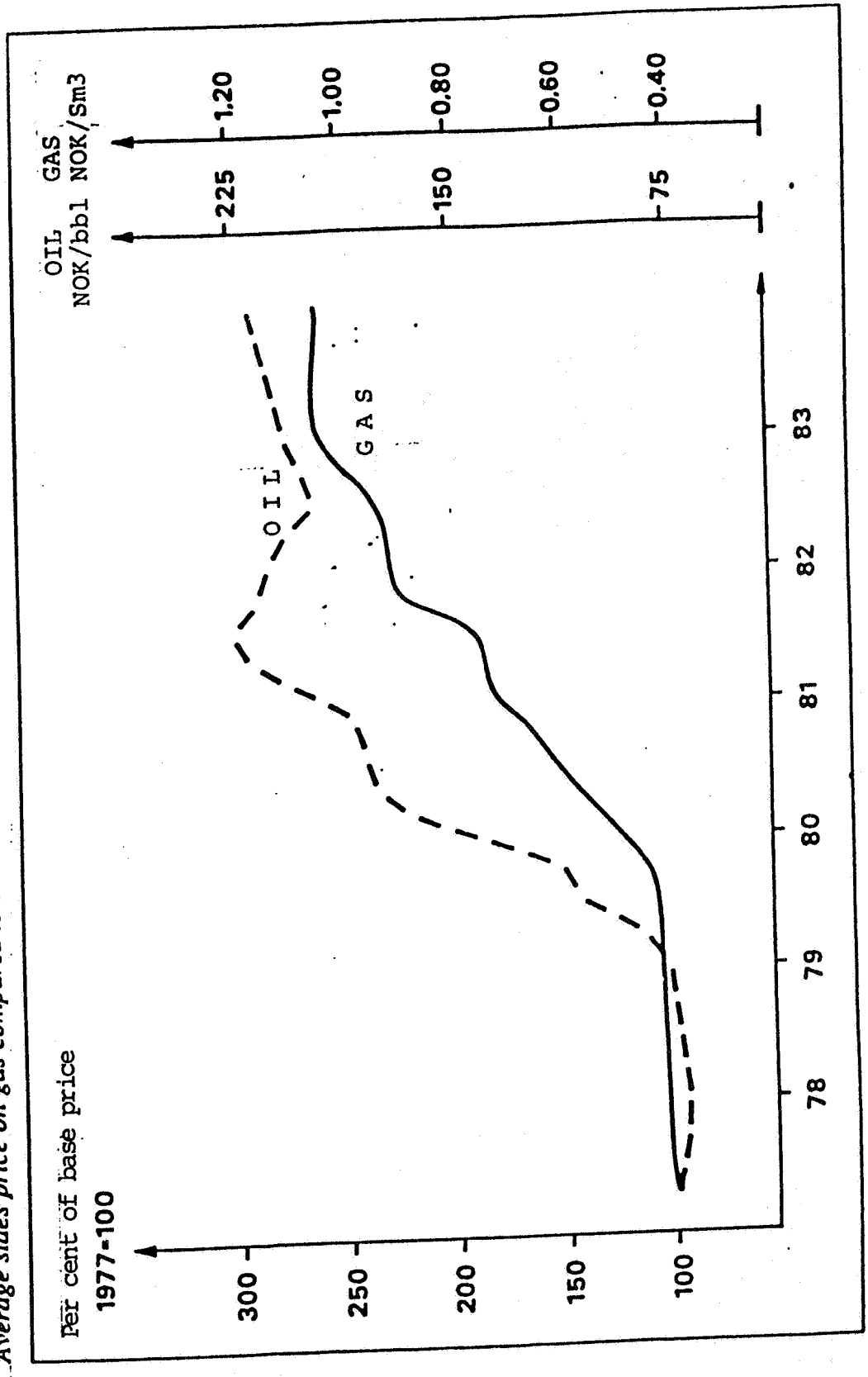


FIG 4.5.2.a
Gjennomsnittlig prisutvikling for norsk gass og forholdet til råolje.
Average slaes price on gas compared to crude oil.

FIG 4.5.2.b
Solgt gass pr rettighetshaver i 1983.
Sales quantities of gas as per licensee in 1983.

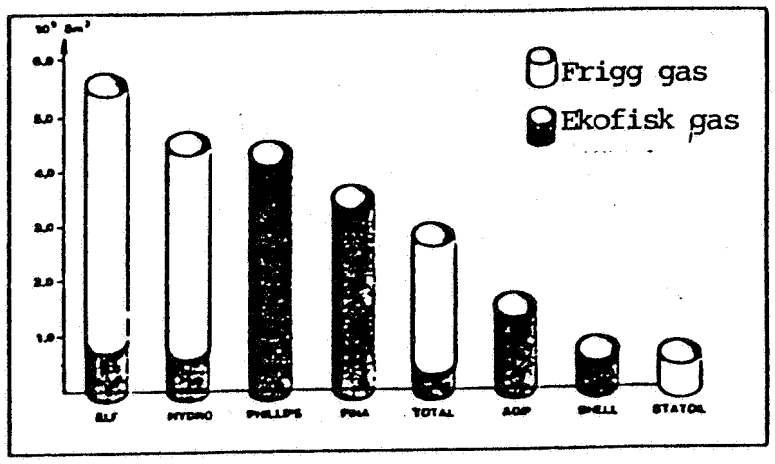


FIG 8.4.a
Olje- og gassproduksjon på norsk sokkel i mill t.o.e.
Oil and gas production from the Norwegian Shelf in million ton oil equivalents.

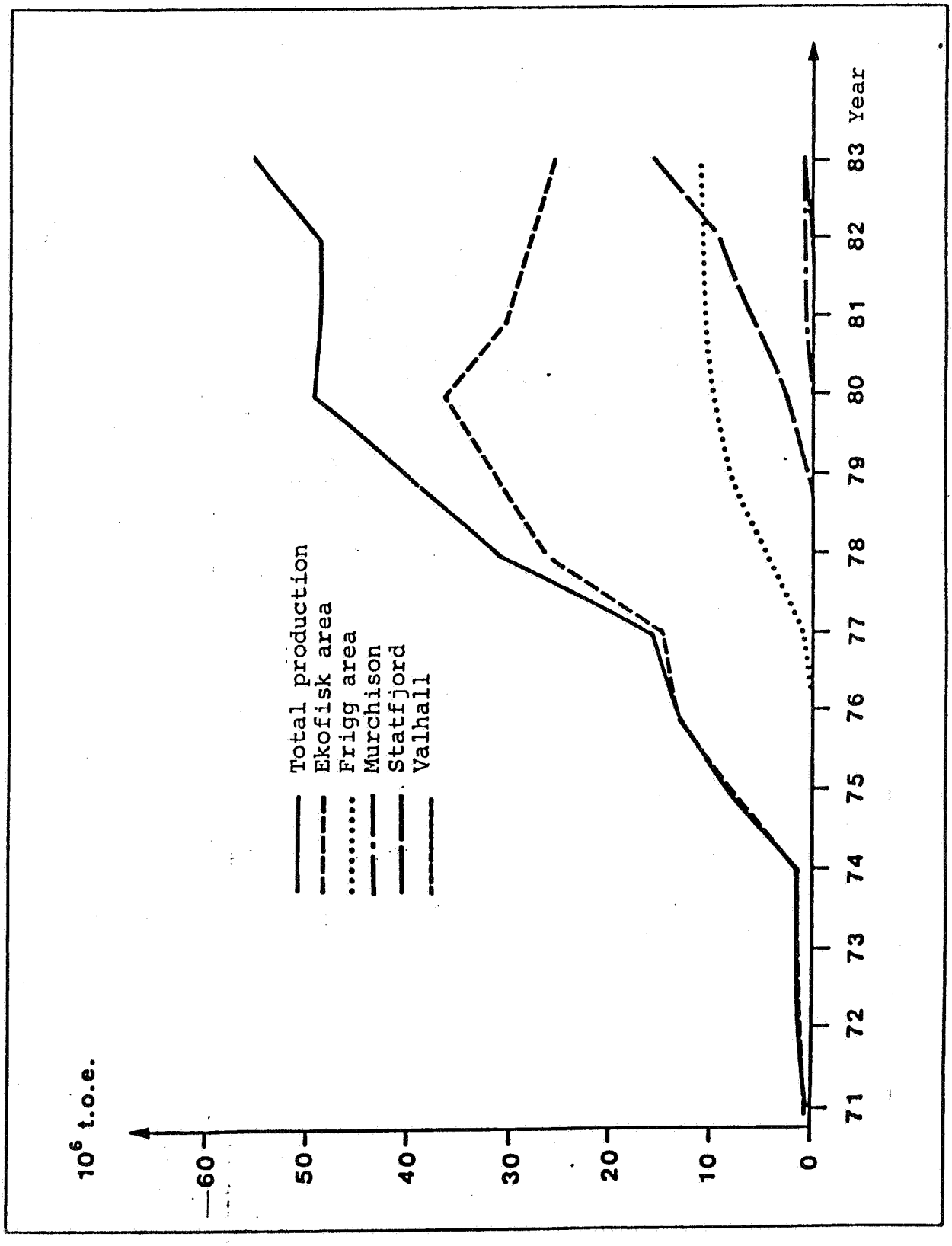
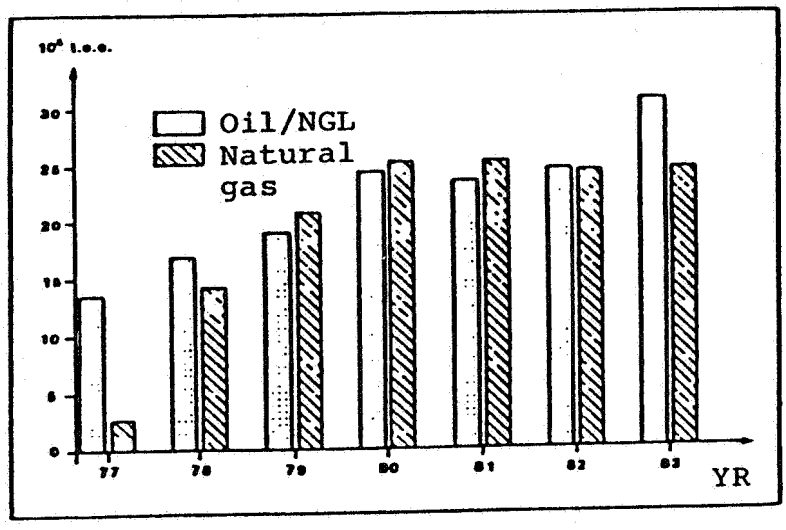


FIG 8.4.b
Olje- og gassproduksjon på norsk kontinentalsokkel 1977-83
Oil and gas production from the Norwegian Shelf.



TAB 1.3.3.a

Personell sluttet ved Oljedirektoratet i 1983 med angivelse av stillingskategori

Personnel who left NPD in 1983 with indication of type of position

Division	Mana-gers	Special advisors	Head Engineer	Senior Engineer	First geolog/ Geolog.	Division engineer/ Engineer	Case officer	Lab. person-nel,etc	Office staff	TOTAL
Resource Management	1	2	0	1	4	0	0	2	0	10
Safety Control	1	1	1	4	0	1	0	0	0	8
Legal/Economic	0	0	0	1	0	0	4	0	0	5
Administration	0	0	0	0	0	0	0	0	2	2
TOTAL	2	3	1	6	4	1	4	2	2	25

TAB 1.3.3.b

Personell sluttet ved Oljedirektoratet i 1983 med angivelse av nytt arbeid

Personnel who left NPD in 1983 with indication of new place of work

Division	Oil industry	Other non-gov't act'y	Other gov't activity	Miscell-aneous	Education	TOTAL
Resource Management	63	0	2	1	1	10
Safety Control	7	0	0	1	0	8
Legal/Economic	3	1	1	0	0	5
Administration	0	0	1	0	1	2
TOTAL	16(139)	1(23)	4(38)	2(33)	2(17)	25(249)

Figures in brackets apply to the period 1973-1983

TAB 1.3.5
Oljedirektoratets inntektsutvikling i perioden 1973 - 83 (tusen kroner)
Income development in the period 1973 - 83 (1 000 Nkr)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Sales of publications	—	—	—	30	135	197	291	387	480	794	1 376
Sales of released test material	—	—	—	2	33	46	282	235	606	206	214
Exploration fees	345	340	220	210	280	380	420	400	480	320	500
Inspection charges	5 525	16 539	19 721	26 717	42 037	45 189	47 358	33 673	26 066	26 492	23 217
Data package sales	—	—	—	1 300	3 170	14 847	31 275	35 304	12 947	20 633	50 831
Miscellaneous	—	288	463	375	76	71	—	—	—	—	765
TOTAL	5 860	17 177	20 404	28 634	45 731	60 730	79 626	69 999	40 579	48 445	76 903
NPD's total budget	28 067	45 380	61 101	79 855	101 160	123 565	123 565	125 949	123 489	126 510	147 765

TAB 2.1.1.a

Tildeling av utvinningstillatelse 085 meddelt ved kgl res av 8.7.83.

Pl 085 Granted by Royal Decree of 8 July 1983.

Prod.lic	Field/block	Ownership %	Operator (O)/licensee
085	31/3	85,000	0 Den Norske Stats Olje selskap a.s
		9,000	0 Norsk Hydro Produksjon a.s
		6,000	0 Saga Petroleum a.s
	31/5	85,000	0 Den Norske Stats Olje selskap a.s
		9,000	0 Norsk Hydro Produksjon a.s
		6,000	0 Saga Petroleum a.s
	31/6	85,000	0 Den Norske Stats Olje selskap a.s
		9,000	0 Norsk Hydro Produksjon a.s
		6,000	0 Saga Petroleum a.s

TAB 2.1.1.b
Utvinningstillatelser pr 31.12.83
Production licenses as of 31 December 1983.

Alloc.with effect from	Prod'n licence no.	Total area sq.km	No. of blocks
01.09.65	001-021	39 842,476	74
07.12.65	022	2 263,565	4
23.05.69	023-031	4 107,833	9
30.05.69	032-033	746,285	2
14.11.69	034-035	1 024,529	2
11.06.71	036	523,937	1
10.08.73	037	586,834	2
01.04.75	038-040,42	1 840,547	7
01.06.75	041	488,659	1
06.08.76	043	604,559	2
27.08.76	044	193,077	1
03.12.76	045-046	1 270,682	4
07.01.77	047	368,363	2
18.02.77	048	321,500	2
23.12.77	049	485,802	1
16.06.78	050	500,509	1
06.04.79	051-058	4 007,887	8
18.01.80	059-061	1 108,078	3
17.03.81	062-064	1 099,522	3
21.08.81	065-072	3 218,945	9
23.04.82	073-078	2 311,912	6
20.08.82	079	102,167	1
10.12.82	080-084	2 082,966	5
08.07.83	085	1 521,160	3
		70 621,794	153

TAB 2.1.1.c
Områder med utvinningstillatelser pr 31.12.83
Licensed area as of 31 December 1983

Prod. licence allocated	Original area (sq.km)	Relinquished area (sq.km)	Area on prod'n licence in sq.km	Area on prod'n licence in per cent	Split on no. of blocks
1965	42 106,041	36 338,422	5 767,619	13,70	26
1969	5 878,647	3 004,025	2 874,622	48,90	13
1971	523,937	262,047	261,890	49,99	1
1973	586,834	295,157	291,677	49,70	2
1975	2 329,206	1 633,827	695,379	29,86	4
1976	2 068,318	924,825	1 143,493	55,29	5
1977	1 175,665	896,981	278,684	23,70	2
1978	500,509		500,509	100,00	1
1979	4 007,887		4 007,887	100,00	8
1980	1 108,078		1 108,078	100,00	3
1981	4 318,467		4 318,467	100,00	12
1982	4 497,045		4 497,045	100,00	12
1983	1 521,160		1 521,160	100,00	3
	70 621,794	43 355,284	27 266,510	38,61	92

TAB 2.1.1.d Tildelingsrunder. Norske og utenlandske andeler.
Licensing rounds. Norwegian and foreign shares.

Round	Year	No. of blocks	Share in percent Norw.	foreign	Operator percent Norw.	foreign
1	1965	78	9	91	0	100
2	1969-71	14	15	85	0	100
Statfjord	1973	2	52	48	0	100
3	1974-78	20	58	42	63	37
Gullfaks	1978	1	100	0	100	0
4	1979	8	58	42	68	32
5	1980-82	12	66	34	92	8
6	1981	9	64	36	50	50
Prod.Lic. 079	1982	1	100	0	100	0
7	1982	5	60	40	80	20
Prod.Lic. 085	1983	3	100	0	100	0

TAB 2.1.4.a
Tilbakeleveringer
Relinquishments

Prod'n licence	Block	Operator
039	24/9	Conoco
047	33/2	Norsk Hydro
048	15/2	Norsk Hydro
049	33/6	Norsk Agip

TAB 2.2.1.a Oljeselskaper som har bestilt Oljedirektoratets seismiske datapakker 1983.
NPD seismic data packages ordered by oil companies in 1983.

	Troms 83 package				Møre Trønde lag /83	Bjørnøya /83 pack 1
	1	2	3	4		
COMPANIES	1 076 km 1)	2 008 km 2)	1 100 km 3)	1 321 km 4)	1 138 km 5)	12 680 km 6)
Agip	x		x			
ARCO	x		x			
Amoco	x		x			
BP	x		x		x	
Conoco	x		x		x	
Elf Aquitaine	x	x	x	x	x	x
Esso	x	x	x	x	x	x
Mobil	x		x		x	
Norsk Hydro	x	x	x	x	x	x
Petrolina	x		x			
Phillips	x		x		x	
Saga	x		x			
Shell	x		x		x	x
Statoil	x	x	x	x		
Svenska Petroleum	x		x			
Texaco	x		x			
Total	x		x			
Union	x		x			

1) Price NOK 1,038,460 3) Price NOK 1,188,166
2) Price NOK 1,905,782 4) Price NOK 1,419,505
5) Composed of seismics shot in 1970, 1972, 1974, 1975 and 1976. Price NOK 585,000.
6) Regional data shot in the period 1974-81 in the area extending from 71.55 - 74.40 deg N and from 10.00 - 26.00 deg E. Price NOK 6,724,268.

TAB 2.2.1.b
Tillatelser til vitenskapelige undersøkelser etter naturforekomster
Licenses for scientific research for natural resources

LICENCE	NAME	FIELD OF STUDY GEO-PHYSICS	GEOL-OGY	BIOL-OGY	AREA
156	Rijkswaterstaat (Directie Noordzee) Nederland		X		Skagerak
157	Universitetet i Bergen Geologisk institutt, avd B	X	X		North Sea
158	Natural Environment Research Council England	X	X		North Sea
159	Institut für Meereskunde an der Universität Kiel		X	X	Norwegian Sea
160	DAFS, Marine Laboratory Skottland		X		North Sea
161	Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale Frankrike	X			North Sea and Skagerak
162	Universitetet i Bergen Jordskjelvstasjonen	X			Continental margin - Lofoten/Sognefjorden
163	Norges geologiske undersøkelse	X			Drammensfjord - Inner/Outer part
164	Lamont-Doherty Geological Observatory USA	X			Norwegian Sea
165	Bundesanstalt für Geo-wissenschaften und Rohstoffe Forbundsrepublikken Tyskland	X			Norwegian Sea
166	Institute of Geological Sciences Skottland	X			North Sea
167	Alfred-Wegener-Institute for Polar Research Forbundsrepublikken Tyskland	X		X	Norwegian Sea
168	Norges geologiske undersøkelser	X			North Møre
169	Institute Français du Pétrole Frankrike	X			Norwegian Sea
170	Universitetet i Tromsø	X	X		Ingøy Deep, Outer part Bjørn Island Trench
171	Netherlands Council of Oceanic Research Nederland	X			North East Atlantic
172	Norsk Polarinstitutt	X	X		Barents Sea
173	Marine Biological Institute, Academy of Science of USSR Sovjetunionen			X	Barents Sea Norwegian Sea
174	Universitetet i Bergen Jordskjelvstasjonen	X			Marginal area between 64° and 68°N. Marginal area between South Cape and Ice Fjord, Svalbard
175	Universität Hamburg Forbundsrepublikken Tyskland			X	North Sea
176	Ministry of Agriculture, Fisheries and Food England	X			Skagerak, North Sea, North East Atlantic
177	DAFS, Marine Laboratory Skottland			X	North Sea
178	Universität Hamburg Forbundsrepublikken Tyskland	X			Skagerak

TAB 2.2.2.a
Påbegynte og/eller avsluttede leteborehull (U) og avgrensningsborehull (A)
Spudded and/or completed exploration wells (U) and delineation wells (A).

Licence No.	Well No.	Drilling spudded/ completed	Operator Licensee	Drill rig Nationality	Well type	Water depth	Total depth (MSL)	Result
315	34/4-4	11.09.82	Saga	Dyvi Delta	U	344	3 775	Oil
		03.02.83	Stat/Saga/Amoco	Norge				
343	1/3-3	27.08.82	Elf	Borgsten Dolphin	U	68	4 850	Oil
		24.03.83	Stat/Elf/Shell	Norge				
351	30/9-1	24.10.82	Norsk Hydro	Treasure Seeker	U	105	2 870	Oil/gas
		29.01.83	Stat/Hydro/Saga	Norge				
352	2/6-3	09.11.82	Elf	Byford Dolphin	U	71	4 035	Dry
		25.02.83	Elf/Petronord	Norge				
353	2/1-5	13.11.82	BP	Sedco 707	U	66	4 429	Oil
		05.04.83	Stat/BP/Conoco	USA				
354	30/11-3	17.11.82	Shell	Borgny Dolphin	U	112	4 637	Gas
		14.03.83	Shell	Norge				
355	6407/1-2	13.11.82	Statoil	Dyvi Delta	U	273	4 531	Condensate
		15.05.82	Stat/Hydro/Con/Amoco	Norge				
356	15/9-17	09.12.82	Statoil	West Vanguard	U	86	3 098	Gas
		30.03.83	Stat/Hydro/Esso	Norge				
357	34/10-16	14.12.82	Statoil	Nordraug	U	138	4 017	Oil/gas
		11.04.83	Stat/Hydro/Saga	Norge				
358	30/6-11	20.12.82	Norsk Hydro	Nortrym	U	146	3 976	Dry
		30.03.83	Stat/Petronord	Norge				
359	7/11-7	29.12.82	Phillips	Cod Plattform	U	75	4 885	Oil
		25.12.83	Phillips-gr	Norge				
360	30/6-10 A	02.12.82	Norsk Hydro	Treasure Seeker	A	109	2 642	Oil/gas
		04.03.83	Stat/Petronord	Norge				
361	1/3-4	15.02.83	Elf	Dyvi Alpha	U	72	3 173	Dry
		08.05.83	Stat/Elf/Shell	Norge				
362	2/2-3	04.02.83	Saga	Treasure Saga	U	65	4 073	Dry
		11.05.83	Stat/Mobil/Saga	Norge				
363	30/6-12	20.02.83	Norsk Hydro	Treasure Seeker	A	104	2 587	Dry
		09.03.83	Stat/Petronord	Norge				
364	34/10-17	23.02.83	Statoil	Deepsea Bergen	U	135	3 441	Oil/gas
		08.07.83	Stat/Hydro/Saga	Norge				
365	31/2-11	17.03.83	Shell	Borgny Dolphin	A	336	1 719	Oil/gas
		25.05.83	Statoil/Shell	Norge				
366	30/6-13	11.03.83	Norsk Hydro	Treasure Seeker	A	105	2 750	Oil/gas
		14.05.83	Stat/Petronord	Norge				
367	7120/12-3	16.03.83	Norsk Hydro	Treasure Scout	U	185	2 500	Gas
		05.05.83	Stat/Conoco/Hydro	Norge				
368	7120/8-3	07.04.83	Statoil	West Vanguard	A	297	2 311	Dry
		24.05.83	Statoil/Esso/Hydro	Norge				
369	30/3-3	01.04.83	Statoil	Ross Isle	U	208	3 397	Dry
		30.05.83	Statoil/Union	Norge				
370	30/9-2	01.04.83	Norsk Hydro	Nortrym	U	104	2 805	Oil/gas
		12.07.83	Stat/Hydro/Saga	Norge				
371	6610/7-1	18.04.82	Statoil	Nordraug	U	265	3 308	Dry
		19.06.83	Stat/Elf/Agip	Norge				
372	7117/9-2	07.05.83	Norsk Hydro	Treasure Scout	U	271	4 977	Dry
		09.09.83	Stat/Hydro/BP	Norge				
373	31/2-12	26.05.83	Shell	Borgny Dolphin	A	334	1 590	Gas
		08.09.83	Stat/Shell	Norge				
374	6609/11-1	19.05.83	Norsk Hydro	Treasure Seeker	U	238	3 043	Dry
		07.07.83	Stat/Hydro/Arco	Norge				
375	6407/2-2	17.05.83	Saga	Treasure Saga	U	258	3 325	Gas/condensate
		31.07.83	Stat/Agip/Arco	Norge				
376	7119/12-3	20.05.83	Statoil	Dyvi Delta	U	211	3 281	Gas/condensate
		12.09.83	Stat/Esso/Hydro	Norge				
377	7120/7-2	26.05.83	Statoil	West Vanguard	U	242	2 501	Gas/condensate
		21.08.83	Stat/Hydro/Saga	Norge				

TAB 2.2.2.b
Boretillatelser gitt på Svalbard
Drilling permits on Svalbard

	Position North-East	Drilling spudded	Drilling completed	Drilling time (days)	Licensee
Grønnfjorden 1 (Spitsbergen)	77°57'34" 14°20'36"	9.6.63 13.6.64 26.6.65 26.6.67 1.8.65	5.9.63 26.8.64 8.9.65 12.8.67 15.3.66	287	Norsk Polar Navigasjon
Ishøgda (Spitsbergen)	77°50'22" 15°38'00"			277	Caltex-gruppen
Bellsund 1 (Fridtjovsbreen) (Fridtjov Glacier)	77°47' 14°46'	23.8.67 29.6.68 7.7.69 10.7.74 16.7.75 22.8.80 1.7.81	2.9.67 21.8.68 16.8.69 18.9.74 20.9.75 5.9.80 10.8.81	299 x)	Norsk Polar Navigasjon
Hopen 1	76°26'55" 25°01'45"	11.8.71	29.9.71	50	Fina-gruppen
Raddedalen (Edgeøya)	77°54'30" 22°41'30"	2.4.72	10.7.72	100	Caltex-gruppen
Plurdalen (Edgeøya)	77°44'33" 21°50'00"	29.6.72	12.10.72	106	Fina-gruppen
Kvadehuken 1 (Spitsbergen)	78°57'03" 11°23'33"	21.4.73	10.8.73	112	Norsk Polar Navigasjon
Hopen 2	76°41'15" 25°28'00"	20.6.73	20.10.73	123	Fina-grupp
Kvadehuken 2 (Spitsbergen)	78°55'32" 11°33'11"	13.8.73 22.3.74	19.11.73 16.6.74	186	Norsk Polar Navigasjon
Sarstangen (Spitsbergen)	78°43'36" 11°28'40"	15.8.74	1.12.74	109	Norsk Polar Navigasjon
Haketangen (Spitsbergen)	76°52'30" 17°05'30"	11.9.76 13.6.77	20.9.76 19.9.77	109	Norsk Polar Navigasjon
Colesbukta (Spitsbergen)	70°07' 15°02'	13.11.74	1.12.75	373	Trust Arktikugol

x) Drilling not finally completed

TAB 2.3
Produksjons- og injeksjonsbrønner
Production and injection wells

Field	Total Drilled	Drilled 1983	Prod-ucing	Injection (Observation)	Drilling at year-end	Plugged/ temp. abandoned	Well maint-enance
Albuskjell	23		17			6	1
Cod	8		6			2	
Edda	10		7			3	
Ekofisk	47	1	37	5		5	7
Eldfisk	38	2	28		1	9	2
Frigg	48 x)		47	(1)			
NØ Frigg	7		6			1	
Odin	1	1			1		
Statfjord	40	13	24	11	2	3	3
Tor	14		10			4	2
Valhall	9	5	7		1	1	3
Vest-Ekofisk	12		9			3	1
Total	257	22	198	17	5	37	19

x) 24 on Norwegian side

TAB 2.4.2.a Påviste petroleumsreserver i felt besluttet utbygd

Proven petroleu reserves in fields declared commercial

	ORIGINAL			REMAINING		
	OIL .10^6Sm^3	NGL .10^6 tonn	GAS .10^9Sm^3	OIL .10^6Sm^3	NGL .106	GAS .10^9Sm^3
Albuskjell	9	1,0	16	4	0,5	7
Cod	3	0,4	6	1,2	0,2	2
Edda	3	0,2	2	0,3	0,1	0,6
Ekofisk m/vanninjeksjon	192	8,0	125	78	5,5	64
Eldfisk	44	1,9	31	23,7	1,3	24
Frigg 1)		0,8	127		0.8	95
Gullfaks Fase I 2)	91	1,1	6	91	1,1	6
Heimdal	3		34	3		31
Murchison 3)	13	0,5	0,6	10	0,4	0,4
Nord-øst Frigg			8			7.9
Odin			22			22
Statfjord 4)	341	13,0	40	299	13	39
Tor	17	1,0	11	3,3	0,4	5
Ula	30	1,3	2	30	1,3	2
Valhall A	19	1,3	16	18	1,2	15,8
Vest-Ekofisk	10	1,0	22	0,5	0,4	4,3
Sum	775	31,5	468,6	562	26,2	326

1) This is the Norwegian part: 60.82%
2) NPD figures for Gullfaks are from 1981. Operator's figures at 30 June 1983 are 127 (oil), 1.5 (NGL) and 9 (gas)
3) Original reserves represent a Norwegian share of 25.1%
4) This is the Norwegian part: 84.09%. For production, NGL products are injected with the gas. Some gas is flared or consumed (fuel gas).

TAB 2.4.3 Påviste petroleumsreserver i aktuelle feltutbyggingsoppgaver

Proven petroleum reserves in current field development projects.

Field	OIL .10⁶Sm³	GAS .10⁹Sm³
Brage	29	6
Gullfaks Fase II	102	12
Gullfaks Sor 1)	19	77
Hod	9	7
Oseberg 2)	173	71
30/6 - Beta	ca 20	
Sleipner 3) + Gamma 4)	27	179
Sleipner-satellitter 5)		34
Tommeliten	6	23
Troll-Vest	58	462
Troll-Ost		825
Valhall	15	12
33/9 Alfa	19	3
33/9 Beta	39	2
	516	1 713

1) Operator's estimate at 6 May 1983
2) Constitutes Alfa, Alfa North and Gamma
3) Constitutes Alfa, Beta, Epsilon and Delta
4) Constitutes Heimdal fm
5) Includes the structures 15/9-My, 15/9-Theta and 15/8-Alfa.

TAB 2.4.4
Petroleumsressurser som kan modnes
Petroleum resources to mature.

Field	RECOVERABLE OIL .10⁶Sm³	RECOV. GAS .10⁹Sm³
Askeladd 1)		46
Balder	35	
Ost-Frigg		5
Hild		51
Huldra (30/2-30/3 Alfa) 2)		
Sor-ost-Tor	4	3
Tyrihans (6407/1) 3)	7	23
2/1-3 og 4	18	2
15/9-Gamma		5
15/5-1	1	4
15/3-1 og 3	2	29
15/3-4	12	5
24/9	3	
25/2-4	4	12
30/3-Beta	24	8
35/8-1	1	10
34/4-1	3	
6507/11 4)		40
7120/7		23
7120/9		35
7120/12		12

1) Being revised
2) The NPD has not prepared its own figures. Operator's figures are 18 billion Sm3 gas.
3) Only includes southern part of Tyrihans field. The northern part is about the same volume.
4) The field extends down into Block 6407/2.

TAB 2.4.5
Endringer i ressursanslag årsberetningene 82-83.
Changes in resource estimates in annual reports 82-83.

FIELD	Oil 10^6Sm^3	Gas 10^9Sm^3	Oil 10^6Sm^3	NGL million tons	Gas 10^9Sm^3
Fields resolved for development:					
Cod	2	5	3	0,4	6
Ekofisk water-flooding	163	111	192	8,0	125
Murchison 1)	9	1	13	0,5	0,6
Valhall A	33	26	19	1,3	16
Other fields:					
Askeladd		75			46
Gullfaks-S					
(34/10 Alfa) 2)	8	4	19		77
Oseberg	117	60	173		71
Sleipner- 3)		10			34
Tommeliten	9	24	6		23
Troll-	120	480	58		462
Troll-		—			825
Tyrihans (6407/1) 4)			7		23
Valhall	25	19	15		12
33/9-Alfa	18	2	19		3
34/4-1			3		
6507/11 5)	—	13			40

1) This is the Norwegian part: 25.1%
2) Operator's estimate used (at 6 May 1983)
3) Includes 15/9-My, 15/9-Theta and 15/8-Alfa
4) Only includes the southern part of the Tyrihans field. The northern part is about the same order of volume
5) The field extends down to Block 6407/2.

TAB 3.a
Skader/døde pr 1 000 årsverk (1976-83). Produksjonsanlegg mv.
Occupational accidents/fatalities/1,000 man years (1976-83). Production installations.

Year	Hours worked	Hours per man-year	Man-years	Injuries	Injuries per 1000 man-years	Deaths	Deaths per 1000 man-years
1976	4 876 316	1 852	2 633	213	80.9	2	0.76
1977	7 929 742	1 852	4 399	282	64.1	2	0.45
1978	14 932 154	1 752	8 523	624	73.2	6	0.70
1979	14 979 074	1 752	8 550	575	67.3	0	0.00
1980	12 238 009	1 752	6 985	452	64.7	0	0.00
1981	15 659 028	1 752	8 938	415	46.4	0	0.00
1982	14 668 483	1 752	8 372	529	63.2	0	0.00
1983	11 474 696	1 752	6 549	327	49.9	0	0.00
TOTAL	96 757 502		54 949	3 417	62.2	10	0.18

TAB 3.b

Skader pr 1 000 årsverk fordelt på funksjon 1979-83. Produksjonsanlegg mv.

Occupational accidents per 1,000 man years, distributed on functions (1979-83). Production installations.

FUNCTION		1979	1980	1981	1982	1983	1979-83
Administration/ production	Man-years	1 098	1 174	1 144	1 306	1 296	6 017
	Injuries	24	23	22	21	31	121
	Injuries per man-year	21,9	19,6	19,2	16,1	23,9	20,1
Drilling	Man-years	1 467	1 095	1 098	1 289	1 300	6 249
	Injuries	187	148	115	138	98	686
	Injuries per man-year	127,5	135,1	104,8	107,0	75,4	109,8
Catering	Man-years	507	383	411	548	525	2 374
	Injuries	18	10	7	22	17	74
	Injuries per man-year	35,5	26,1	17,0	40,2	32,4	31,2
Building/ maintenance	Man-years	5 482	4 333	6 258	5 229	3 429	24 730
	Injuries	345	270	270	348	181	1 413
	Injuries per man-year	62,9	62,3	43,1	66,5	52,8	57,1
Unspecified	Man-years	—	—	—	—	—	—
	Injuries	1	1	1	—	—	3
	Injuries per man-year	—	—	—	—	—	—
Total	Man-years	8 550	6 985	8 938	8 372	6 550	39 395
	Injuries	575	452	415	529	327	2 298
	Injuries per man-year	67,3	64,7	46,4	63,2	49,9	58,3

TAB 3.c

Arbeidsulykker 1982-83. Produksjonsanlegg mv. Skadehendelse/yrke.

Occupational accidents 1982-83. Production installations. Accidental events/Occupation.

Injury incident \ Occupation	Administration	Drillfloor worker	Driller	Electrician	Catering	Assistant worker	Instrument technician	Crane operator	Painter/ sandblaster	Mechanic/ motorman	Operator	Plateworker/ insulator	Pipeworker/ plumber	Services technician	Scaffolder	Welder	Derrick-man	Unspecified	TOTAL	%	Year
Other contact with objects/machinery in motion	2	20	3	4	9	30	1	2	1	11	1	3	7	2	5	2	12	0	115	21,7	1982
	1	14	4	2	2	13	1	0	2	6	1	2	1	3	5	1	4	2	64	19,6	1983
Fire, explosion, etc	0	0	0	1	0	4	0	0	0	2	0	0	0	0	0	1	0	0	8	1,5	-82
	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0,3	-83
Fall to lower level	2	2	1	2	0	10	1	0	5	4	0	2	4	2	3	5	1	0	44	8,3	-82
	1	1	0	0	0	8	2	1	2	4	1	3	3	0	1	1	0	0	28	8,6	-83
Fall to same level	2	2	0	5	2	10	0	1	4	2	3	2	4	3	5	5	2	1	53	10,0	-82
	1	0	0	2	4	4	3	0	2	2	2	4	2	2	2	0	0	0	30	9,2	-83
Stepping on uneven surface, mis-stepping	2	1	0	8	1	6	1	0	0	1	1	1	5	3	3	8	1	0	42	7,9	-82
	1	1	0	1	1	3	1	2	4	3	1	0	0	3	2	3	3	0	29	8,9	-83
Falling objects	0	2	0	2	0	10	1	0	0	2	1	3	5	1	4	1	0	0	32	6,0	-82
	2	3	2	0	0	6	0	0	0	2	0	6	0	2	1	0	1	0	25	7,7	-83
Other contact with objects at rest	0	2	0	1	4	5	1	0	1	2	0	4	1	0	6	6	0	0	33	6,3	-82
	0	2	0	3	4	5	1	0	1	2	0	6	1	1	1	1	0	3	31	9,5	-83
Handling accidents	0	4	1	6	2	12	1	2	4	10	1	9	10	2	2	7	4	0	77	14,6	-82
	0	5	0	1	0	6	1	0	3	4	5	3	2	4	5	2	2	1	49	15,0	-83
Contact with chemical/ physio-compounds	0	1	0	0	0	7	0	0	9	1	0	1	1	2	1	1	0	0	24	4,5	-82
	0	0	0	0	0	2	1	0	8	3	1	1	0	3	0	0	1	0	20	6,1	-83
Overloading of part of body	0	5	0	3	1	8	0	1	2	3	1	0	3	1	6	1	4	0	39	7,4	-82
	0	0	0	1	1	7	1	1	0	2	3	0	4	0	3	0	3	0	26	8,0	-83
Splinters/splashes	1	0	0	1	0	3	0	1	2	3	0	4	8	0	1	13	1	1	39	7,4	-82
	0	1	1	0	0	1	0	0	0	4	0	1	3	3	0	6	0	0	20	6,1	-83
Electric current	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1,0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-83
Extreme temperature	0	0	0	0	2	0	0	0	0	3	1	0	3	0	0	1	0	0	10	1,9	-82
	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0,3	-83
Fall into sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-83
Other	1	0	0	0	1	2	0	0	0	1	0	1	0	0	0	2	0	0	8	1,5	-82
	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3	0,9	-83
TOTAL	10	39	5	38	22	107	6	7	28	45	9	30	51	16	36	53	25	2	529		-82
	6	27	7	10	17	57	12	5	22	32	14	27	16	21	20	14	14	6	327		-83
%	1,9	7,4	0,9	7,2	4,2	20.2	1,1	1,3	5,3	8,6	1,7	5,7	9,6	3,0	6,8	10.0	4,7	0.4		100	-82
	1,8	8,3	2,1	3,1	5,2	17,4	3,7	1,5	6,7	9,8	4,3	8,3	4,9	6,4	6,1	4,3	4,3	1,8		100	-83

TAB 3.d
Arbeidsulykker 1982-83. Produksjonsanlegg mv. Skadehendelse/skadet legemsdel.
Occupational accidents 1982-83. Production installations. Accidental events/Injured part of the body.

Occupation / Injury incident	Eye	Back	Toe/foot	Hip/leg	Stomach/ chest	Arm/ shoulder	Head/ face	Tooth	Hand/ finger	Other	TOTAL	%	Year
Other contact with objects/machinery in motion	1	2	15	5	6	7	4	5	69	1	115	21,7	1982
	0	1	7	4	2	3	5	3	39	0	64	19,6	1983
Fire, explosion, etc	0	0	0	0	0	0	7	0	1	0	8	1,5	-82
	0	0	0	0	0	1	0	0	0	0	1	0,3	-83
Fall to lower level	0	12	8	3	7	5	4	1	3	1	44	8,3	-82
	0	8	6	5	1	2	2	0	4	0	28	8,6	-83
Fall to same level	0	8	12	4	4	6	1	1	17	0	53	10,0	-82
	0	8	2	4	4	1	2	2	7	0	30	9,2	-83
Stepping on uneven surface, mis-stepping	0	0	30	5	1	2	0	2	1	1	42	7,9	-82
	0	5	17	6	0	0	0	1	0	0	29	8,9	-83
Falling objects	0	0	8	6	1	1	6	1	8	1	32	6,0	-82
	0	1	11	0	1	1	3	1	7	0	25	7,7	-83
Other contact with objects at rest	1	1	2	8	1	4	3	1	11	1	33	6,3	-82
	0	0	2	6	3	1	4	1	14	0	31	9,5	-83
Handling accidents	1	0	5	3	1	4	3	5	55	0	77	14,6	-82
	1	5	7	0	2	2	0	6	26	0	49	15,0	-83
Contact with chemical/ physio-compounds	21	0	0	0	0	1	1	0	0	1	24	4,5	-82
	19	0	0	0	0	0	0	0	0	1	20	6,1	-83
Overloading of part of body	0	27	0	1	3	6	0	0	2	0	39	7,4	-82
	0	20	0	2	1	3	0	0	0	0	26	8,0	-83
Splinters/splashes	38	0	0	0	0	0	0	0	1	0	39	7,4	-82
	17	0	0	0	0	0	1	0	1	1	20	6,1	-83
Electric current	0	0	0	0	0	1	2	0	2	0	5	1,0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	-83
Extreme temperature	0	0	0	1	0	1	3	0	5	0	10	1,9	-82
	0	0	0	0	0	0	0	0	1	0	1	0,3	-83
Fall into sea	0	0	0	0	0	0	0	0	0	0	0	0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	-83
Other	2	1	0	0	1	0	0	0	2	2	8	1,5	-82
	1	0	0	0	0	0	0	0	1	0	3	0,9	-83
TOTAL	64	51	80	36	25	38	34	16	177	8	529		-82
	38	48	52	27	14	15	17	14	100	2	327		-83
%	12,1	9,6	15,1	6,8	4,7	7,2	6,5	3,0	33,5	1,5		100	-82
	11,6	14,6	15,9	8,3	4,3	4,6	5,2	4,3	30,6	0,6		100	-83

TAB 3.e
Arbeidsulykker 1982-83. Produksjonsanlegg mv. Skadehendelse/Medvirkende faktor.
Occupational accidents 1982-83. Production installations. Accidental events/Contributing factor.

Occupation / Injury incident	Chemical/ physio/biol. factors	Cold/press-ure/heat/ ventilation	Materials/ packaging	Electrical equipment	Other machinery	Drill strings	Handtools/ machines/ implements	Loose/fixed fittings on structure	Lifting/ transp. gear	Other	TOTAL	%	Year
Other contact with objects/machinery in motion	0	4	16	0	5	10	15	35	29	1	115	21,7	1982
	0	5	9	0	8	7	4	18	13	0	64	19,6	1983
Fire, explosion, etc	7	1	0	0	0	0	0	0	0	0	8	1,5	-82
	0	0	0	0	0	0	1	0	0	0	1	0,3	-83
Fall to lower level	4	0	5	0	0	0	1	26	2	6	44	8,3	-82
	0	0	1	0	1	0	0	25	0	1	28	8,6	-83
Fall to same level	7	0	7	0	0	1	1	34	0	3	53	10,0	-82
	1	0	1	0	0	0	0	27	1	0	30	9,2	-83
Stepping on uneven surface, mis-stepping	1	0	4	0	1	0	0	32	0	4	42	7,9	-82
	0	0	2	0	0	0	0	27	0	0	29	8,9	-83
Falling objects	0	0	14	0	1	0	6	9	1	1	32	6,0	-82
	0	1	5	1	3	0	3	9	3	0	25	7,7	-83
Other contact with objects at rest	1	0	5	0	3	0	3	21	0	0	33	6,3	-82
	0	0	5	0	2	2	0	19	1	2	31	9,5	-83
Handling accidents	0	0	31	2	3	2	30	7	2	0	77	14,6	-82
	0	0	9	0	2	0	27	9	1	1	49	15,0	-83
Contact with chemical/ physio-compounds	21	2	1	0	0	0	0	0	0	0	24	4,5	-82
	14	6	0	0	0	0	0	0	0	0	20	6,1	-83
Overloading of part of body	1	0	23	0	0	0	3	7	4	1	39	7,4	-82
	1	0	8	0	3	0	1	9	0	4	26	8,0	-83
Splinters/splashes	1	0	3	1	0	0	26	0	0	8	39	7,4	-82
	0	2	4	0	1	0	7	0	1	5	20	6,1	-83
Electric current	0	0	0	5	0	0	0	0	0	0	5	1,0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	-83
Extreme temperature	2	4	1	0	0	0	3	0	0	0	10	1,9	-82
	0	1	0	0	0	0	0	0	0	0	1	0,3	-83
Fall into sea	0	0	0	0	0	0	0	0	0	0	0	0	-82
	0	0	0	0	0	0	0	0	0	0	0	0	-83
Other	0	0	1	0	0	0	0	2	1	4	8	1,5	-82
	1	0	0	0	1	0	1	0	0	0	3	0,9	-83
TOTAL	45	11	111	8	13	13	86	173	39	28	529		-82
	17	15	44	1	21	9	43	143	20	14	327		-83
%	8,5	2,1	21,0	1,5	2,5	2,5	16,6	32,7	7,4	5,3		100	-82
	5,2	4,6	13,3	0,5	6,4	2,8	13,1	43,7	6,1	4,3		100	-83

TAB 3.f

Arbeidsulykker 1979-83. Produksjonsanlegg mv. Skadehendelse/yrke.

Occupational accidents 1979-83. Production installations. Accidental events/Occupation.

Injury incident \ Occupation	Administration	Drillfloor worker	Driller	Electrician	Catering	Assistant worker	Instrument technician	Crane operator	Painter/ sandblaster	Mechanic/ motorman	Operator	Plateworker/ insulator	Pipeworker/ plumber	Services technician	Scaffolder	Welder	Derrick-man	Unspecified	TOTAL	%	Year
Other contact with objects/machinery in motion	12	114	11	13	13	138	8	7	6	32	6	11	23	11	25	13	51	4	498	21,7	1979 -83
Fire, explosion, etc	0	0	0	1	0	5	0	0	0	2	0	1	2	0	0	1	0	0	12	0,5	1979 -83
Fall to lower level	8	12	7	18	3	41	6	2	15	16	4	9	23	6	14	15	9	0	208	9,1	1979 -83
Fall to same level	10	13	1	23	11	37	9	5	10	14	13	14	25	10	20	18	6	3	242	10,5	1979 -83
Stepping on uneven surface, mis-stepping	10	8	0	28	5	32	6	3	7	10	6	9	20	7	12	21	8	1	193	8,4	1979 -83
Falling objects	5	8	3	4	0	23	2	0	1	5	1	9	10	4	9	5	0	0	89	3,9	1979 -83
Other contact with objects at rest	1	9	1	10	10	26	8	0	7	14	1	18	12	3	15	12	4	6	157	6,8	1979 -83
Handling accidents	2	34	5	24	14	65	10	4	13	43	14	25	48	7	16	30	17	1	372	16,2	1979 -83
Contact with chemical/ physio-compounds	0	7	0	5	3	26	2	1	32	8	8	5	7	7	2	5	3	0	121	5,3	1979 -83
Overloading of part of body	3	13	0	13	6	35	1	3	9	14	6	4	26	2	17	8	12	0	172	7,5	1979 -83
Splinters/splashes	3	5	2	2	0	16	1	1	5	10	3	14	34	3	2	44	1	1	147	6,4	1979 -83
Electric current	0	0	0	14	0	1	1	0	0	1	0	1	0	0	0	0	0	0	18	0,8	1979 -83
Extreme temperature	0	0	0	1	7	1	0	0	0	3	3	2	4	1	0	2	0	0	24	1,1	1979 -83
Fall into sea	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	<0,1	1979 -83
Other	4	4	0	4	2	6	1	2	2	3	2	4	6	0	1	3	0	0	42	1,8	1979 -83
TOTAL	58	227	30	160	74	452	55	28	108	175	67	126	240	61	133	177	111	16	2 298		1979 -83
%	2,5	9,9	1,3	7,0	3,2	19,7	2,4	1,2	4,7	7,6	2,9	5,5	10,4	2,7	5,8	7,7	4,8	0,7		100	1979 -83

TAB 4.2
Leveranser til leteboring 1983
Deliveries of goods and services in 1983 to the exploration drilling market

CATEGORY			NOK mill	Percentage share
Hire of drill rig/ platform			1 530	42
GOODS DELIVERED			635	17
Pipe		189		
Drill mud		119		
Cement/ chemicals		49		
Fuel/ lube oil		143		
Drill bits/ tools		62		
Diverse goods delivered		73		
SERVICES DELIVERED			1 005	27
Supply boats/ stand-by boats		309		
Helicopter transport		126		
Communication/ navigation/ weather services		17		
Logging		241		
Testing		133		
Core samples		14		
Engineering studies		49		
Diverse services delivered		116		
DIVERSE EXPENDITURE	91		530	14
Modification of rigs/ platforms			530	14
Maintenance/ repair		42		
Insurance		12		
Base expenditure		88		
Administration, etc		183		
Diverse expenditure		114		
TOTAL			3 700	100

TAB 4.3.1
Innbetalt produksjonsavgift i kroner i 1982 og 1983
Royalties 1982 and 1983

PRODUCTION	1982	1983
Oil Ekofisk/ Valhall	1 865 906 281	2 008 357 221
Oil Statfjord	1 572 124 252	3 311 772 676
Production bonus (Statfjord)	25 000 000	50 000 000
Oil Murchison	97 479 895	114 066 651
Gas Murchison		603 722
Gas Ekofisk	1 174 163 613	1 182 976 611
Gas Frigg	945 373 212	861 972 454
Gas Valhall		2 542 466
NGL Ekofisk/ Valhall	70 993 200	118 394 171
Condensate Frigg	5 831 606	6 929 175
LPG and NGL Murchison	216 965	6 329 969
TOTAL	5 757 089 024	7 663 945 116

TAB 4.3.2
Innbetalt produksjonsavgift for olje
Royalties on oil-production

	Ekofisk/ Valhall	Statfjord	Murchison
Provisional settlement, 4th qu. 82	418 343 094	528 736 301	19 020 466
Price adjustment, 3rd-4th qu. 1982	142 137 543	148 025 097	7 214 800
Provisional settlement, 1st qu. 83	441 657 172	876 397 197	27 271 441
Provisional settlement, 2nd qu. 83	623 141 332	1 051 269 485	39 723 994
Price adjustment, 1st-2nd qu. 1983	(114 201 217)	(210 047 585)	(6 308 531)
Provisional settlement, 3rd qu. 83	497 279 297	917 392 181	27 144 481
	2 008 357 221	3 311 772 676	114 066 651

TAB 4.3.3
Innbetalt produksjonsavgift gass
Royalties on gas production

	4.qu.82	1.qu.83	2qu.83	3.qu.83	
EKOFISK AREA					
Phillips group	116 443 546	275 515 727	232 505 718	247 340 453	871 805 444
Less refunded by NPD	1 889 716	1 322 168	1 512 834	601 553	5 326 271
Net Phillips Pet.Co.	114 553 830	274 193 559	230 992 884	246 738 900	866 479 173
Dyno/Methanor	108 905 732	50 537 112	48 296 687	23 115 732	230 855 263
Shell	14 012 043	17 036 608	15 275 747	13 854 625	60 179 023
Amoco/Noco	6 346 887	4 410 768	3 433 204	(78 989)	14 111 870
Less refunded by NPD	—	—	—	392 036	392 036
Net Amoco/Noco	6 346 887	4 410 768	3 433 204	(471 025)	13 719 834
TOTAL EKOFISK	243 818 492	346 178 047	297 998 522	283 238 232	1 171 233 293
FRIGG AREA					
Petronord group (North East Frigg)	12 510 597	10 716 455	8 765 735	4 908 438	36 901 225
Petronord group (Frigg)	245 127 187	258 751 256	187 810 202	116 297 610	807 986 255
Total Petronord group	257 637 784	269 467 711	196 575 937	121 206 048	844 887 480
Esso Exploration	5 187 384	5 631 130	3 898 680	2 367 780	17 084 974
TOTAL FRIGG	262 825 168	275 098 841	200 474 617	123 573 828	861 972 454
VALHALL					
Amoco/Noco				2 542 466	2 542 466
MURCHISON					
Stat/Mobil				603 722	603 722
TOTAL ALL FIELDS	506 643 660	621 276 888	498 473 139	409 958 248	2 036 351 935

TAB 4.3.4
Innbetalt produksjonsavgift NGL
Royalties on NGL production

	4.qu.82	1.qu.83	2.qu.83	3qu.83	TOTAL
EKOFISK AREA					
Amoco/Noco-group	750 721	290 355	969 423	613 571	2 624 070
Shell	698 936	2 108 985	1 845 219	827 874	5 481 014
Phillips-group	23 526 056	25 064 359	33 140 701	28 602 674	110 333 799
Sum Ekofisk	24 975 722	27 463 699	35 977 343	30 044 119	118 438 883
MURCHISON					
LPG (Sullom Voe) Stat/Mobil-group	255 904	2 433 630	2 777 710	691 115	6 158 359
NGL (St Fergus) Stat/Mobil-group				171 610	171 610
Sum Murchison	255 904	2 433 630	2 777 710	862 725	6 329 969
FRIGG AREA					
Petronord-group	2 304 272	2 121 170	1 565 382	938 351	6 929 175
VALHALL					
Amoco/Noco-group	—	30 713	330 476	(405 901)	(44 712)
Sum All fields	27 535 898	32 049 212	40 628 911	31 439 294	131 653 315

Paid up royalty on NGL amounts to less than 2% of total paid up royalty.

TAB 8.3.a
Månedlig aktivitet på norsk sokkel 1983
Monthly activity on the Norwegian Shelf 1983.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Drilled at year-end	1982/83													12 wells	
Spudded	1983	0	4	3	4	6	1	4	3	5	3	2	5	40 «	
															52 wells
In progress	1983														
														35 wells	
Completed	1983	1	2	5	1	7	1	3	4	6	2	0	3	7 «	
Suspended	1983			1		1		1				1	3		42 wells
Abandoned	1983														10 wells
Drilled at year-end	1983/84														
Rig days:														238	6,1 %
- Foreign														3 659	93,9 %
- Norwegian															
Rig days:		370	334	379	356	335	232	326	324	293	326	329	293		
Total		3 897											100 %		

TAB 8.3.b
Borefartøydøgn på norsk sokkel 1983
Rig days on the Norwegian Shelf 1983

Drilling rig	1. quarter	2. quarter	3. quarter	4. quarter	TOTAL
Borgny Dolphin	87	80	89	73	329
Borgsten Dolphin	83			0	83
Byford Dolphin	56			4	60
Cod Platform	90	91	92	86	359
Deepsea Bergen	37	86	84	84	291
Dyvi Alpha	79	38		0	117
Dyvi Delta	90	80	88	92	350
Neddrill Trigon			51	92	143
Nordraug	90	72	34	0	196
Nortrym	89	89	90	86	354
Ross Isle		76	88	72	236
Sedco 707	90	5		0	95
Treasure Saga	56	77	84	87	304
Treasure Scout	79	78	80	88	325
Treasure Seeker	68	78	77	92	315
West Vanguard	89	73	86	82	340
	1 083	923	943	948	3 897

TAB 8.3.c
Borefartøymåneder pr kvartal 1966-83
Rig months per quarter 1966-83

Year	1. quarter	2. quarter	3. quarter	4. quarter	TOTAL PER YEAR
1966			2	3	5
1967	3	3	5	6	17
1968	5	11	9	8	33
1969	6	7	9	6	28
1970	5	8	16	15	44
1971	12	12	14	9	47
1972	9	13	18	13	53
1973	5	7	10	17	39
1974	19	15	8	12	54
1975	9	16	17	13	55
1976	17	8	13	8	46
1977	5	10	17	18	52
1978	10	14	14	11	49
1979	15	14	20	25	74
1980	32	29	34	35	130
1981	34	31	32	39	136
1982	36	40	36	34	146
1983	36	31	31	32	130
	260	269	305	304	1 138

TAB 8.3.d
Borehull fordelt på operatørselskaper
Exploration wells distributed on operators

Statoil	76	wells
Phillips	52	«
Norsk Hydro	48	«
Esso	44	«
Elf	38	«
Amoco	33	«
Shell	28	«
Saga	24	«
Mobil	16	«
BP	14	«
Conoco	13	«
Gulf	5	«
Murphy	4	«
Texaco	2	«
Agip	1	«
Syracuse	1	«
Union Oil	1	«
	400	wells

TAB 8.3.e
Borehull påbegynt i 1983
Exploration wells spudded in 1983

Statoil	14	wells
Norsk Hydro	13	«
Saga	6	«
Shell	3	«
Elf	2	«
Conoco	1	«
Phillips	1	
	40	wells

TAB 8.3.f
Sesongsvingninger i aktiviteten 1966-83
Seasonal variations in activities 1966-83

Month	No. wells spudded
January	17
February	24
March	21
April	39
May	34
June	39
July	46
August	44
September	35
October	37
November	28
December	36
TOTAL	400

TAB 8.3.g
Gjennomsnitt vanndyp og boredyp
Average water depth and total depth

Year	Mean depth of water (m)	Mean total depth (m)
1966	110	2 737
1967	93	2 599
1968	75	3 495
1969	70	3 143
1970	89	2 983
1971	82	3 101
1972	79	3 712
1973	86	3 089
1974	109	3 078
1975	109	2 954
1976	124	2 949
1977	94	2 719
1978	109	3 502
1979	153	3 375
1980	176	3 115
1981	181	3 235
1982	162	3 314
1983	201	3 155

TAB 8.3.h
Borefartøy som har vært i aktivitet på norsk kontinentalsokkel
Drilling rigs that have been in operation on the Norwegian Shelf

Name of drilling rig	No. of wells	Type of rig
Aladdin	1	Semisubmersible
Chris Chenery	2	«
Borgny Dolphin (formerly Fernstar)	16	«
Borgsten Dolphin (formerly Haakon Magnus)	6	«
Byford Dolphin (form. Deepsea Driller)	9	«
Cod Platform	1	Fixed installation
Deepsea Bergen	4	Semisubmersible
Deepsea Driller (now Byford Dolphin)	8	«
Deepsea Saga	17	«
Drillmaster	6	«
Drillship	1	Drillship
Dyvi Alpha	16	Semisubmersible
Dyvi Beta	7	Jack-up
Dyvi Gamma	1	«
Dyvi Delta	6	Semisubmersible
Ekofisk B	1	Fixed installation
Endeavour	2	Jack-up
Fernstar (now Borgny Dolphin)	3	Semisubmersible
Haakon Magnus (now Borgsten Dolphin)	2	«
Gulftide	3	Jack-up

TAB 8.4.a
Produksjon i millioner tonn oljeekvivalenter
Production in million ton oil equivalents

1983	Oil	Gas	Total
Ekofisk- area	13 115	12 715	25 831
Statfjord	15 785	0	15 785
Frigg- area	0	11 619	11 619
Valhall	789	101	891
Murchison	875	19	894
Sum 1983	30 565	24 455	55 019
Sum 1982	24 484	24 445	48 928

The figures show Norwegian shares of Statfjord, Frigg and Murchison: 84.09322%, 60.82% and 16.25%.

In the figures for oil produced, NGL is included.

The figures for gas from the Ekofisk area, Murchison and Valhall indicate amounts sold.

In the figures for gas from the Frigg area, condensate is included.

TAB 8.4.b
Månedlig olje- og gassproduksjon fra Ekofisk-området
Monthly oil and gas production from the Ekofisk area

1983	Produced oil incl. NGL	Produced gas	Injected gas	Flared gas	Gas consumed(fuel)	Stable oil Teesside	Gas sales Emden
	10^3 Sm³	10^6 Sm³	10^6 Sm³	10^6 Sm³	10^6 Sm³	10^3 Sm³	10^6 Sm³
January	1 463	1 293	15	4	61	1 315	1 206
February	1 316	1 173	69	2	60	1 183	1 029
March	1 496	1 330	63	3	68	1 309	1 187
April	1 419	1 259	148	9	65	1 252	1 033
May	1 456	1 300	175	7	72	1 286	1 041
June	1 411	1 288	215	3	74	1 258	986
July	1 478	1 339	214	3	71	1 334	1 048
August	1 441	1 312	213	4	72	1 319	1 023
September	1 358	1 245	178	4	69	1 282	1 002
October	1 411	1 310	194	2	72	1 348	1 052
November	1 352	1 258	153	3	68	1 305	1 055
December	1 369	1 285	80	4	71	1 356	1 156
Year's total	16 972	15 391	1 716	48	824	15 548	12 817

TAB 8.4.c
Månedlig gass- og kondensatproduksjon fra Frigg-området
Monthly gas and condensate production from the Frigg area

1983	Produced gas 10^6 Sm³	Produced condens-ate	Flared gas 10^6 Sm³	Consumed gas 10^6 Sm³	Gas sold St.Fergus 10^6 Sm³	Condensate St.Fergus tons
January	1 111	523	0	4	1 159	3 322
February	1 068	666	0	5	1 113	3 936
March	1 082	555	0	4	1 133	3 338
April	1 014	459	0	4	1 064	2 704
May	753	412	0	3	803	3 037
June	569	220	0	2	606	1 823
July	487	208	0	2	532	564
August	512	339	0	2	552	1 991
September	589	429	0	2	628	1 871
October	1 061	440	0	4	1 210	2 373
November	1 183	490	0	7	1 338	4 594
December	1 288	644	0	4	1 444	4 682
TOTAL FOR YEAR	10 719 x)	5 385	1	42	11 585 x)	34 236

Figures show Norwegian share of Frigg: 60.82%, NE Frigg and Odin: 100%

x) The difference between gas produced and gas sold is due to allocation factors.

TAB 8.4.d
Månedlig olje- og gassproduksjon fra Murchison
Monthly oil and gas production from the Murchison field

1983	Produced oil Stable oil	Produced gas	Injected gas	Flared gas	Consumed gas	Stable oil Sullom Voe	Gas sold St.Fergus
	10^3 Sm^3	10^6 Sm^3	10^6 Sm^3	10^6 Sm^3	10^6 Sm^3	10^3 Sm^3	10^6 Sm^3
January	75	8	2	4	1	62	0
February	92	9	1	6	1	78	0
March	84	9	3	3	1	70	0
April	71	7	1	4	1	59	0
May	99	10	3	4	1	83	0
June	90	9	2	4	1	91	0
July	87	9	1	3	1	87	1
August	92	9	0	1	1	76	4
September	90	9	0	3	1	74	3
October	86	8	0	1	1	71	3
November	92	9	0	1	1	77	3
December	98	10	0	1	1	81	4
TOTAL FOR YR	1 055 x)	107	13	35	10	908 x)	19

Figures show Norwegian share of Murchison: 16.25%

x) The difference between "produced oil" and "stable oil Sullom Voe" is due to allocation factors.

TAB 8.4.e
Månedlig olje- og gassproduksjon fra Statfjord
Monthly oil and gas production from the Statfjord field

1983	Produced oil Stable oil 10^3 Sm^3	Produced gas 10^6 Sm^3	Injected gas 10^6 Sm^3	Flared gas 10^6 Sm^3	Consumed gas 10^6 Sm^3
January	1 191	209	168	28	13
February	1 501	260	227	18	15
March	1 609	281	245	18	17
April	1 622	287	256	14	17
May	1 573	275	234	24	17
June	1 644	293	256	19	17
July	1 826	323	285	20	18
August	1 361	243	207	23	14
September	1 443	258	226	16	16
October	1 714	310	278	15	18
November	1 721	315	286	12	18
December	1 837	327	299	10	17
TOTAL FOR YEAR	19 044	3 381	2 967	217	197

Figures are for Norwegian share of Statfjord: 84.09322%

TAB 8.4.f
Månedlig olje- og gassproduksjon allokert til Valhall
Monthly oil and gas production allocated to the Valhall field

1983	Produced oil incl NGL 10^3 Sm^3	Produced gas 10^6 Sm^3	Flared gas 10^6 Sm^3	Consumed gas 10^6 Sm^3	Stable oil Teesside 10^3 Sm^3	Gas sold Emden 10^6 Sm^3
January	44	8	4	3	43	0
February	38	7	2	4	38	0
March	42	7	2	5	40	0
April	47	8	3	5	44	0
May	52	11	5	6	49	0
June	61	16	9	7	57	0
July	64	14	5	6	60	2
August	75	15	1	6	71	8
September	112	24	3	6	106	15
October	135	29	2	7	128	19
November	154	31	1	7	144	24
December	191	42	3	6	181	31
TOTAL FOR YEAR	1 021	217	44	71	966	101