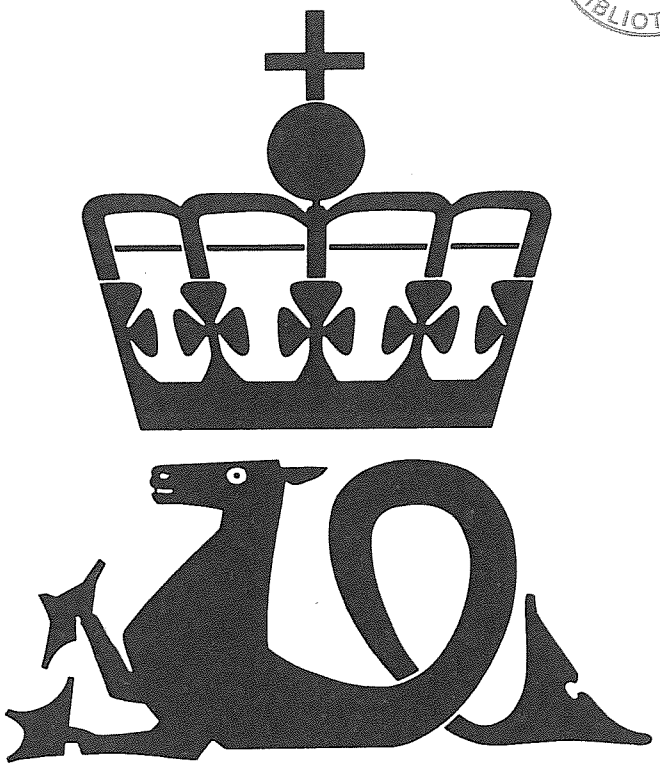


Norwegian Petroleum Directorate

ANNUAL REPORT 1984

Norwegian Petroleum Directorate

ANNUAL REPORT 1984

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

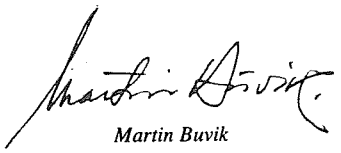
Contents

Preface

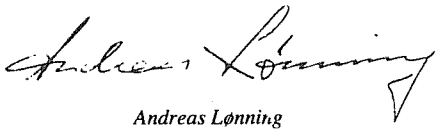
In pursuance of § 4, Section f, of the Instructions for the Norwegian Petroleum Directorate, the Board of Directors shall each year publish a report on the activities of the Directorate. The Board of Directors hereby presents the Annual Report for 1984.

Stavanger, 29 February 1984

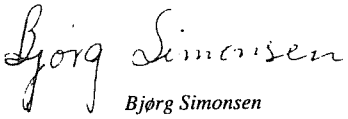
Members of the Board of Directors of the Norwegian Petroleum Directorate



Martin Buvik

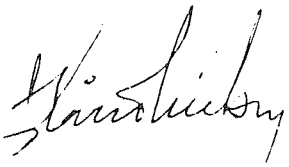


Andreas Lønning

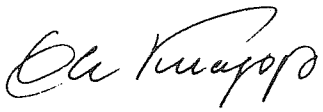


Bjørg Simonsen

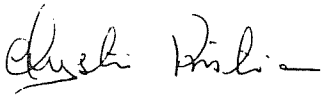
Liv Hatland



Kåre D. Nielsen



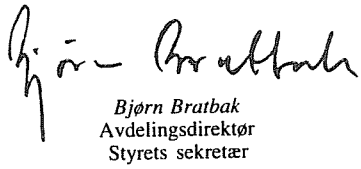
Ole Knapp



Øystein Kristiansen

Kjell G. Dørum

Fredrik Hagemann
Direktør



Bjørn Bratbak
Avdelingsdirektør
Styrets sekretær

Report by the Board of Directors

Drilling activities increased in 1984 in relation to 1983, and stand with a total of 47 wells at around the same level as in 1982. Drilling activity north of Stad increased from three wells during the first drilling season in 1980 to 13 wells in 1984. During these five years a total of 43 wells have been drilled north of Stad, one of them being abandoned shallow, and 17 being classified as discoveries.

Highly interesting discoveries have been made on Haltenbanken and Tromsøflaket in blocks allocated in the eighth licensing round. On Haltenbanken Shell have discovered substantial deposits of oil on Block 6407/9 and Statoil, in Block 6506/12, has made a major gas/condensate discovery, which at the end of the year was still being tested. On Tromsøflaket, Statoil has proven large amounts of gas in Block 7121/4 with an underlying zone of possibly recoverable oil.

Drilling results on Block 34/7 were not as good as expected, a fact which emphasizes the geological complexity of the tract. Following four wells drilled, there still remain interesting undrilled prospects within this block.

As a step towards securing a goal-oriented, long-term plan for awarding priorities for the exploration areas in the north, the Norwegian Petroleum Directorate prepared, in collaboration with the Ministry of Petroleum and Energy, a five-year plan for seismic surveys. The plan, prepared in 1983, entails substantial expansion of the Norwegian Petroleum Directorate's annual seismic surveys from 1985. In fact, due to an increase in appropriations through a supplementary Storting Proposition in the autumn of 1984, it became possible to increase surveys to a record of 21,000 kilometers of seismics as early as 1984. Because of the favourable ice conditions, seismics could also be collected north of Svalbard. The Norwegian Petroleum Directorate has never before performed seismic surveys this far north.

The five-year plan stakes the path for a gradual and systematic expansion of the exploration areas providing the authorities with an overview of the prospective value of an area before the acreage is declared open to the companies. The Norwegian Petroleum Directorate considers that a gradual and systematic expansion of the exploration areas is the best and most rapid method of ensuring discoveries. The success rate is not merely a function of sesmic coverage, but also depends on exploiting the information gained from drilling operation in adjacent areas. Safety is also more readily secured using this opening procedure, insofar as one gains valuable insights into pressure and environmental conditions in the areas being drilled.

The Norwegian Petroleum Directorate also offers the results of the seismic surveys for sale. Such sales have expanded considerably and in 1983 returned an income to the state of approximately NOK 290 million, as against some NOK 50 million in 1983.

In 1983, on the basis of Storting Report No. 80 (1983–84) a long-term plan was outlined for allocation of production licences, which should be looked at in conjunction with the five-year seismic survey plan. The ninth licensing round is the first step in this long-term plan and will be followed by the tenth round, consisting of two phases. The tenth round first phase is expected to be announced early in 1985, with subsequent allocations in two stages later that year. The second phase is planned to follow on immediately after the first.

In all, 25 blocks in the ninth licensing round were announced in June 1984. Of these, seven are in the North Sea, six on Haltenbanken and 12 northeast of the Troms I area. In addition, previously allocated blocks from the fifth and eighth licensing rounds on Haltenbanken and Tromsøflaket were announced anew. By the expiry of the applications deadline, 18 applications had been received for 18 blocks. The allocation of blocks is expected to take place early in 1985.

The. Norwegian Petroleum Directorate's resources estimates for the Norwegian Continental Shelf were adjusted during 1984, partly due to the new discoveries, and partly due to updates on previous estimates. For oil (inclusive NGL), an increase in resources estimates of 256 million Sm^3 was made, while gas resources estimates have risen by 286 billion Sm^3. The Norwegian Petroleum Directorate's present estimate for proven, technically recoverable reserves is 4.2 billion tons oil equivalents (t.o.e), of which 0.37 t.o.e. have already been depleted.

In connection with possible transfer of operator responsibility on the Statfjord field, the Norwegian Petroleum Directorate in the autumn of 1984 assessed the safety, resource and capacity related consequences of such transfer at the request of the Ministry of Petroleum and Energy and Ministry of Labour.

According to information received, the new Petroleum Act is expected to pass through the Storting by early 1985.

Regarding safety related control, the draft act with appurtenant safety regulations clears the ground for progress towards the necessary changes in the present

division of supervisory responsibility for the petroleum activity.

According to the draft act, a holistic, safety related assessment is to be performed. The board assumes that this will result in one public agency, the Norwegian Petroleum Directorate, being assigned the task.

In all, exploration drilling, new field developments, additional operational installations, plus the further strengthening of safety and the predicted centralization of supervision, will bring about a considerable increase in the Norwegian Petroleum Directorate's work.

Mobile installations are used in ever increasing degree for production purposes, production plant or integrated components of such plant. The activities of Norwegian and foreign registered mobile installations are basically regulated by the country in question's maritime legislation (flag state jurisdiction). Additionally, their use is subject to Norwegian Continental Shelf legislation insofar as safety and contingency matters are concerned. The requirements of the shelf legislation are decisive for whether a service permit shall be given. The relationship between Norwegian maritime legislation and shelf legislation has given rise to a number of questions regarding the authorities' management, control and coordination.

The board expresses concern at the situation which has arisen. The considerations of sound operation, the need for constitutional clarity in the allocation of governmental authority, and the consideration of consistency in legislation all speak for prompt clarification.

The Norwegian Petroleum Directorate considers it important that the interests in the two Troll licences are managed such that the Troll reservoir is depleted according to a coherent plan. The importance of this has been highlighted for the four operators, and by the Norwegian Petroleum Directorate having set up a separate group to work on the Troll development.

Having our own, updated, independent reserves estimates and assessments of the production and development strategies is a precondition for the Norwegian Petroleum Directorate to be able to meet the objective of a sound exploitation of the resources. The Directorate, in conjunction with consultants (Franlab and Rogalandsforskning), has developed an advanced reservoir simulation tool for use on Troll. A central feature in the evaluation of Troll is how much of the oil can be recovered, and the Directorate has requested the four operators to examine this thoroughly.

During the autumn of 1984 the Norwegian Petroleum Directorate purchased a three dimensional interpretation station for seismics. The station will be a useful tool for the examination of areas where three dimensional (3-D) seismics have been shot, and will contribute to a more rapid assessment of the fields. The Directorate has been using the interpreting station in connection with its work with the Oseberg field.

On 16 October 1984 the Odin field was officially opened. Odin has been on stream since April and produces gas from Eocene sandstone. The field has been developed with one platform and is tied in to the Frigg field center by pipeline.

On the basis of the know-how presently available concerning the Frigg reservoirs and experience gained with the use of the underwater production system, the operator has prepared a development concept for East Frigg which is wholly based on subsea production. The concept represents a natural, further development of equipment which has already provided practical experience. This, together with favourable reservoir conditions, makes it possible to recover relatively small quantities of gas in an economically sound manner. At the same time as further invaluable experience is gained with subsea production equipment, the project will provide experience of installation and hookup operations utilizing remote control from a surface vessel.

In this report period too, the Norwegian Petroleum Directorate has prepared its Petroleum Outlook. This year's analysis places particular emphasis on evaluating the opportunity to develop areas north of Stad. Further, alternative development patterns are presented which reflect the uncertainty attached to petroleum price developments and marketing prospects for Norwegian gas.

In 1984 a strengthening of resource management was accomplished through a reorganization of the Norwegian Petroleum Directorate's economic functions.

The personnel situation in 1984 was relatively good with fewer positions vacant than in previous years. Our work load has increased, however, which has caused a heavier burden on individual members of staff. The use of computing and other technical aids is nevertheless contributing to increased productivity.

The board in its plan and budget proposals for 1985 proposed that the Harstad regional office be strengthened to approximately 25 staff members. Considering the Storting's decision in favour of five new positions in 1985, the board assumes that it will take some time before the planned objective can be achieved. The board does not believe it useful to establish further regional offices in the immediate future.

In cooperation with the Royal Norwegian Council for Scientific and Industrial Research (NTNF) and the British Ministry of Energy, the Norwegian Petroleum Directorate has since 1980 been building up a factual data base containing information on UK and Norwegian offshore related research projects. A copy of the data base was installed in London in 1984 as a further step towards the internationalization of this service.

Construction of a new administration block is running according to schedule with completion set for 1 December 1985. The foundation stone was laid on 10 May 1984 by HRH Crown Prince Harald, who used the occasion to visit the Norwegian Petroleum Directorate and be briefed on the oil activity.

During the report period the Directorate also received a visit by Prime Minister Kåre Willoch. This was the first occasion on which a Norwegian prime minister has visited the Directorate.

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 last amended 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 financial control to ensure compliance with applicable legislation, regulations, decisions, licensing terms, agreements, etc. in the exploration for and exploitation of petroleum, see § 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 object of the Norwegian Petroleum Directorate

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

"The object 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 financial 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, Personnel Director, Oslo
5 Kåre D. Nielsen, Deputy Managing Director, Oslo
6 Ole Knapp, Secretary, Oslo
7 Øystein Kristiansen, Special Advisor, Stavanger
8 Inge Døskeland, Special Advisor, Stavanger

Deputies:

For 1–4:
Inge Johansen, University Rector, Trondheim
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:
Kjell G Dørum, Senior Engineer, Stavanger
Angela Ebbesen, Senior Consultant, Stavanger

By letter from the Ministry of Petroleum and Energy of 26 June 1984, Inge Johansen, University Rector, Trondheim, was relieved of his office as first deputy, having taken over as chairman of the board in Statoil.

Special Advisor Odd Erik Hansgaard left his position in the Directorate on 21 August 1984, permitting Senior Engineer Kjell G Dørum to accede to the board.

During the report period the board held nine meetings.

In May the board visited Norsk Hydro's oil division in Bergen, and in October the board accompanied the Statoil board on an inspection of the Statoil petrochemicals plant at Bamble.

1.3.2 Organization

In the Annual Report for 1983 a transfer of financial functions from the Legal and Economic Department to the Resource Management Department was being considered. Following a brief trial period it was determined that from 1 September 1984 the Economic Field Planning Section and the Royalty and Petroleum Market Section should be located within the Resource Management Department in a separate Resource Economics Division.

With effect from 22 February 1984 the typing pool and training functions were transferred from the Administration Department to the respective departments.

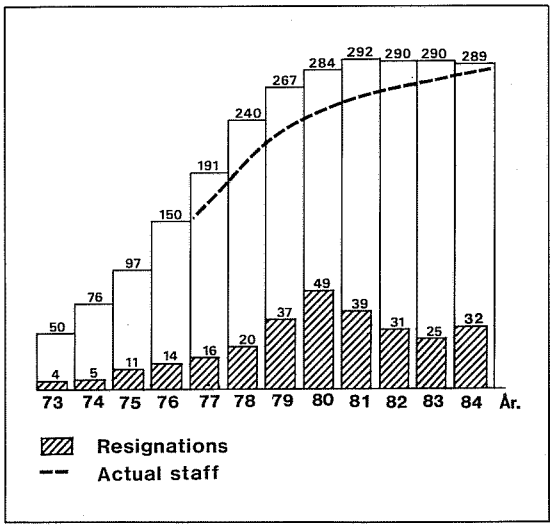
With effect from 10 October 1984, certain administrative service functions were collected in a pool with the designation Text and Data Group. This was done to ensure the best possible service with regard to the special departments, and to achieve a directed and efficient use of computerized and other office automation equipment.

The question of setting up a position as information manager was discussed in the 1983 Annual Report, in which it was stated that the Directorate did not have the authority to appoint an information manager on the basis of the special powers granted. The position has now been resolved to be established in 1985.

1.3.3 Personnel

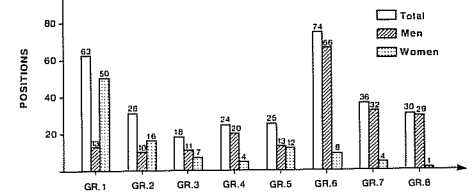
In the budget for 1984, five new positions were established. At the end of the report period the Directorate had 289 authorized permanent positions. In addition there were three positions salaried by the Directorate for Development Aid (NORAD). At the end of the report period there were 286 persons employed, see Figure 1.3.3.a. Staff members include 34.5 per cent women. Figure 1.3.3.b shows the proportions of men and women in the various job categories within the Norwegian Petroleum Directorate.

FIG. 1.3.3.a
Positions 1973–1984
Permanent positions and engagements



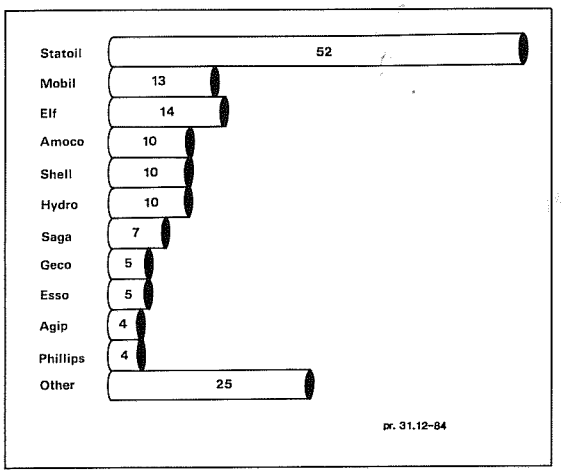
In addition, eight positions were salaried through other agencies' budgets, either as occupationally disabled persons or through the youth employment scheme. The Norwegian Petroleum Directorate has an arrangement with the Labour Exchange regarding jobs for pu-

FIG. 1.3.3.b
Positions in NPD per 31. December 1984



Group 1
Office Assistant, Clerk, Laboratory Assistant, Draftsman, First Clerk, First Lab. Assistant.
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.
Group 7
Special Advisor, Senior Doctor, Chief Engineer.
Group 8
Section Manager, Deputy Director, Divisional Director, Director General.

FIG. 1.3.3.c
Personell who left NPD for oil companies During period 1973–1984



pils attending the tenth school year (16–17 years old). The scheme is based on seven pupils working two days a week in the Directorate and three days at school. Two pensioned state employees have been working during parts of the period on pensioner conditions. Also working at 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. Two persons doing civilian service have worked with the research data base Infoil 2.

During the report period the Directorate took on 34 new members of staff. Of the newcomers, ten relocated to Stavanger, ten come from oil related activities and seven are newly qualified.

Staff turnover in 1984 increased somewhat compared with the previous year, with 32 members of staff leaving their positions, see Table 1.3.3.a. This constitutes 11 per cent of total authorized positions. Figure 1.3.3.c shows the personnel transfer from the Norwegian Petroleum Directorate to various oil companies during the period 1973–1984. Table 1.3.3.b shows the numbers of resignations and states the leavers' new jobs. The outward flow in 1984 has tended to be greater for experienced professionals and supervisors than last year. The resignations among economics professionals continue to be high and resignations among legal professionals have also occurred. The turnover rate among geo personnel has remained more or less stable, while technical professionals have shown a smaller tendency to leave than previously.

During the report period a total of 76 positions became vacant. The numbers of applications to these jobs have been variable, but there continues to be a tendency towards greater interest in applying for vacancies.

The applicants can be broken down as follows:

No of applicants

Position category	No. of vacancies announced	Total applicants		Internal applicants		External applicants	
		Men	Women	Men	Women	Men	Women
Management positions	5	28	2	11	1	17	1
Special advisors	12	114	13	30	8	81	9
Technical EOs	22	244	25	51	16	193	9
Non-technical EOs	11	98	55	4	6	94	49
Office positions	26	69	365	10	49	59	316

* EO = Executive Officer

Equal opportunities agreement
On 25 October 1984 a separate agreement on equal opportunities for the sexes was entered into in accordance with the Main Agreement for employees of the state. The objective of the agreement is to accomplish intentions inherent in the Equal Opportunities Act, besides stipulating further rules for the realization of the gender quota codes given in the Main Agreement.

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, 14 meetings were held which dealt, among other subjects, with:
– budget proposals

- annual report
- contract between NPD and NORAD for 1983
- internal organizational changes
- personnel policy guidelines
- computer based personnel records
- equal opportunities agreement
- jobs for occupationally disabled
- individual jobs for unemployed youth
- the NPD's leadership philosophy
- supervisor positions
- guidelines for payment of compensation following inspection tours offshore
- resignation of economic professional staff
- staff code
- use of credit cards.

TAB 1.3.3.a
Personnel who left NPD in 1984 with indication of type of position

Department	Managers	Spec advisors	Head Engineer	Senior Engineer	Senior Geol./ Geol.	Sect. Eng./ Eng.	Senior Adm. Secr./ Couns./ Senior Couns.	Office staff	Total	Turnover in %
Resource Management	1	5	0	1	1	2	2	3	15	14,6
Safety Control	2	3	0	0	0	0	1	2	8	8,4
Legal/Economic	1	0	0	0	0	0	1	0	2	10,5
Administration	0	0	0	0	0	0	0	7	7	9,8
Total	4	8	0	1	1	2	4	12	32	11,1

TAB 1.3.3.b
Personnel who left NPD in 1984 with indication of new place of work

Department	Oil industry	Other nongov't activity	Other gov't activity	Miscellaneous	Education	Total
Resource Management	7	3	1	3	1	15
Safety Control	4	1	2	1	0	8
Legal/Economic	2	0	0	0	0	2
Administration	1	0	2	3	1	7
Total	14(153)	4(27)	5(43)	7(40)	2(19)	32(281)

Figures in brackets apply to the period 1973–1984

1.3.4 Training

The training budget for the report period was NOK 2.5 million. The funds have been used in accordance with earlier practice, and large amounts have as previously been appropriated to travelling and overnight expenses. During the period there has occurred an increase in the number of staff who participated in on-the-job (OTJ) training with the oil companies. Among other arrangements, eight staff members from the Safety Control Department completed training programs lasting approximately six months with the oil companies Phillips, BP, Esso, Shell, Statoil, Statpipe and the Norwegian Geotechnical Institute. One reason that these courses were highly successful was that the companies provided tailor-made programs for each trainee.

1984 saw the introduction of a major training program in project management and quality assurance at building yards for offshore installations. The first part of the program has been accomplished and the remainder will follow during 1985.

During the report period The Norwegian Petroleum Directorate held an inhouse management seminar at which all management staff participated. Work is being done to present a work specification for the entire Directorate, the purpose of which is to unify the Directorate about a common understanding of our tasks, objectives and working methods, thereby securing a uniform and sound execution of the authority vested in us.

1.3.5. Budget and finance

In 1984, a total of NOK 236,369,000 was allocated to the various Directorate tasks. The amount was distributed as follows:

– Operating budget	NOK	106,965,436
– Geological and geophysical surveys on the continental shelf	NOK	68,625,365
– Safety and emergency preparedness research from the Ministry of Labour	NOK	2,438,776
– Inspection costs	NOK	8,090,604
– Clearing up the seabed	NOK	4,270,883
– Engineering of new facilities	NOK	43,200,000
Total appropriation budget for 1984	NOK	233,591,064

NOK 58,083,924 of the operating budget was allocated to salaries and NOK 10,030,642 to the running of buildings and premises, while NOK 3,204,309 covered the operation of the weather ship AMI.

The remaining NOK 35,646,561 of the operating budget represents other expenses such as external consultancy services for research and development projects, travelling, training, electronic data processing (EDP), investments in new equipment, etc.

Revenues

In addition to the royalties and acreage fees collected (Chapter 4) the Directorate received revenues totalling NOK 327,439,362. Income development in the period 1973–1984 is shown in Table 1.3.5.

Revenues in 1984 are distributed thus (in kroner):

Sales of publications	NOK	1,498,594
Sales of released survey results	NOK	72,194
Survey fees	NOK	600,000
Refunded inspection costs	NOK	22,531,831
Sales of seismic survey results	NOK	301,620,768
Miscellaneous revenues	NOK	1,115,975
Total revenue for 1984	NOK	327,439,362

As may be seen from the table of revenues above, the Norwegian Petroleum Directorate during the 1984 Income Year experienced a strong growth in incomes due to its increased sales of seismic data packages.

TAB 1.3.5
Income development in the period 1973–84 (1,000 NOK)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Sales of publications	–	–	–	30	135	197	291	387	480	794	1 376	1 498
Sales of released test materials	–	–	–	2	33	46	282	235	606	206	214	72
Exploration fees	345	340	220	210	280	380	420	400	480	320	500	600
Inspection charges	5 525	16 539	19 721	26 717	42 037	45 189	47 358	33 673	26 066	26 492	23 217	22 531
Data package sales	–	–	–	1 300	3 170	14 847	31 275	35 304	12 947	20 633	50 831	301 620
Miscellaneous	–	288	463	375	76	71	–	–	–	–	765	1 115
TOTAL	5 860	17 177	20 404	28 634	45 731	60 730	79 626	69 999	40 579	48 445	76 903	327 436
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	190 391

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 entertained a number of official delegations from other countries. Furthermore, many foreign journalists, individually or in groups, visited the Directorate to obtain information about the Directorate and the oil activity. For their part, Norwegian Petroleum Directorate staff have frequently participated as speakers in various forums.

The Norwegian Petroleum Directorate's Annual Report is a central feature of the Directorate's information activities. The 1983 Annual Report and the Directorate's updated map of the continental shelf became available in May. Simultaneously, the Directorate's analysis of perspectives, the Petroleum Outlook for 1983, was published. In conjuction with this, representatives of the press were invited to meet with the Directorate's senior management.

The Norwegian Petroleum Directorate participated with its own stand at the Offshore North Sea exhibition ONS'84, which was arranged in Stavanger in August.

During 1984 a total of 70 press bulletins were issued. Most of these were released in conjunction with new wells about which the Norwegian Petroleum Directorate seeks to provide maximum information.

1.3.7. The Harstad office

The Harstad regional 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 Harstad office's field of work. The office has also represented the Directorate at steering committee meetings for production licences off North Norway.

Because the lease for the original office premises expired and could not be renewed, the regional office is renting temporary quarters in the Norsk Hydro administration building in Harstad.

During the report period, measures were taken to resolve the practical which will confront us in connection with the pending expansion of the regional office in 1985.

1.3.8. The library

Library activity was considerable again in 1984. Compared with previous years, the library registered a steady increase in the number of applications to borrow books, make copies and examine references. Over 40 per cent of all enquiries stem from external users at home and abroad, including 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 computerized catalogue (ODIN) and the library's services for oil companies, administrative agencies and other libraries.

The library actively participates in the publication of the Norwegian Petroleum Directorate's literature reference work Olje-indeks and the reference data base OIL. Enquiries about literature references in the oil index and OIL are on the increase.

The library has also worked actively and been a member of the working group dealing with an increase in the activities of the INFOIL secretariate within the discipline of documentation technology for oil activities.

During the report year contact was established with the Norwegian Term Bank in Bergen and Statoil to issue a large Norwegian thesaurus within the petroleum field, but the matter has not yet been resolved. Cooperation with Statoil regarding the preparation and publication of the PETROLEUMSTESAURUS has therefore continued as before.

1.3.9. The INFOIL secretariate

The popularity of the information data bases OIL and INFOIL 2 is continuing to increase, and the number of references in the OIL data base has passed 20,000.

At the end of the report period the INFOIL 2 data base held details of 1150 Norwegian and British research projects within petroleum technology. The data base was installed during the year in a separate computer at the Underwater Engineering Group in London for UK users.

Efforts are continuing to pursuade Canada, France, West Germany, Denmark and the USA to participate by making project data from their respective countries available to the data base. A catalogue has been issued in Norwegian and English containing information on 500 ongoing projects in Norway and the UK.

The INFOIL group arranged in September the Offshore Information Conference 1984 which was held in Stavanger. The conference attracted 120 participants. The Institute of Offshore Engineering at the Heriot-Watt Universtiy acted as joint organizer.

Enquiries by engineering contractors, oil companies and the Oil Library have led to scouting meetings and participation in a working group dealing with the growing activity of the INFOIL secretariate in the area of documentation techniques for petroleum related reports on a national basis. The work has resulted in a report with activity proposals for a trial period of one year.

1.3.10. Organizational development

During the report period the Norwegian Petroleum Directorate carried on the work of developing better planning and control mechanisms. Some of these measures are discussed in more detail below.

1.3.10.1 Safety Control Department

Reporting of drilling data

The Safety Control Department's computing services have particularly been concentrated on the development and implementation of the final operating version of the drilling data bank, the Daily Drilling Report System DDRS.

The purpose of the DDRS project is to improve the utilization of incoming information concerning the drilling activity on the Norwegian Continental Shelf. The day-to-day follow-up work was previously very time consuming insofar as the statistics from the operating companies arrived by telex.

A pilot version of a drilling data bank was therefore developed under the Norwegian Petroleum Directorate's research program for safety, procedures and monitoring (SPO) in 1982. That same year it was put into operation in the Norwegian Petroleum Directorate as a pilot project for the development of a final operating version. The pilot version was in operation until about June 1983. During the operating phase one well per operator was followed up and analysed. Furthermore, close contacts were forged with the operating companies for the exchange of points of views regarding further plans. Following the completion of trial operations, it became clear that the possibilities are enormous that the project will provide a safety premium, plus a better overall long-term view.

On this basis the Norwegian Petroleum Directorate prepared criteria for the final operational version of the system. One of the most central modifications was to adapt new routines for the input of data. Previously this had been done manually, a process which was time consuming, even when monitoring only one well per operator. It was therefore decided that the operating companies themselves should input the necessary data concerning the daily drilling reports. Furthermore, this should be done using an online link to the Norwegian Petroleum Directorate's computer at the Safety Control Department. This DDRS system was finally developed and implemented on 1 April 1984. Experience gained to date appears most satisfactory.

Gradually as the operating companies themselves develop and bring into use computerized systems for the collection and systemization of their daily drilling reports, the Norwegian Petroleum Directorate will place emphasis on facilitating routines for "automatic" transmission of data. Such "automatic" transmission of the daily drilling reports will take place by retrieving the data first from the operator's computer facility. From then on, the data will be transferred to the Norwegian Petroleum Directorate's computer network and loaded into the Directorate's own DDRS system. The advantages of such a system will be very great. The Norwegian Petroleum Directorate will be able to secure prompter reports, plus better data quality; while the operating companies will be able to eliminate unnecessary manual duplication of the daily drilling reports. Assuming the present schedules, the option for such "automatic" transmission will be available by the end of 1984.

Damage records for structures, marine risers and pipelines

The Safety Control Department has built up a computerized damage reports record for structures, marine riser pipes and pipelines covering all installations which operate on the Norwegian Continental Shelf. All damage incidents back to 1982 have been logged, plus earlier, not yet repaired, damage. The records are cross-referenced to a documentation system and an inspection status index.

1.3.10.2 Resource Management Department

Use of computers

The use of computer assisted tools is increasingly affecting the work of the Resource Management Department. Greater numbers of work tasks and an increasing flow of data from the continental shelf have made it necessary to rationalize the Department's the work routines maximally to be able, as far as practically, to circumvent the limitations imposed by staff numbers.

The practical application of the Norwegian Petroleum Directorate's GEODATABASE is being continually expanded. By developing general, user-friendly programs, aids and tools are gradually being built up so that the professionals – geologists and geophysicists – themselves can use utilize modern computer systems in their daily work.

In 1984 an interpretation station for three dimensional seismics was brought into use. This represents a substantial rationalization and quality upgrade in the work of drafting geological maps.

A data base for technical reservoir data has been constructed and made operational during the year. Reporting of data in machine-readable form from the operators on the Norwegian Continental Shelf is being planned. Continual evolution of the user-friendly programs is ongoing to render the data easily accessible for reservoir related tasks such as prognoses and simulation.

Several reservoir simulation models have been installed. These are now being used in major studies in which the data basis itself has been structured in cooperation with external consultants (FRANLAB, IFE), while hardware operation is undertaken on the Norwegian Petroleum Directorate's own computer facility. This yields large savings in the budget for external assistance, which can therefore be utilized for other tasks. Additionally it provides valuable experience for staff members at the Norwegian Petroleum Directorate.

An advanced model was brought into operation in 1984 to simulate uncertainties in production prognoses. During the work a better and more rational system for generation of prognoses covering oil and gas production on the Norwegian Continental Shelf was developed.

The Resource Economics Division has expanded and rationalized its use of computers during 1984. Great emphasis was placed on allowing members of staff within the division to utilize the computer resources as best possible.

Computers are used as an aid in the solution of routine and analytical tasks alike.

During the year a number of small software systems were developed which enable communication between already existing systems to take place. The greater part of resources has been allocated to the further development of already existing models to improve them and render them more user-friendly.

The division's main systems are a model for field and company analysis (the company model), a model for time phase evaluation of fields under given presuppositions (portfolio model), a model for royalty computation (PABS) and a model for production reports from the North Sea (PPRS).

In the years to come it will be necessary to expand computing capacity to be able to meet requirements.

In 1984 special emphasis was placed on improving our competence and software selection within the computer graphics field.

1.3.10.3 Administration Department

Use of computers

During the year, the typing pool and secretarial services received major computer assisted aids and several computer terminals. At the end of the period most of the Directorate's written work was being done on a word processing basis. Efforts are being made to expand each secretary's opportunities to make use of other terminal based computing systems.

The use of the Norwegian Petroleum Directorate's computerized filing system again progressed very satisfactorily during 1984. The experience won from the filing system is the subject of great attention, both from public agencies and private industry. By year-end 1984, the system was sufficiently expanded for all Directorate employees to be able to access the file from their own terminals.

In 1984 the Norwegian Petroleum Directorate brought into use a terminal oriented budgetting and finances system. This has provided the Directorate with a better implement with which to manage its budget efficiently and in a planned way. One advantages of the system is that it provides the means to substantially simplify the annual closing of accounts.

The period also saw the renewal and improved utilization of equipment. Changes have been made in copying equipment hardware both in the offices and the house printshop. The Directorate thus secured a rapid and efficient copying service, capable of handling both large and small batches of documents.

Work has been initiated to achieve a greater degree of integration between the reproduction, telecommunications, text and data services.

Computerized personnel records

To be able to rationalize the work of personnel administration and to provide better service to the special departments, the Personnel Section has reworked the internal personnel records from a manual to a computerized system.

A separate agreement has been entered into with the staff unions and instruction codes have been prepared in accordance with the central agreement relating to wages and personnel records for public sector employees. The special agreement covers the personal details to be kept in the records, and states who may be allowed access to the personal information stored there. The instructions cover data security and state the person responsible for registration.

1.3.11 Premises

The office situation was satisfactory during the period. Construction of a new administration block is progressing according to plan, with takeover scheduled for 1 December 1985. The foundation stone was laid by HRH Crown Prince Harald on 10 May 1984 (Figure 1.3.11).

FIG. 1.3.11
The foundation stone for NPD's new administration block was laid by HRH Crown Prince Harald on 10 May 1984.

2. Activities on the Norwegian Continental Shelf

2.1. Exploration and production licences

2.1.1. New production licences

In 1984 there were allocated 15 new production licences. Production licences 086–100 (Table 2.1.1.a) constitute the eighth licensing round, with five licences in the North Sea, five on Haltenbanken and five on Tromsøflaket. The allocation was accomplished with nine Norwegian operators and six foreign operating companies.

TAB 2.1.1.a
Eight licensing round granted by Royal Decree of 9 March 1984

Prod. lic.	Field/block	Ownership %		Operator(0)/licensee
086	6/3,7/1	50.000	0	Den norske stats oljeselskap a.s
087	16/4	20.000	0	Norsk Hydro Produksjon a.s
088	24/6,25/4	30.000	0	Total Marine Norsk A/S
089	34/7	10.000	0	Saga Petroleum a.s
090	35/11	40.000	0	Mobil Development Norway A/S
091	6406/3	50.000	0	Den norske stats oljeselskap a.s
092	6407/6	50.000	0	Den norske stats oljeselskap a.s
093	6407/9	30.000	0	A/S Norske Shell
094	6506/12	50.000	0	Den norske stats oljeselskap a.s
095	6507/7	30.000	0	Norske Conoco A/S
096	7119/9	35.000	0	Elf Aquitaine Norge A/S
097	7120/6	20.000	0	Norsk Hydro Produksjon a.s
098	7120/10	50.000	0	Esso Exploration and Production Norway A/S
099	7121/4	50.000	0	Den norske stats oljeselskap a.s
100	7121/7	50.000	0	Den norske stats oljeselskap a.s

TAB 2.1.1.b Production licenses as of 31 December 1984

Alloc. with effect from	Production 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
09.03.84	086–100	6 346,604	15
		76 968,398	168

2.1.2. Exploration licences

At 31 December 1983, a total of 124 commercial exploration licences had been allocated. The following licences were awarded in 1984:

Mobil Exploration Norway Inc	Licence No. 114
Texaco Exploration Norway A/S	115
Geophysical Service Inc	116
Chevron Exploration North Sea Limited	117
Oceaneering Norway A/S	118
Norsk Agip A/S	119
Tenneco Oil Company Norsk A/S	120
Norsk Hydro A/S	121
Racal Geophysics Limited	122
Geophysical Company of Norway A/S	123
Western Geophysical Company of America	124

Licence No. 124 was awarded in 1984 but became effective first on 1 January 1985.

2.1.3 Transfer of licences

During 1984 the following transfers were approved pursuant to § 48 in King's Resolution of 8 December 1972.

TAB 2.1.1.c Licensed area as of 31 December 1984

Production licence allocated	Original area (sq. km)	Relinquished area (sq. km)	Area on production licence in sq. km	Area on production 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	924,8			
1975	2 329,206	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
1984	6 346,604	–	6 346,604	100,00	15
	76 968,398	43 456,013	33 512,385	43,54	106

TAB 2.1.1.d Licensing rounds. Norwegian and foreign shares

Round	Year	No. of blocks	Share in per cent Norw.	Share in per cent Foreign	Operator per cent Norw.	Operator per cent 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
8	1984	17	60	40	60	40

Production licence 025

Norsk Hydro Produksjon A/S has acquired 9.6 per cent from Elf Aquitaine Norge A/S. Following this, participation in Licence 025 is:

Elf Aquitaine Norge A/S	34.0 %
Norsk Hydro Produksjon A/S	29.2 %
Total Marine Norsk A/S	21.8 %
Lasmo Norge A/S	15.0 %

2.1.4 Relinquishments

In 1984 a relinquishment was made on production licence 022, from which Block 3/5 was relinquished in its entirety. Gulf Oil Corporation – Norway Branch was the operator.

2.2. Surveys and exploration drilling

2.2.1. Geophysical and geological surveys

2.2.1.1. Opening of new exploration areas

On the background of the Storting's desire to give priority to exploration activity in the north, a sizeable increase in the Norwegian Petroleum Directorate's seismic survey budget was made effective in 1984. A total of over 21,000 km seismics were gathered (Figure 2.2.1.a), far in excess of the predictions. One of the reasons was the very favourable ice conditions in the Barents Sea. Lines were shot as far north as 81 degrees 25 minutes north, and as far east as 35 degrees east (Figure 2.2.1.b). Additionally, it was decided to open the Trøndelag II area to the oil companies (west and south of the Haltenbank area), thus enabling this acreage too to be covered satisfactorily with seismic lines (Figure 2.2.1.c).

FIG. 2.2.1.a
Seismic surveys carried out by the Norwegian Petroleum Directorate off northern Norway.

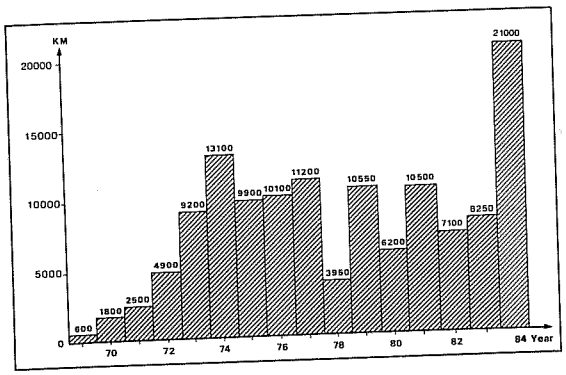
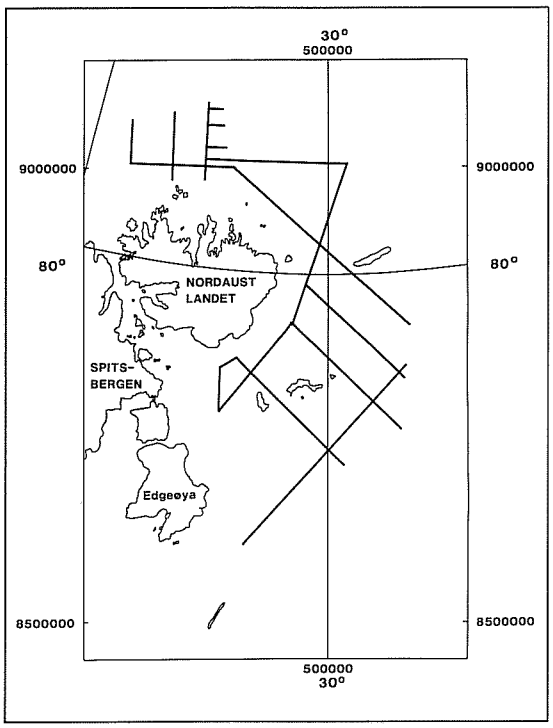


FIG. 2.2.1.b
North East Svalbard Seismic Surveys 1984



During 1984 the Norwegian Petroleum Directorate has made ready six new areas for further investigation, viz. Bear Island East and South, Finnmark West, Nordland III, Trøndelag II and Møre South (Figure 2.2.1.d). Regional seismics were also gathered in the Troms III and Svalbard Northeast (White Island, Storbanken, Edge Island) areas.

2.2.1.2. The Directorate's geophysical surveys 1984

During 1984 the Norwegian Petroleum Directorate collected seismics from eight areas. Some 1987 km were shot northeast of Svalbard (Figure 2.2.1.b), 10,300 km in the Bear Island area (South and East), 2359 on Finnmark West, 872 km on Troms III (Figures 2.2.1.e and f), 1236 km on Nordland III, 3025 km on Trøndelag II and 1070 km on Møre South (Figures 2.2.1.c and g).

Concurrently with the seismic recordings, gravimetric data was also collected. In the Bear Island areas moreover, in addition to the ordinary seismic measurements (down to approx 7 seconds), extra deep signals were also recorded (down to approx 15 seconds), plus shallow data (high frequency signals) to approximately 1 second.

The Geophysical Company of Norway (Geco) has collected most of the data, with the exception of lines shot in Møre South and 1,730 km on Trøndelag II. The latter was shot by Merlin Profilers, whilst Møre South was undertaken by Seismograph Service Limited (SSL) of England.

Processing of the collected data was performed by a

FIG. 2.2.1.c
Areas opened for company conducted seismic surveys between 62° N og 68° N

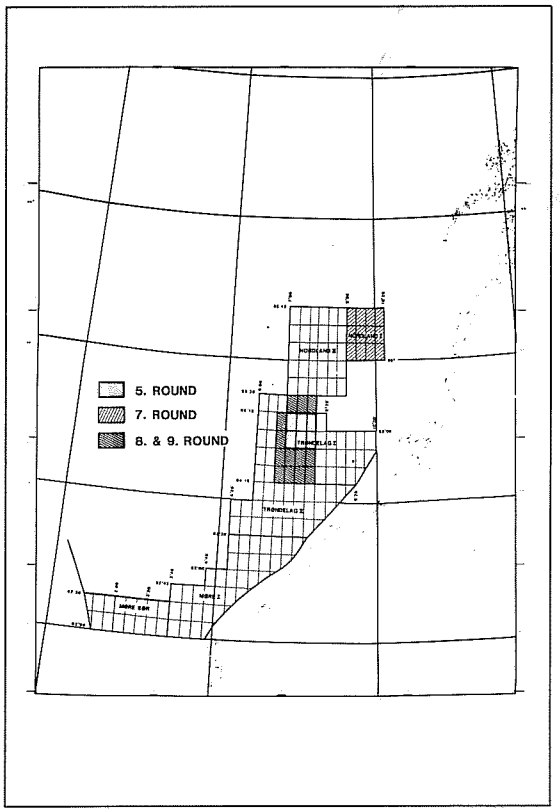


FIG. 2.2.1.e
Seismic surveys, Troms/Finnmark/Bjørnøya

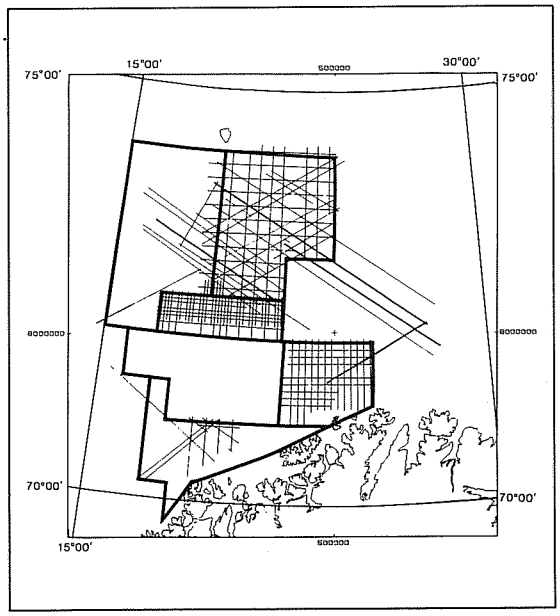
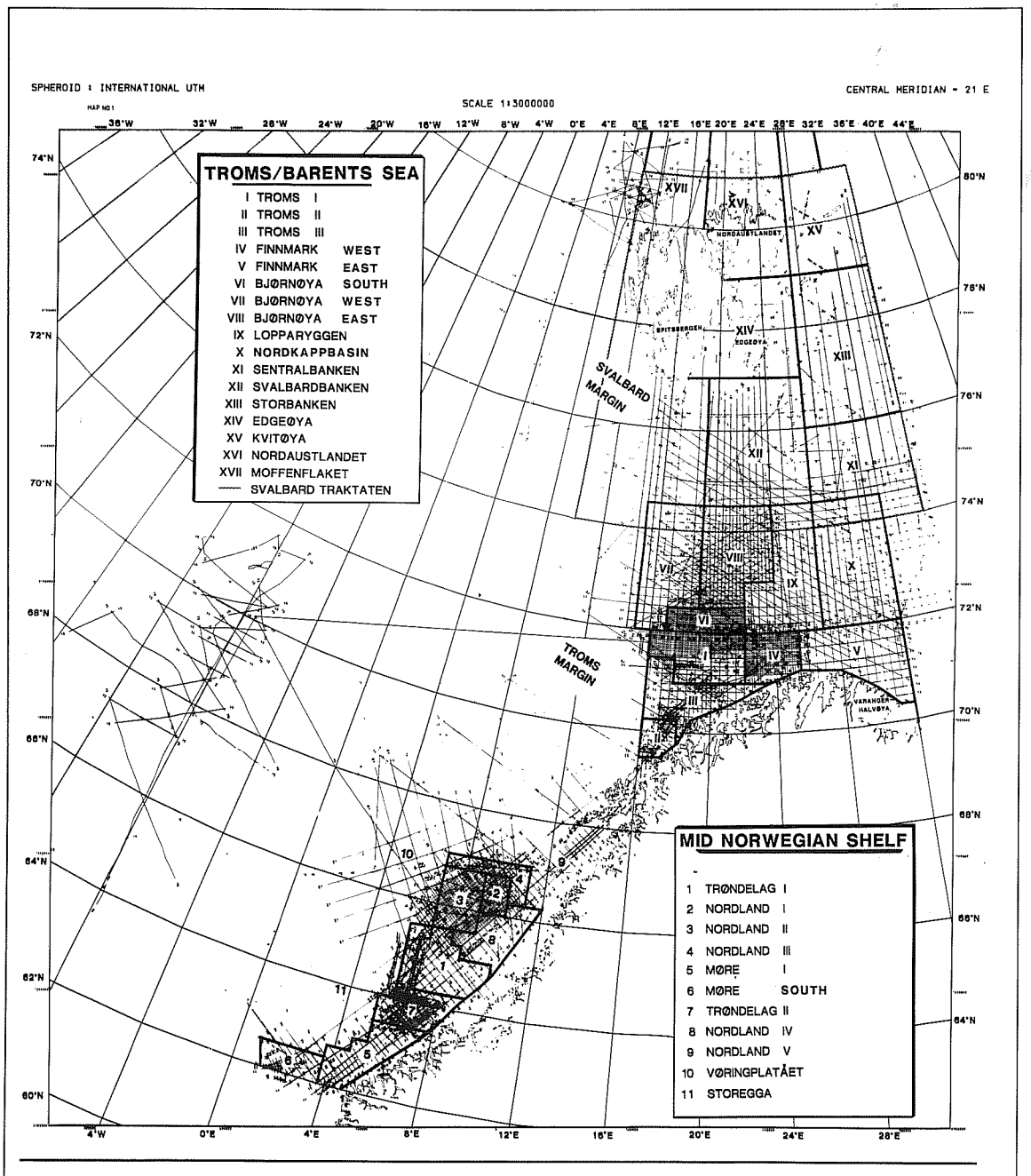


FIG. 2.2.1.d
Future exploration areas north of Stad

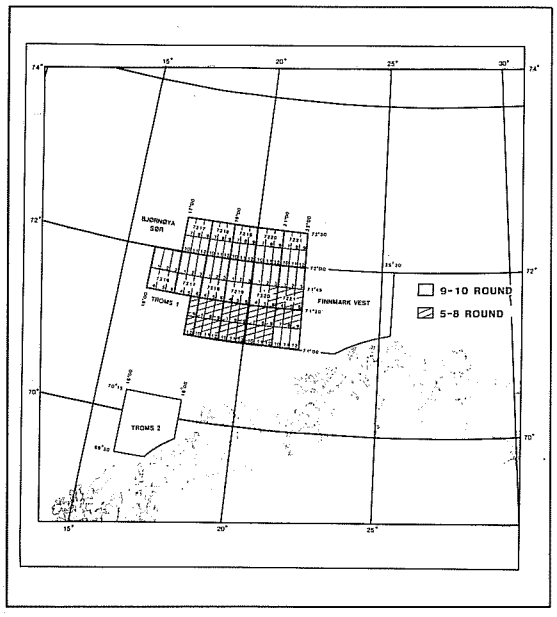


REGIONAL SEISMIC SURVEYS IN NORWEGIAN SEA AND BARENTS SEA

number of companies. Bjørn Island figures were processed by Western Geophysical, Compagnie Generale de Geophysique (CGG) in England and Geophysical Service International (GSI) in Stavanger. The Finnmark West lines were processed, as in 1983, by GSI in England. Data from Troms III (plus 126 km from 1983) were dealt with by CGG in England, from Nordland III by Geco in Stavanger, from Trøndelag II by Merlin Profilers in Oslo, and from Møre South by SSL in England. The basic seismics in the Bjørn Island area were gathered and processed by A/S Geoteam in Norway. Gravimetric data is processed by CGG in Paris and Geco in Oslo.

Additionally the Norwegian Petroleum Directorate has reprocessed 307 km seismics from 1974 and 1976 concerning the Troms II area, plus 1549 km from 1981 stemming from the Vøring Plateau, with Horizon Exploration in England.

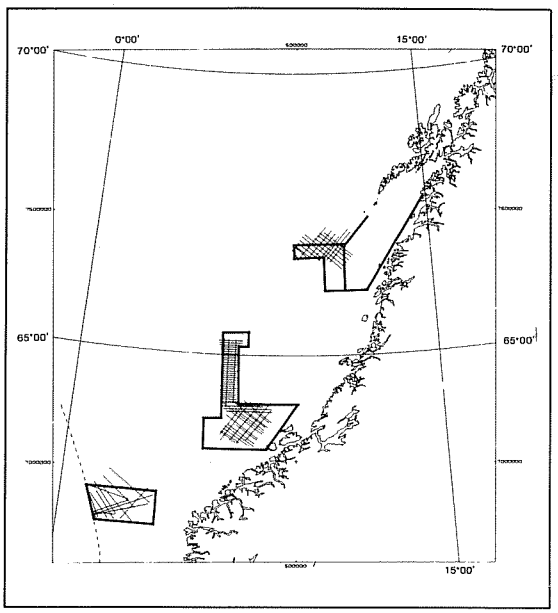
FIG. 2.2.1.f
Areas opened for company conducted seismic surveys, Troms/Finnmark



Furthermore some test lines were processed both within the Norwegian Petroleum Directorate and outside with various contractors. This was the case for data collected in Møre South as well as the Bear Island area. These data utilize special signal sources and recording equipment. Among other things, water cannon and digital receiver cables were employed. Moreover, some companies are planning to perform corresponding trial seismics in 1985. The Norwegian Petroleum Directorate in this context would like to enter into closer cooperation with them, and looks upon this work as an important step in the direction of improving data quality in new and complicated geological areas.

In 1985 the Directorate plans to shoot seismics in the following areas: Nordland IV (approx 1000 km) Troms III (approx 3000 km) Loppa Ridge East and North Cape Basin (approx 10,000 – 12,000 km) and Jan Mayan (approx 3000 km). See Figure 2.2.1.d.

FIG. 2.2.1.g
Seismic surveys on the Mid-Norwegian Shelf 1984



2.2.1.3. Geophysical surveys administrated by the companies

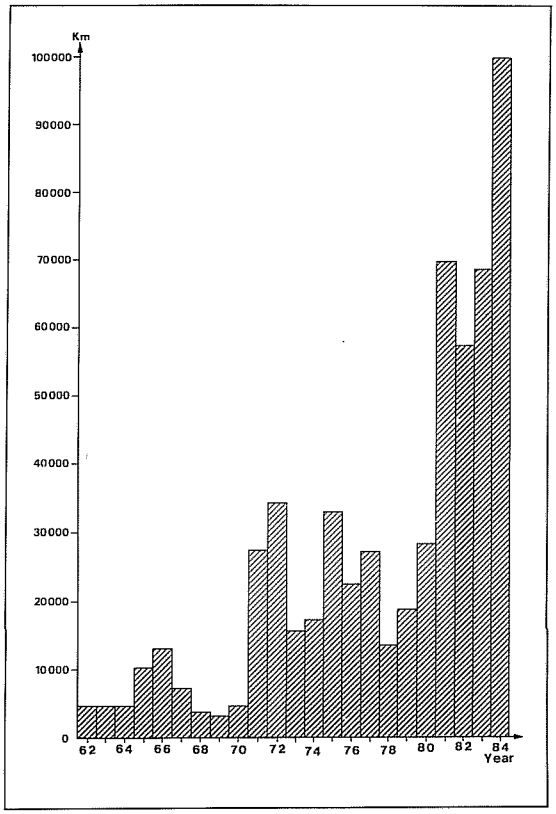
A total of 78,900 km seismics were shot on the Norwegian Continental Shelf under oil company or contractor direction. Of this length, 45,600 km were shot in the North Sea, and 33,300 km north of Stad in the areas Møre I, Trøndelag I and II, Nordland I and II, Troms I and II, Finnmark West, Bear Island South and Svalbard. Figure 2.2.1.h shows the total geophysical surveys performed on the Norwegian Continental Shelf.

The three Norwegian companies Statoil, Hydro and Saga – in part as operators for a group of companies – have shot a total of 22,600 km north and 20,500 south of Stad, while the foreign companies have shot 10,700 km north of Stad and 25,100 km south of Stad. Among others, the companies NOPEC, Geco and GSI have undertaken 8769 km speculative surveys north of Stad and 15,462 km south of Stad. Additionally, Geco, CGG and SSL have collected test lines on Møre South.

Of these seismic measurements, 14,327 km were three dimensional investigations. This type of data is collected in limited areas over fields which have been proven and are being considered for development. Saga recorded 9700 km in the area of Blocks 34/4 and 34/7, Conoco 1400 km on Murchison, GSI 350 km on Block 34/8 and BP 2850 km on Block 7/12.

As a result of the large amounts of data in connection with both three and two dimensional surveys,

FIG. 2.2.1.h
Seismic surveys carried out on the whole Norwegian Shelf (surveys north of Stad included)



there has arisen a large demand for computers for interpretation of these data. The Norwegian Petroleum Directorate has procured two interpretation stations from Geco, and the plan is to also make use of external facilities, not least with GSI in Stavanger.

These interpretation stations are continually being developed and the experience harvested shows that such equipment will undoubtedly be of great assistance in the interpretation of these data.

2.2.1.4 Sale of seismic data

In 1983 the Norwegian Petroleum Directorate offered the oil companies five new packages of seismic data, plus supplementary data for a couple of earlier packages. Due to the increase in activity in connection with the ninth and tenth licensing rounds, sales in 1984 broke all previous records by almost 200 per cent. Some companies have ordered almost 20–30 million kroner worth of data. Incomes from such sales are now greater than the Directorate's total budget, and the incomes are expected to be at least as large in the years to come, depending on the announcement tempo for new areas.

At the request of the companies, the Norwegian Petroleum Directorate will restrict publication of who has bought which packages, from considerations of exploration strategy and competitive relations. However, operators for speculative and group surveys north of Stad will of necessity have to gain knowledge of who has purchased the Norwegian Petroleum Directorate's data packages, because this is a precondition for participation in these surveys or purchase of such data.

The following figures apply for 1984:

Package designation	Offered	No. sold 1984
Møre/Trøndelag		
Regional package I	1978	1
Regional package II	1982	6
Møre/Trøndelag	1983	8
Nordlands Ridge		
Regional data	1982	7
Regional data	1983	16
Regional data 84		
Mid-Norwegian shelf	1984	11
Møre South -84	1984	4
Tampen Spur	1984	3
Trænabanken	1979	2
Troms main package	1977	2
Troms I East	1978	1
Regional data Troms East (incl supplementary data)	1982/84	8
Regional data Troms/Barents Sea (parts)	1978	10
Troms North 82/83		
Package I, II, III and IV	1983	12
Troms II	1984	2
Finnmark West -83	1983	7
Finnmark West -84	1984	3
Bear Island -83	1983	10

Booked incomes for 1984 were approximately NOK 280 million, as against approx NOK 50 million in 1983.

2.2.1.5 Release of shelf data and material

In connection with the Norwegian Petroleum Directorate's follow-up of the oil activities on the Norwegian Continental Shelf, the Directorate receives, apart from anything else, 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 oper-

ators, and data and material cannot be released until 5 years after completion of the well.

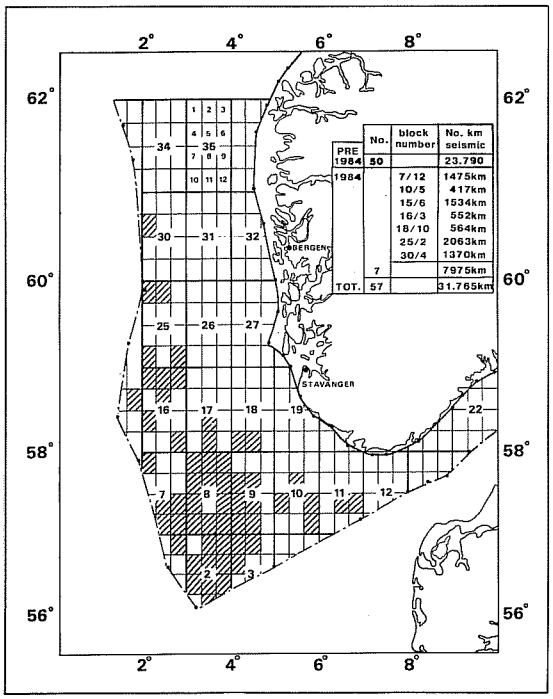
Well Data Summary Sheets (WDSS) are published annually, and provide a synopsis of wells which are 5 years old. The purpose of this series is to show which well holes have been released, and what core and log material is available for the various wells. Furthermore, some technical data and test results 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 1984, 57 blocks had been released, seven of them in 1984. In all, 31,765 profile kilometers have been released, of which 7,975 km in 1984.

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

FIG. 2.2.1.i
Blocks where seismic data have been released



2.2.1.6 Scientific research

As of 31 December 1984, a total of 196 licences for scientific research had been awarded on the Norwegian Continental Shelf. As seen from Table 2.2.1.a, 18 such licences were granted for 1984. Most research stressed geophysics, with some geology and biology work.

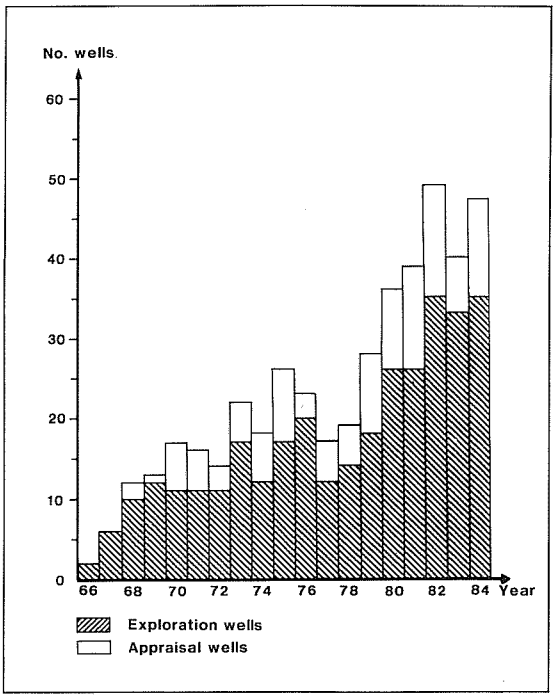
2.2.2. Exploration and appraisal drilling

At the end of the year 1983–84 there were ten exploration and appraisal wells being drilled. All of these were finished in 1984.

There has been an increase in the number of exploration and appraisal wells spudded in 1984 compared with 1983, and the level approaches the record year of 1982.

In the course of 1984, 47 new wells were initiated, 35 of which were exploration wells and twelve appraisal wells, against 40 wells in 1983 (Figure 2.2.2.a).

FIG. 2.2.2.a
Drilling activity on the Norwegian Continental Shelf (Number of wells per year)



Some 35 of the spudded wells were finished during the year. Twelve wells were being drilled at year's end.

In all, the following 14 wells had been temporarily abandoned on the Norwegian Shelf at year's end:

1/9–1	7/11–8	30/2–1	34/10–3
1/9–4	15/9–17	30/6–9	34/10–5
2/7–14		30/6–13	
2/7–19		30/9–2	
2/11–65			

At year's end a total of 447 exploration and appraisal wells had been spudded on the Norwegian Shelf. A break-down of these showed 328 exploration wells and 119 appraisal wells (Table 2.2.2.a).

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. The greatest activity has occurred south of Stad, with some 62 per cent of the 47 well bores.

As in 1983, extra great activity has continued on the Troll field on which nine new wells were started, of which one was abandoned shallow. On Block 34/7, Saga has spudded four well bores.

The Norwegian companies Saga, Norsk Hydro and Statoil have had operator responsibility in 1984 for 31 wells spudded, while the remaining 17 are split among six different foreign companies. Statoil has drilled 15 wells, while Norsk Hydro stood for nine and Saga six.

Since the start in 1966, a total of 17 companies have been operators on the Norwegian Continental Shelf. Statoil has drilled the most wells (91), followed by Norsk Hydro with 58 and Phillips with 52. Fifty-seven different drilling vessels have operated on the Norwegian Shelf.

TAB 2.2.1.a
Licence for scientific research for natural resources

Licence	Name	Field of study			Area
		Geo-physics	Geo-logy	Bio-logy	
179	Universitetet i Bergen, Geologisk institutt, avd B		X		Coastel areas Kristiansand, Færder, Inner part of Skagerak
180	Institut für Meereskunde an der Universität Kiel, Forbundsrepublikken Tyskland			X	Northern Skagerrak
181	British Geological Survey, Marine Geophysics Research Programme, Skottland	X			North Sea
182	Institutt for kontinentalsokkelundersøkelser	X	X		Norwegian Sea
183	DAFS, Marine Laboratory, Skottland		X	X	North Sea
184	Institutt for kontinentalsokkelundersøkelser	X			Barents Sea
185	Universitetet i Bergen, Jordskjelvstasjonen	X			Skagerrak
186	Institut für Meereskunde an der Universität Kiel, Forbundsrepublikken Tyskland	X			Skagerrak
187	Universität Hamburg, Forbundsrepublikken Tyskland			X	Greenland Sea
188	Senckenbergishce Naturforschende Gesellschaft, Forbundsrepublikken Tyskland			X	North Sea – Skagerrak
189	Institutt for kontinentalsokkelundersøkelser	X	X		Barents Sea
190	Institut Francais du Pétrole, Frankrike	X			Norwegian Sea
191	Norges geologiske undersøkelser	X			Møre and Romsdal, Sogn and Fjordane
192	Alfred-Wegener-Institute for Polar Research, Forbundsrepublikken Tyskland	X	X	X	Norwegian Sea, Greenland Sea
193	Universitetet i Tromsø, Institutt for biologi og geologi	X	X		Coast of Finnmark, Bjørnøyrenna
194	Nederlands Instituut vor Onderzoek der Zee, Nederland		X		Skagerrak
195	Universitetet i Bergen, Jordskjelvstasjonen	X			Greenland Sea
196	Universitetet i Bergen, Geologisk institutt, avd B	X	X		North Sea

TAB 2.2.2.a
Spudded and/or completed exploration wells (U) and appraisal wells (A)

Licence No	Well No	Drilling apudded/ completed	Operator Licensee	Drill rig Nationality	Well type	Water depth	Total depth (MSL)	Result
161	7/12–2 R	23.03.84 29.04.84	BP Stat/BP gr	Dyvi Alpha	U	071	3651	Oil/gas
183	7/12–4 R	16.03.84 20.03.84	BP Stat/BP gr	Dyvi Alpha	A	071	3596	Oil/gas
263	31/2–5 R2	22.03.84 22.04.84	Shell Stat/Shell/Con	Borgny Dolphin	U	333	2500	Oil/gas
359	7/11–7 R	29.09.84 08.10.84	Phillips Phillips gr	Cod Platform	U	078	4885	Oil
384	2/5–7	11.08.83 24.02.84	Shell Stat/Shell/PPCO	Neddrill Trigon	U	066	4497	Oil

Licence no	Well no	Drilling apudded/ completed	Operator Licensee	Drill rig Nationality	Well type	Water dybde	Total depth (MSL)	Result
385	6610/7–2	28.08.83 13.03.84	Statoil Stat/Elf/Agip	West Vanguard	U	235	4193	Dry
388	6407/1–3	17.09.83 16.01.84	Statoil	Dyvi Delta	U	286	4440	Oil/gas
390	29/9–1	23.09.83 24.02.84	Norsk Hydro	Treasure Seeker	U	104	4678	Gas
391	31/5–2 R	11.06.84 30.08.84	Saga Stat/Hydro/Saga	Treasure Saga	U	316	2474	Oil/gas
393	31/6–2 R	31.07.84 08.09.84	Statoil Stat/Hydro/Saga	Deepsea Bergen	A	304	2212	Gas
395	34/4–5	13.11.83 06.04.84	Saga Stat/Saga/Amoco	Treasure Saga	U	379	3891	Oil
396	15/9–18	16.12.83 02.03.84	Statoil Stat/Esso/Hydro	Deepsea Bergen	U	097	3599	Oil
397	15/3–5	28.12.83 13.05.84	Elf Petronord gr	Byford Dolphin	U	135	4105	Oil
398	30/6–14	17.12.83 08.02.84	Norsk Hydro Stat/Petronord gr	Treasure Scout	U	148	2877	Oil
399	34/10–20 X	23.12.83 23.04.84	Statoil Stat/Hydro/Saga	Ross Isle	U	134	3721	Abandoned
400	30/9–3	31.12.83 06.03.84	Norsk Hydro Stat/Hydro/Saga	Nortrym	U	111	3113	Oil/gas
401	31/2–13	02.01.84 15.03.84	Shell Stat/Shell	Borgny Dolphin	A	333	1702	Oil/gas
402	30/11–4	25.01.84 24.07.84	Shell Shell	Dyvi Delta	U	110	5226	Oil
403	31/3–2	04.03.84 30.04.84	Norsk Hydro Stat/Hydro/Saga	Treasure Seeker	A	340	2065	Oil/gas
404	7120/12–4	18.02.84 16.04.84	Norsk Hydro Stat/Con/Hydro	Treasure Scout	U	152	2176	Dry
405	31/5–3	10.04.84 09.06.84	Saga Stat/Hydro/Saga	Treasure Saga	A	327	2227	Oil/gas
406	30/9–3 A	06.03.84 20.05.84	Norsk Hydro Stat/Hydro/Saga	Nortrym	U	111	4275 3984 TVD	Oil/gas
407	31/6–4 X	05.03.84 16.03.84	Statoil Stat/Hydro/Saga	Deepsea Bergen	A	305	797	Abandoned
408	7120/7–3	18.03.84 09.06.84	Statoil Stat/Hydro/Saga	West Vanguard	U	258	3040	Dry
409	31/6–5	16.03.84 21.05.84	Statoil Stat/Hydro/Saga	Deepsea Bergen	A	304	2059	Oil/gas
410	7120/9–2	18.04.84 20.10.84	Norsk Hydro Stat/Hydro/Elf	Treasure Scout	U	294	5049	Gas
411	31/2–14	23.04.84 21.06.84	Shell Shell/Stat	Borgny Dolphin	A	339	1700	Oil
412	6406/3–1	27.04.84 14.08.84	Statoil Stat/Mobil/Saga	Ross Isle	U	256	4880	Dry
413	2/1–6	30.04.84 12.08.84	BP Stat/BP/Conoco	Dyvi Alpha	A	066	4563	Oil
414	30/6–15	02.05.84 05.09.84	Norsk Hydro Stat/Petronord	Treasure Seeker	U	107	3947 3175 TVD	Oil/gas
415	34/7–1	09.05.84 24.07.84	Saga Stat/Saga/Esso	Vildkat	U	328	2880	Oil
416	31/6–6	22.05.84 29.07.84	Statoil Stat/Hydro/Saga	Deepsea Bergen	A	313	2267	Gas
417	35/11–1	24.05.84 06.08.84	Mobil Mobil/Stat/Hydro	Nortrym	U	365	3336	Dry
418	2/3–4	28.05.84 24.07.84	Gulf Gulf/Wintershall	Glomar Moray F.I.	U	056	3348	Dry
419	7121/7–1	11.06.84 05.08.84	Statoil Stat/Elf/Spab	West Vanguard	U	326	2138	Gas/cond
420	25/2–8	18.06.84 01.08.84	Elf Elf/Hydro/Total	Pelerin	A	106	2368	Oil/gas
421	7119/9–1	28.06.84 25.09.84	Elf Stat/Elf/Saga	Byford Dolphin	U	201	3218	Dry
422	6407/9–1	26.06.84 07.09.84	Shell Stat/Shell/BP	Borgny Dolphin	U	248	2475	Oil
423	16/7–5	27.06.84 03.08.84	Esso Stat/Esso/Hydro	Zapata Ugland	U	080	2875	Dry
424	34/7–2	02.09.84 11.10.84	Saga Stat/Esso/Hyd/Saga	Treasure Saga	U	246	2449	Dry
425	31/4–7	26.07.84 11.09.84	Norsk Hydro Stat/Esso/Hydro	Vildkat	U	136	2480	Oil/gas
426	34/10–21	26.07.84 22.10.84	Statoil Stat/Hydro/Saga	Dyvi Delta	U	136	3976	Gas/cond

Licence no	Well no	Drilling apudded/ completed	Operator Licensee	Drill rig Nationality	Well type	Water dybde	Total depth (MSL)	Result
427	6507/7–1	10.08.84 01.12.84	Conoco Stat/Con/Arco/Ten	Nortrym	U	371	4800	Gas
428	7121/4–1	06.08.84 27.10.84	Statoil Stat/Total/Con	West Vanguard	U	335	2565	Oil/gas
429	7120/10–1	10.08.84 08.09.84	Esso Esso/Statoil	Zapata Ugland	U	183	1975	Dry
430	6506/12–1	16.08.84	Statoil Stat/Mobil/Agip	Ross Isle	U	250	4906	
431	2/1–7	06.09.84	BP Stat/BP/Conoco	Glomar Moray F.I.	U	68		
432	16/4–1	08.09.84 19.11.84	Norsk Hydro Stat/Shell/Hydro	Treasure Seeker	U	96	2884	Dry
433	15/12–4	13.09.84 31.10.84	Statoil Statoil/Esso	Deepsea Bergen	U	87	3134	Oil
434	31/2–15	10.09.84 15.11.84	Shell Stat/Shell	Borgny Dolphin	A	343	1652	Oil/gas
435	1/3–5	01.10.84	Shell Shell	Neddrill Trigon	U	71		
436	34/7–3	14.09.84	Saga Stat/Esso/Hyd/Saga	Vildkat	U	303	3389	
437	6407/6–1	16.09.84 26.10.84	Statoil Stat/Mobil/Britoil	Zapata Ugland	U	227	2868	Dry
438	31/3–3	13.10.84 17.11.84	Saga Stat/Hydro/Saga	Treasure Saga	U	332	2547	Dry
439	6609/5–1	03.11.84	Statoil Stat/PPCO/Esso	West Vanguard	U	293		
440	34/10–22	25.10.84 05.11.84	Statoil Stat/Hyd/Saga	Dyvi Delta	A	138	550	Gas
441	6/3–1	02.11.84	Statoil Stat/Con/Hyd/Amer	Deepsea Bergen	U	086		
442	30/6–16	09.11.84	Norsk Hydro Stat/Petronord gr	Treasure Scout	U	108		
443	6407/9–2	18.11.84	Shell Stat/Shell/BP	Borgny Dolphin	A	247		
444	30/9–4	22.11.84	Norsk Hydro Stat/Hydro/Saga	Treasure Seeker	U	110		
445	34/7–4	19.11.84	Saga Stat/Esso/Hyd/Saga	Treasure Saga	U	319		
446	7/8–4	10.12.84	Conoco Stat/Con/Hydro	Nortrym	U	082		
447	30/2–2	19.12.84	Statoil Stat/Union/Ten	Dyvi Delta	U	123		

2.2.2.1 Distribution by prospect type

In 1984 too, exploration activity has almost exclusively been focused on Jurassic sandstone reservoirs. Thirty-nine of the 47 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 eight wells include three in Permean (two in Central Graben and one on Tromsøflaket), one in Triassic (34/7–1), two in Paleocene (16/4–1 and 16/7–5), one in Eocene (25/2–8), and one in Tertiary (34/10–22) rock.

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

2.2.2.2 Svalbard

No drillings were made for oil or gas on Svalbard in 1984 (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.

Increasing interest has been shown in mapping Svalbard's geology in recent years. So far this activity has largely been limited to the summer six months.

The Soviet company Trust Arktikugol has plans to initiate petroleum drillings in Vassdalen by Van Mijen fjord during 1985. Norsk Polarinvest also has plans to initiate petroleum drilling.

During late November and early December, the Norwegian Petroleum Directorate undertook an inspection of drilling installations now being constructed. The inspection was organized together with the Chief Constable and Mines Supervisor for Svalbard. The Norwegian Petroleum Directorate will perform further follow-ups of the activity after a drilling licence has been awarded.

2.2.3 Discoveries and fields being evaluated

2.2.3.1 Discoveries in 1984

Several new, interesting discoveries were made on the Norwegian Shelf during 1984, of which the most interesting were made north of Stad. Particularly encouraging was Shell's discovery in Block 6407/9 on Halten-

FIG. 2.2.2.b
Wells drilled in 1984 in relation to main structural elements

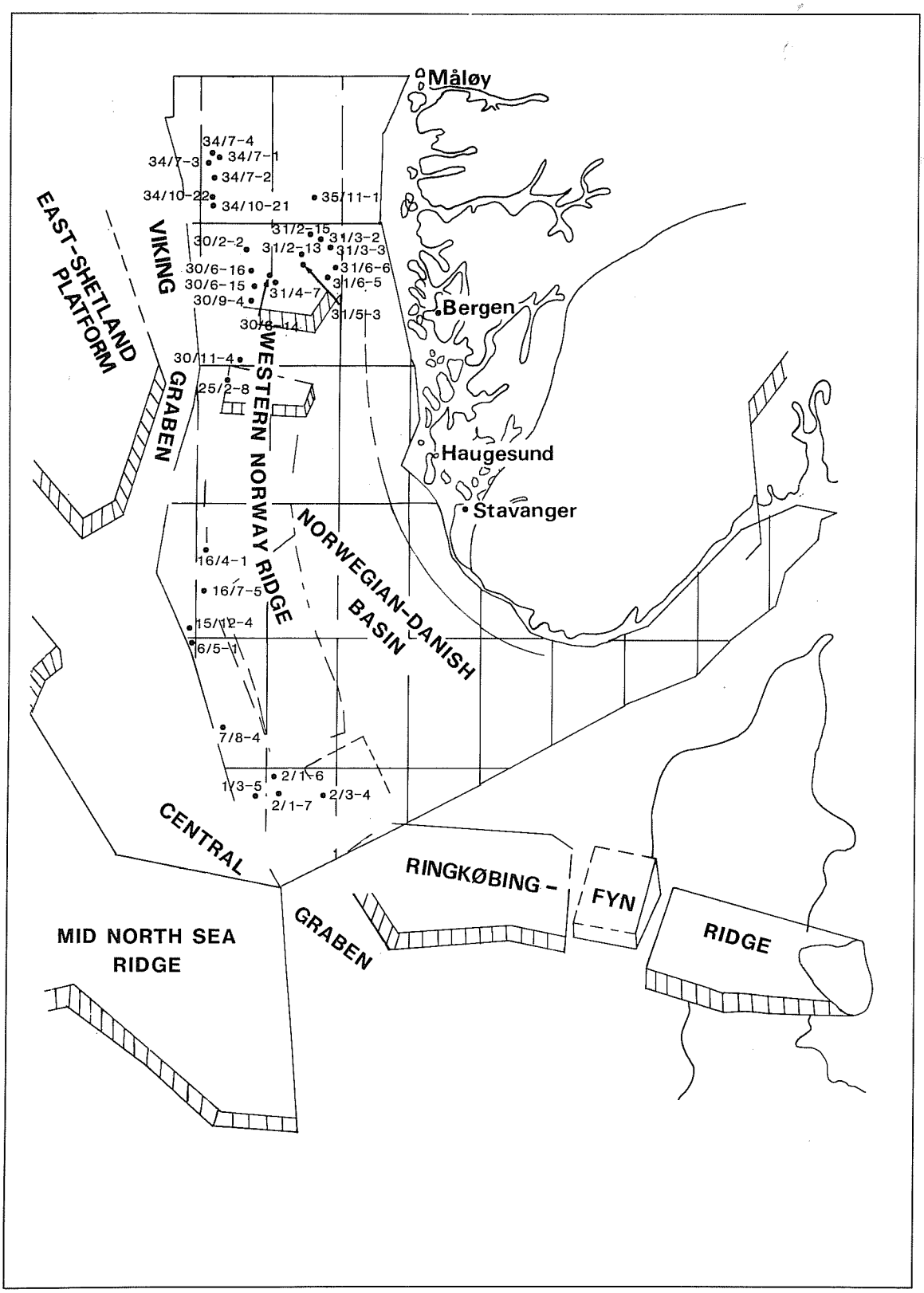
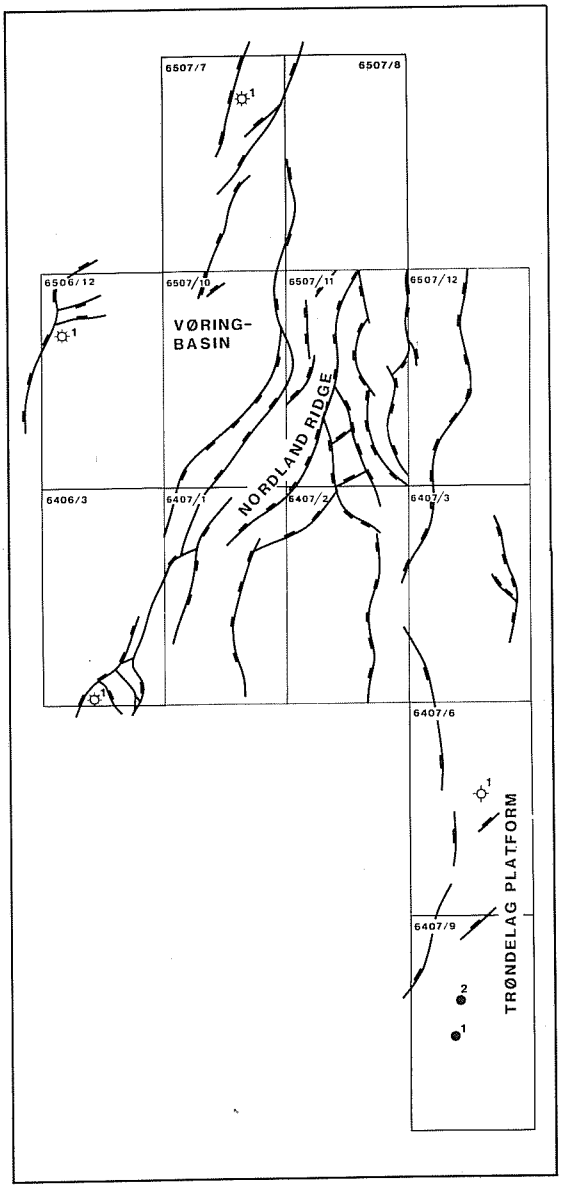


FIG. 2.2.2.c
Wells drilled in 1984 in relation to main structural elements on Haltenbanken



banken. Oil was proven in sandstone strata of Jurassic age. The discovery is reckoned to be a sizeable one, and at year's end the first appraisal well was being tested. The result of this well will provide important information for the calculation of the magnitude of the strike.

Statoil also made a substantial discovery on Haltenbanken in 1984. On Block 6506/12 Statoil is in the process at year's end of completing a highly comprehensive test program. Seven intervals will have been examined by the time the test is completed. Hydrocarbon compositions have not been finalized with conviction as yet, but the results so far indicate that the field holds gas and condensate.

FIG. 2.2.2.d
Wells drilled in 1984 in relation to main structural elements on Trænabanken

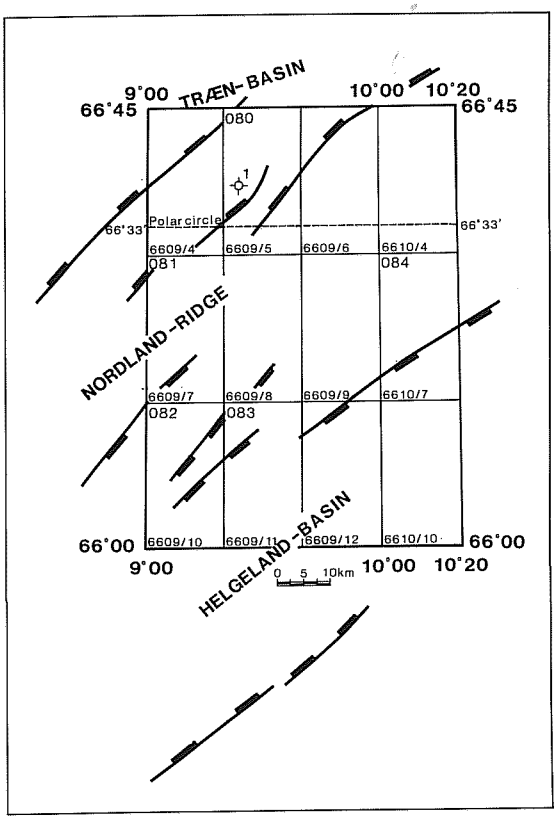


FIG. 2.2.2.e
Wells drilled in 1984 relation to main structural elements on Tromsøflaket

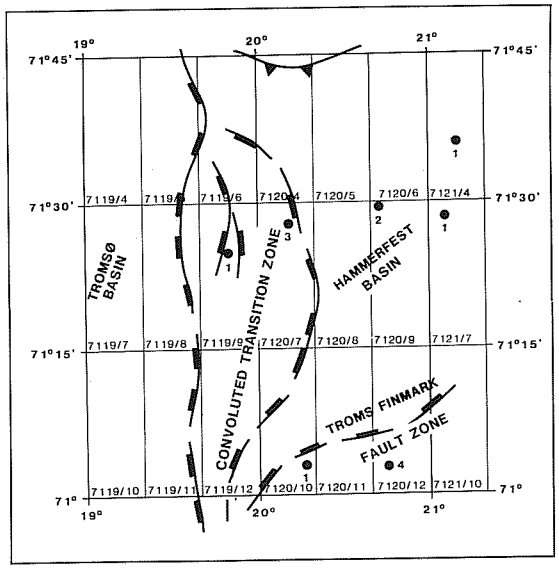
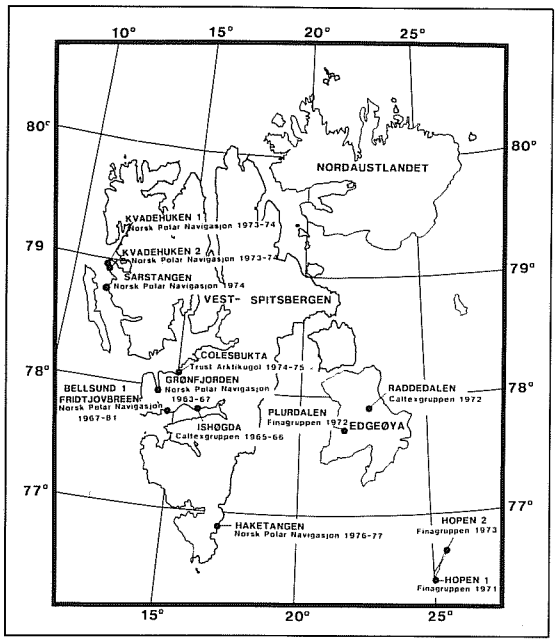


FIG. 2.2.2.f
Well locations on Svalbard



On Tromsøflaket, Statoil have made a large gas discovery on Block 7121/4. This structure stretches into the neighbouring Block 7120/6 and probably also into Blocks 7121/5 and 7120/5. Norsk Hydro in 1985 intends to examine the extent of the discovery in Block 7120/6. What is interesting about the strike is that some of the reservoir produces oil. This is the first oil produced on Tromsøflaket.

Through its drillings on Block 7121/7, Statoil has proven that the gas discovery made by Norsk Hydro in Block 7120/9–1 earlier, does in fact stretch into this block.

In the Troll area nine new wells have been drilled. The drillings have primarily been to delimit the Troll field. Only one well has been an exploration well (31/3–3). The bore was dry. Drilling was performed on a stand-alone structure outside the Troll field proper. Special tests have been performed in the appraisal wells with a view to examining the gas and water penetration upon production from the oil bearing zone.

Four wells have been spudded on Block 34/7. Three of these (34/7–1, 3 and 4) were drilled on the Snorre field which extends into Block 34/4 in the north. The drilling results show that the field is divided into an easterly and a westerly part with different oil and water

TAB 2.2.2.b
Drilling permits on Svalbard

Well (locality)	Position North East	Spudded	Completed	Drilling time days	Operator Licensee	Total depth metres	Kb elev. over msl meter
Grønnfjorden 1 (Nordenskiøld land)	77°57′34″ 14°20′36″	9.6.63 13.6.64 26.6.65	5.9.63 26.8.64 8.9.65	287	Norsk Polar Navigasjon	971,6	7,5
Ishøgda (Spitsbergen)	77°50′22″ 15°58′00″	26.6.67 1.8.65	12.8.67 15.3.66	277	Texaco Caltex gruppen	3 304	18
Bellsund 1 (Fridtjovsbreen)	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*	Norsk Polar Navigasjon	405	
Hopen 1 (Hopen)	76°26′57″ 25°01′45″	11.8.71	29.9.71	50	Forasol Fina gruppen	908	9,1
Raddedalen (Edgeøya)	77°54′10″ 22°41′50″	2.4.72	12.7.72	100	Total Caltex gruppen	2 823	84
Plurdalen (Edgeøya)	77°44′33″ 21°50′00″	29.6.72	12.10.72	108	Fina Fina gruppen	2 351	144,6
Kvadehuken 1 (Brøggerhalvøya)	78°57′03″ 11°23′33″	1.9.72 21.4.73	10.11.72 19.6.73	112	Terratest A/S Norsk Polar Navig.	479	
Hopen 2 (Hopen)	76°41′15″ 25°28′00″	20.6.73	20.10.73	123	Westburne Int. Ltd. Fina gruppen	2 840,3	314,7
Kvadehuken 2 (Brøggerhalvøya)	78°55′32″ 11°33′11″	13.8.73 22.3.74	19.11.73 16.6.74	186	Terratest A/S Norsk Polar Navig.	394	
Sarstangen (Forlandsrevet)	78°43′36″ 11°28′40″	15.8.74	1.12.74	109	Terratest A/S Norsk Polar Navig.	1 113,5	5
Haketangen (Tromsøbreen)	76°52′30″ 17°05′30″	11.9.76 13.6.77	22.9.76 19.9.77	109	Terratest A/S Norsk Polar Navig.	990	6,7
Colesbukta (Nordenskiøld land)	78°07′ 15°02′	13.11.74	1.12.75	373	Trust Arktikugol	3 180	12
				2 133 drilling days		19 759,4 m drilled	

*Drilling not finally completed

contacts. Drilling on Snorre has provided positive results. To the south in the block, Well 34/7–2 was nevertheless dry, though it is still too early to write off this area with its highly complex geology.

In the Oseberg area, Norsk Hydro has spudded three new wells to prove resources on separate structures around the main Oseberg structures.

Furthermore, oil has been found in Wells 6/3–1, 15/3–5 and 34/4–5. Gas has been found in Wells 29/9–1, 30/11–4 and 6507/7–1. The gas found in Well 30/11–4 turned out to be unproducable, and in Well 6507/7–1 only small amounts of gas were produced.

At year's end 1984 there were twelve exploration and appraisal wells being drilled, of which eight had reached the reservoir level.

In all, drillings took place on 32 new prospects in 1984. Sixteen new finds were made. This represents a finds ratio of 50 per cent, which is excellent for exploration drilling.

2.2.3.2 Drilling on new structures

Block 6/3

Block 6/3 was allocated together with Block 7/1 in 1984 with Statoil as operator. Both blocks had previously been relinquished. Well 6/3–1 was drilled on a structure near the borderline with the British sector. Discoveries of hydrocarbons were made at two levels. The well was not yet completed at year's end, but testing was being prepared. Provisional results before testing indicate that gas and condensate has been found in sandstone of Cretaceous age, and oil and gas in sandstone of Jurassic age.

Block 15/3

The block was allocated in 1969 with Elf as operator. Previous drillings have yielded one dry bore and three wells in which discoveries were made. Well 15/3–5 was drilled centrally in the block. Oil was proven in an approximately 100 meter thick silt and sandstone sequence of Jurassic age. Due to inclusions of shale, the net producable reservoir sandstone is no more than some 5 meters, and the reservoir was consequently not tested.

Block 15/12

The block was allocated in 1974 with Statoil as operator. Parts of the block were relinquished in 1980. Well 15/12–4 was drilled on the southernmost part of the non-relinquished area. An oil column of under 1 meter was proven in sandstone strata of Jurassic age. The reservoir thickness is believed to increase further up the structure. The well was not production tested since the reservoir is so thin.

Block 31/4

The block was allocated in 1979 with Norsk Hydro as operator. Previous drillings include three wells with discoveries, two dry holes and one well abandoned for technical reasons before reaching the prospect.

Well 31/4–7 was drilled on the southwestern part of the block and proved hydrocarbons at two levels in Jurassic sandstone. In the Statfjord formation (lower Jurassic), oil was proven in a 16 meter thick zone. A production test provided a maximum production of approximately 7005 Sm^3 oil per day through a 16 mm choke, the oil having a density of 0.83 g/ml. In the Heather formation (upper Jurassic), a 34 meter thick gas bearing zone was proven. The reservoir is silted and of poor quality. A production test was performed which, at its best, produced approximately 3000 Sm^3 per day through a 14 mm choke. The discovery provides additional reserves of approximately 10 per cent in relation to the previously proven reserves in the Brage field.

Block 34/4

The block was allocated in 1979 with Saga as operator. Previous drillings include two dry holes and two wells which made discoveries.

Well 34/4–5 was drilled on a separate structure in the northeast of the block. Oil was proven in an approximately 40 meter thick sandstone layer dating from the lower Jurassic. The maximum production from this zone was metered to 50 Sm^3 oil per day through a 4 mm choke, the density being 0.83 g/ml.

Block 34/7

The block was allocated in 1984 with Saga as operator. During 1984 four new wells were spudded and two of these are in the process of completion at year's end. Results have shown one dry hole and three discoveries.

Well 34/7–1 was drilled in the easterly part of the Snorre field and examined the southern extent of the discovery already made on Block 34/4–4 immediately to the north. An approximately 190 meter thick oil bearing zone was proven in sandstone stemming from the Jurassic era. Production tests were run at three levels. The most promising test produced 1815 Sm^3 oil per day through a 17.5 mm choke.

Well 34/7–2 was drilled in the southern part of the block without proving hydrocarbons of any significance.

Well 34/7–3 was drilled in the southwestern part of the Snorre field. Hydrocarbons were proven in Jurassic sandstone strata. The well was being tested at year's end.

Well 34/7–4 was drilled on the northwest flank of the Snorre field. Hydrocarbons were proven in Jurassic sandstone strata.

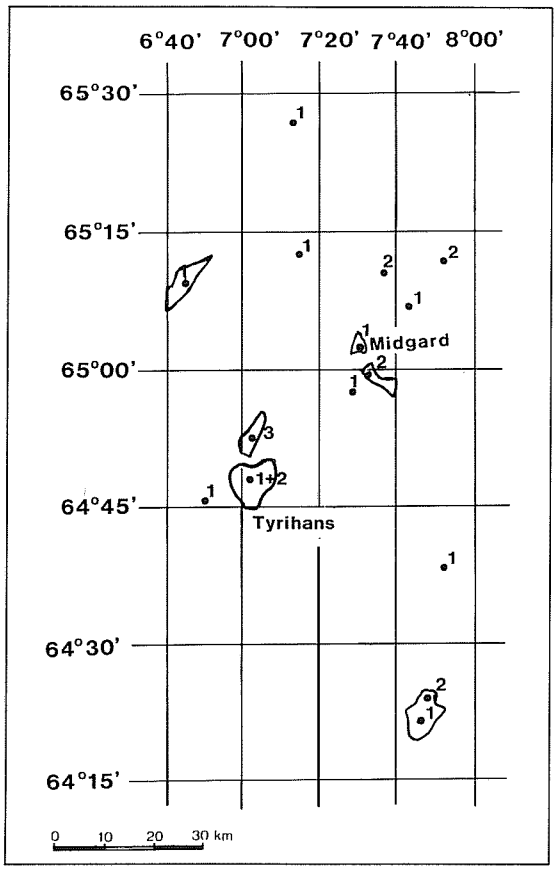
The Norwegian Petroleum Directorate's resources estimate for the Snorre field now stands at 99 million Sm^3 oil and 27 billion Sm^3 gas.

Block 34/10

The block was allocated in 1978 with Statoil as operator.

At year's end 1983–84, Well 34/10–20 was being drilled on a separate structure in the southeast of the block (the Gamma structure). This well never reached its prospective strata due to high pressure.

FIG. 2.2.3.a
The Haltenbanken Area



Well 34/10–21 was drilled in a previously undrilled substructure in the northwestern corner of Gullfaks South. Gas was proven in sandstone strata of the Brent formation (mid Jurassic). A production test gave a flow of up to 1.1 million Sm^3 gas and approximately 190 Sm^3 condensate per day through a 25.4 mm choke. Furthermore, traces of hydrocarbons were proven in sandstone layers from the Stratfjord formation (lower Jurassic). This structure is small and has only contributed minor additions to the Gullfaks South resources estimates.

Well 34/10–22 was drilled at the future site of the Gullfaks A platform. The well was designed to examine the possible existance of shallow gas bearing strata. The examination is purely technical in nature and has no economic interest, since the shallow gas occurrences are very minor.

Block 6407/9

The block was allocated in 1984 with Shell as operator (Figure 2.2.3.a). One exploration well had been drilled and one appraisal well was being tested at year-end.

Well 6407/9–1 was drilled centrally in the block on a comparatively level structure.

The well proved light oil in sandstone strata of Jurassic age. A production test which was performed provided at best approximately 1350 Sm^3 oil per day through a 51 mm choke.

By year's end one was about to perform a production test of the first appraisal well into this find. The Norwegian Petroleum Directorate's resources estimate for the structure now stands at 39 million Sm^3 oil. The estimate is somewhat uncertain because the structure is difficult to map with any confidence.

This discovery of a structure with only oil on Haltenbanken has been of great importance to the further activities in the area off Mid-Norway.

Block 6406/12

The block was allocated in 1984 with Statoil as operator (Figure 2.2.3.a). The first well had not been completed by year's end. It proved hydrocarbons in Jurassic sandstone in an interval extending over 400 meters. The reservoir quality varies from good sand to shaley sand and pure shale. The test program for the well covers seven levels, which is the most comprehensive program so far on the Norwegian continental shelf. Provisional test results indicate that the hydrocarbons lie in several independent levels, containing both gas and condensate. There still attaches great uncertainty to the resources estimates. More wells will have to be drilled before anything can be stated with confidence.

Block 6407/7

The block was allocated in 1984 with Conoco as operator (Figure 2.2.3.a). The first well was drilled to the northeast in the block. The well proved gas in Jurassic sandstone. The rock possesses poor reservoir properties and a production test only yielded small amounts of gas. Additionally, traces of hydrocarbons were observed in Cretaceous sandstone, though these were not tested.

Block 7121/4

The block was allocated in 1984 with Statoil as operator. The first exploration well proved both oil and gas. This is the first producable oil on Tromsøflaket. Well 7121/4–1 was drilled in the middle of the block.

Hydrocarbons were proven at two different levels in sandstone layers of lower and middle Jurassic age.

In all four tests were performed: one in the water zone, one in the lower reservoir, and two in the upper reservoir.

The lowermost reservoir produced 508,300 Sm^3 gas, 37.8 Sm^3 condensate and 289.6 Sm^3 water per day through a 19.05 mm choke.

The major part of the resources exist in the upper reservoir. Reservoir properties in the upper reservoir vary, the best being towards the top, the poorest towards the bottom. One test was performed in each of the zones. The maximum production from the lower zone was measured at 89,000 Sm^3 gas and 94 Sm^3 oil per day through a 12.7 mm choke. The density of the oil is 0.85 g/ml (34 degrees API). The upper zone produced at best 845,700 Sm^3 gas and 109 Sm^3 condensate per day through a 25.4 mm choke.

The two tests show that there is a difference in liquid content in the two zones. The upper zone produced primarily gas, with small amounts of condensate (Gas-Oil Ratio approx 8000 m^3/m^3). The lower zone produced some oil together with the gas (GOR approx 1000 m^3/m^3). This oil is relatively heavy, having a density of 0.85 g/ml. By comparison, the other gas finds off North Norway (Askeladd, Well 7120/9–1) show a gas/oil ratio of approximately 20,000.

The structure extends into the neighbouring Block 7120/6 and probably also into Blocks 7121/5 and 7120/5. Further drillings are necessary in order to be able to make any certain estimate of the size of the structure.

The Norwegian Petroleum Directorate's resources estimate for the structure is presently 114 billion Sm^3 gas.

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 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 Sm^3 oil and 23 billion Sm^3 gas. The oil represents condensate which separates out during production.

The operator has to date recommended ten 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 thence into the Emden line.

The work schedule has been displaced somewhat. The 1985 program is dependent on achieving progress towards a sales agreement for gas by 1 August 1985. At the present time, the operator is planning to present a commerciality declaration and landing application by the end of December 1985. This will mean production start on Tommeliten in 1990.

Hod

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

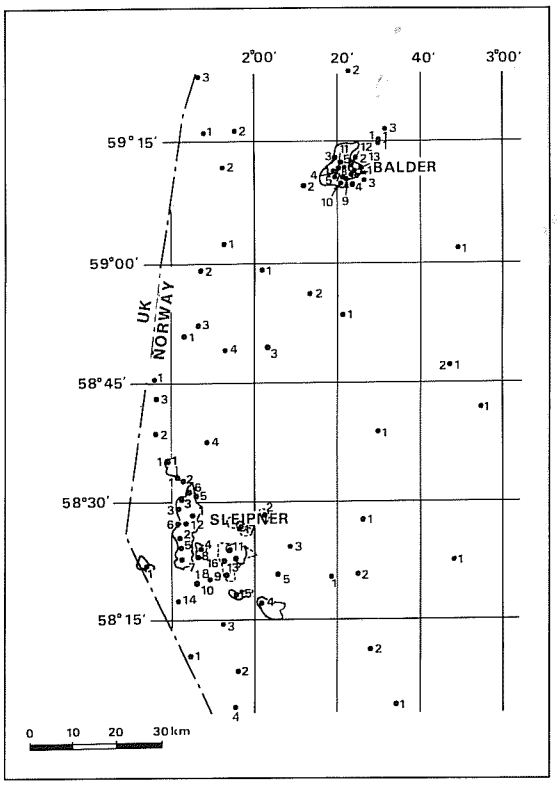
The Norwegian Petroleum Directorate's estimated recoverable reserves were reduced in 1984 to 7.0 million Sm^3 oil and 5.0 billion Sm^3 gas.

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 on Block 2/11, 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 study to evaluate production as well as reevaluate the geological model for the Hod structures from subsea completed wells. This study is expected to be finished in 1985. A subsea solution can possibly reduce the development costs of the Hod field. If the study shows that it is interesting, both economically and technically, to undertake trial production from a subsea completed well, production can start at the earliest in the autumn of 1986. Production will be carried by pipeline to Valhall. The operator is estimating 1–2 years of trial production to gain experience with subsea completion before taking a decision to expand production to encompass additional wells.

FIG. 2.2.3.b
The Sleipner and Balder Area



The Sleipner area

The Sleipner area is made up of Blocks 15/5, 15/6, 15/8, 15/9 and 16/7. Drillings and discoveries are summarized in Figure 2.2.3.b.

Allocations, production licences and operator responsibilities as per year's end 1984, were as follows:

Block	15/5	15/6	15/8, 15/9	16/7
Allocation year	1977	1969	1970	1981
Operator	Norsk Hydro	Esso	Statoil	Esso
Production licence	048	029	046	072

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

New discoveries in the Sleipner area
Two new wells were drilled on Sleipner in 1984. Well 15/9–18 was completed during 1984. Small amounts of hydrocarbons were proven in this hole, which was abandoned without being tested. Well 16/7–5 proved dry.

Reserves estimate
Recoverable reserves on the Sleipner field, which includes the Alfa, Beta, Epsilon and Delta structures, are estimated to amount to 134.7 billion Sm^3 gas, 27.5 million Sm^3 oil and 9.2 million tons NGL.

For Sleipner East (previously called Gamma) the recoverable reserves in the Heimdal formation and the Jurassic and Triassic reservoir are estimated at 51.4 billion Sm^3 gas, 17.2 million Sm^3 oil and 9.7 million tons NGL. In place resources are estimated to amount to 15 billion Sm^3 gas in the My structure, and 18 billion Sm^3 gas in the Theta structure.

Development of the Sleipner area
The development concept envisaged for Blocks 15/6 and 15/9 involves an integrated platform on Sleipner East and two integrated platforms on Sleipner West. The field development plan is designed such that lesser structures in the area can be tied in.

The selection of transportation alternative for gas and condensate depends on the outcome of the negotiations between the UK and Norwegian authorities.

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.

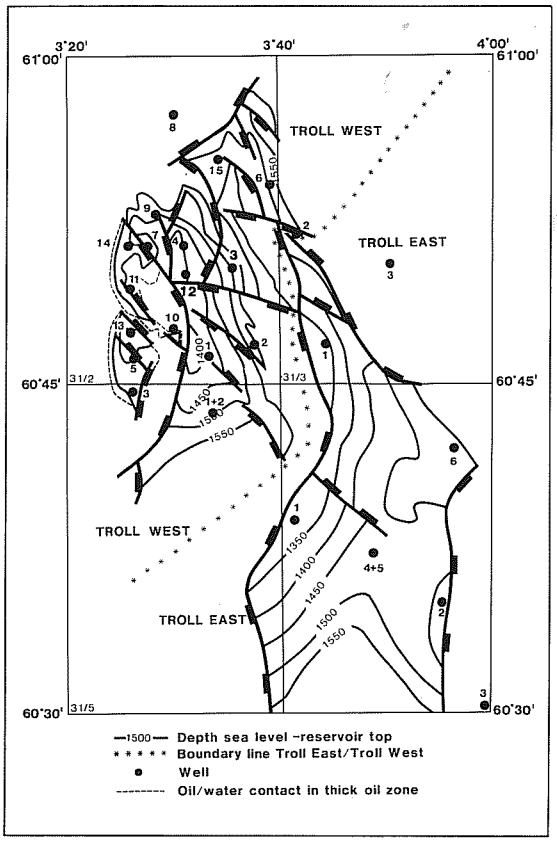
As yet, no final decision has been made as to development of the field. No wells have been drilled in the block since 1981.

The recoverable oil reserves are now estimated to run to 35 million Sm^3.

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.

The Troll field
The Troll field extends over parts of several blocks: 31/2, 31/3, 31/5 and 31/6 (Figure 2.2.3.e). 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.

FIG. 2.2.3.c
The Troll field



Operator responsibility here is divided among Statoil, Saga and Norsk Hydro.

The reservoir lies in three geological formations of upper Jurassic age (approx 140–150 million years old). The uppermost formation (Sogn) 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 (Fens) 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 rests 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 1984

Well	Status	Operator	Penetrated HC column
31/2–13	Appraisal	Shell	43 m gas over 24 m oil
31/2–14	Appraisal	Shell	35 m gas over 28 m oil
31/2–15	Appraisal	Shell	101 m hydrocarbon column: top 79 m are gas bearing, bottom 15 m oil bearing. Interim zone of 7 m with uncertain hydrocarbon composition.
31/3–2	Appraisal	N Hydro	At least 11 m oil
31/3–3	Expl outside Troll	Saga	Dry
31/5–3	Exploration	Saga	18.5 m gas over 22 m oil
31/6–2R	Appraisal	Statoil	111 m gas
31/6–5	Appraisal	Statoil	52 m gas over 3–4 m oil
31/6–6	Appraisal	Statoil	13 m gas

Test results

Well	Test interval	Choke (mm)	Rates per day
31/2–13	Oil test	14–21	477–588 Sm^3 oil
31/2–14	Oil test	38.1	1335 Sm^3 oil
31/3–2	Oil test	65	1590 Sm^3 oil, 438,000 Sm^3 gas
31/5–1	Oil test	24–44	1250 Sm^3 oil
	Gas test	44	1.24 mill Sm^3 gas
31/5–3	Oil test	31	1350 Sm^3 oil
	Water test	45	1240 Sm^3 water
31/6–2R	Gas test	38	860,000 Sm^3 gas
31/6–5	Gas test	38	1.23 mill Sm^3 gas
31/6–6	Gas test	25.4	780,000 Sm^3 gas

None of the above-mentioned gas tests equal the maximum production for the Troll field (Well 31/2–12: 3.5 million Sm^3 gas per day), although the test results must nevertheless be characterized as good.

Wells 31/3–3 and 31/6–3 were drilled on separate structures southeast of the Troll field. The reservoirs were 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 fifteen, three, two and five wells, respectively. The Norwegian Petroleum Directorate's present reserve estimate for the Troll field is 1,287 billion Sm^3 recoverable gas deposits, and 58 million Sm^3 recoverable oil deposits. The Norwegian Petroleum Directorate has for the time being ignored the oil quantities in those parts of the field which have a 10–17 meter oil zone, since the uncertainty attaching to production of this oil is great at the time of writing. New recovery methods or more favourable geological conditions in parts of the field which have not yet been 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 results of ongoing reservoir simulation work will reduce this uncertainty.

Based on the interpretative work presently available, 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 plans 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.

Norske Shell has presented a development alternative which involves 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 (close to Well 31/12–4). This alternative provides a large gas to oil ratio, plateau production being 16 billion Sm^3 gas and 4 million Sm^3 oil per year.

Due to the enormous depths of water, development of the Troll field will be highly complicated and comprehensive. This means that one will be forced to preselect a small number of concepts which can then be further developed to reach development maturity. Such work is being undertaken at present also within the 085 licence group, and a status for this work is expected to be ready by mid 1985. The work will evaluate

costs and safety, production and regularity for several types of fixed and mobile platforms using various degrees of processing on the platforms. At the same time, an evaluation will be made of seafloor systems both as regards remote transmission of the well flow to shore, and from the well to the platform.

Safety, preparedness and the working environment

The Norwegian Petroleum Directorate's evaluations and following up of the development of the Troll field have been concentrated on safety aspects of platform concepts for Troll West (production licence no. 085).

In connection with A/S Norske Shell's development of the T-300 concept, the Directorate has been especially interested in following up the stated risk evaluation for the Troll field, to satisfy itself that the following factors are given sufficient thought:

- The platform concept diverges from the elongated shape which has become normal on comparable installations, and which the Directorate considers to provide a good point of departure for satisfying the superordinate safety acceptance criteria.
- The distance separating the wellhead area from the accommodation quarters will be relatively small.
- A solution based on a single concrete shaft will cause many and various functions to have to be concentrated in this one shaft and the hookup area.
- The solution provides limited options regarding the placement of critical components, for example the gas and marine riser lines.
- The requirements concerning separation of fire pump systems seem difficult to satisfy.
- The accessibility of external protective measures in an accident situation appear to be reduced in relation to the elongated platform concept.

The risk evaluation presented for the Troll field was performed on the assumption that a safety valve would be assembled in the gas line 800 meters from the installation, and that double-walled marine risers would be provided. The Norwegian Petroleum Directorate has nevertheless noted that A/S Norske Shell has recently indicated towards the Directorate that it has not been decided that the company considers it necessary to make use of two barriers to prevent any gas leakage in the gas export system.

The risk assessment indicates some probability that twin faults may occur in the inner and outer marine riser walls. For example, a fracture in the inner wall may precipitate overloading of the outer wall; or common welding or material defects may arise in both riser walls during fabrication. Against the background of the highly critical consequences of a possible riser failure, the Norwegian Petroleum Directorate has therefore encouraged A/S Norske Shell to carefully evaluate the selection of barriers for the installations connected to the gas line when the development plans for Troll are presented.

Due to the great water depths on the Troll field, A/S Norske Shell and Statoil this year set up a working group which has the task of implementing a program of study entitled "Deep Diving and Intervention Techniques Development, Diving and Subsea Intervention Studies".

During 1984 the working group has prepared its "Work Package No. 1, Unmanned Testing of Selected Breathing Equipment", "Work Package No. 2, Human Factors and Equipment Studies" and "Work Package No. 3, Pipeline Repair Methods".

The Norwegian Petroleum Directorate has been informed of the studies and has taken the initiative for a total of three meetings in 1984, at which A/S Norske Shell and Statoil have submitted situation reports concerning the studies. For each of the in all seven Work Packages, an evaluation will be performed. This will be done by an external contractor following bid invitations.

The field is difficult to map towards the east and southeast and the reserves estimates are rather uncertain.

The operator estimates the recoverable reserves to be in the order of 75.2 million Sm^3 oil and 10.5 billion Sm^3 gas on Delta East, Phase II. These estimates have been calculated since the results for Well 34/10–19 were received.

Gullfaks – Phase II

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

Phase II includes 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 34/10–19, 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 estimates are highly uncertain. The Norwegian Petroleum Directorate's estimate for recoverable reserves is of the order of 72.5 million Sm^3 oil and 10.5 billion Sm^3 gas. These estimates follow receipt of details of the 34/10–19 well.

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 has lead to the development solution with two platforms being changed. Several new solutions are being assessed, and the most probable is a solution with a full process platform located near Gullfaks A in the middle part of the field, where the water depth is 220 meters. Subsea completion wells will be used to the extent this is necessary to secure good depletion of the reservoir.

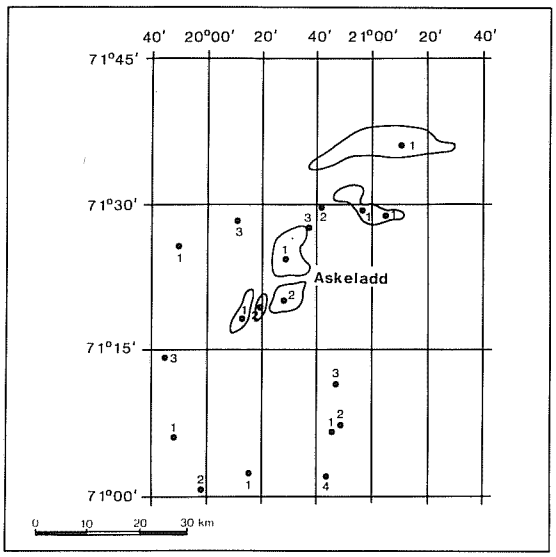
The operator is considering speeding up the development of Phase II in relation to the original plan, which

was to start production in 1995. The present plan for Phase II incorporates an option for production start in 1990–91.

The Askeladden area

A total of nine wells have been drilled on Blocks 7120/7, 7120/8, 7120/9 and 7120/7 (Figure 2.2.3.d). Seven of these have proven hydrocarbons in five different structures. Their locational and reservoir similarities have caused these three blocks to warrant a common evaluation.

FIG. 2.2.3.d
The Askeladd area



Additionally Statoil has made a substantial discovery of gas in Block 7121/4 in 1984, though this also produced oil.

Statoil and Norsk Hydro have performed extensive studies of the area. Besides the field installations for landing, the shore and offshore terminals and further transportation to the market have been evaluated. In this context it can be mentioned that the gas transport studies have included an evaluation of pipeline carriage along the Norwegian coast through Norway, plus LNG dispatch to the market. Sweden for its part has examined the possibilities of a gas line from North Norway down through Sweden.

Block 7120/7

The block was allocated in 1982 with Statoil as operator. Statoil proved gas in the first well on a structure centrally located in the block. The second well was drilled on a structure on the border to Block 7120/8 (Askeladden). In this well too, gas was proven. In 1984 a well was drilled to the north in the block without demonstrating hydrocarbons.

The proven reserves in the block following the first well are estimated at 23 billion Sm^3 recoverable gas. There remain some structures in Block 7120/7 which have not yet been tested and which may provide additions to the estimates for the block.

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.

The discoveries made in Wells 7120/8-1, 7120/8-2 and 7120/7–2 are compatible with a reserves estimate of 41 billion Sm^3 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 Sm^3 gas and 9.5 Sm^3 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 both allocated in 1984 in the eighth licensing round.

Proven recoverable reserves on the field are estimated to 35 billion Sm^3 gas. The block has structures which have not been tested, but which will be tested in the coming years.

In 1984 a well was drilled in the northwest of the block which was designed to test Permean reservoir rocks. For technical reasons the well never reached these rocks. Against all expectations, gas was proven in the hole in Jurassic sandstone at the same level as in Well 7120/9–1. The structure is a small one with small reserves.

Block 7121/7

This block was allocated in 1984 with Statoil as operator. Statoil has drilled the first well and has proven gas in the eastern extension of the discovery, which

TAB 2.3
Production and injection wells

Field	Total drilled	Prod-ucing	Injection/ (observa-tion)	Drilling	Susp/ plugged compl	Spudded 1984
Albuskjell	23	17			6	
Cod	8	6			2	
Edda	10	7			3	
Ekofisk	51	40	5[2]		5	4
Eldfisk	40	29		1	11	2
Frigg	48[1]	46	(1)		1	
NØ Frigg	7	6			1	
Odin	11	9		1	1	10
Statfjord	52	28	17	3	4	11
Tor	14	11			3	
Valhall	15	13		1	1	6
Vest-Ekofisk	12	8			4	
Totalt	291	220	23[2]	6	42	33

1) 24 on Norwegian side
2) 4 wells are production/injection wells dependent on gas sales

No. of wells	Status
220	Producing (128 oil, 31 condensate and 61 gas)
11	Shut down
22	Injection
1	Observation
6	Being drilled (2/4-K13, 33/9-A3 S, 2/8-A14, 30/10-A10, 30/9-C38 and 33/12-B26)
1	Shut down (10/1-A12) and drilled deeper on UK licence with new designation (10/1-A25)
2	Suspended following placement of 508 mm casing (30/10-A9 and 33/9-C34)
1	Suspended following placement of 13 3/8" casing (33/9-A11)
1	Suspended at total depth (2/4-K4)
26	Never produced
291 wells	

Norsk Hydro proved in the westerly neighbour, Block 7120/9. Well 7121/7–1 confirms Norsk Hydro's discovery.

2.2.3.4 Fields declared commercial

During 1984 the East Frigg field was declared commercial.

2.3. Fields being planned, developed or in production

Production drilling and well maintenance

On the Norwegian part of the continental shelf there are now twelve fields having permanent installations: Albuskjell, Cod, Edda, Ekofisk, Eldfisk, Frigg, North East Frigg, Odin, Statfjord, Tor, Valhall and West Ekofisk.

During 1984, drilling licences were given for 31 production/injection wells, and 29 new wells were spudded. Twelve of these are oil producers, ten gas producers, six water injection wells, and one was abandoned due to technical difficulties (see Table 2.3).

2.3.1 Valhall

Production licence 006

Licensees:

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.

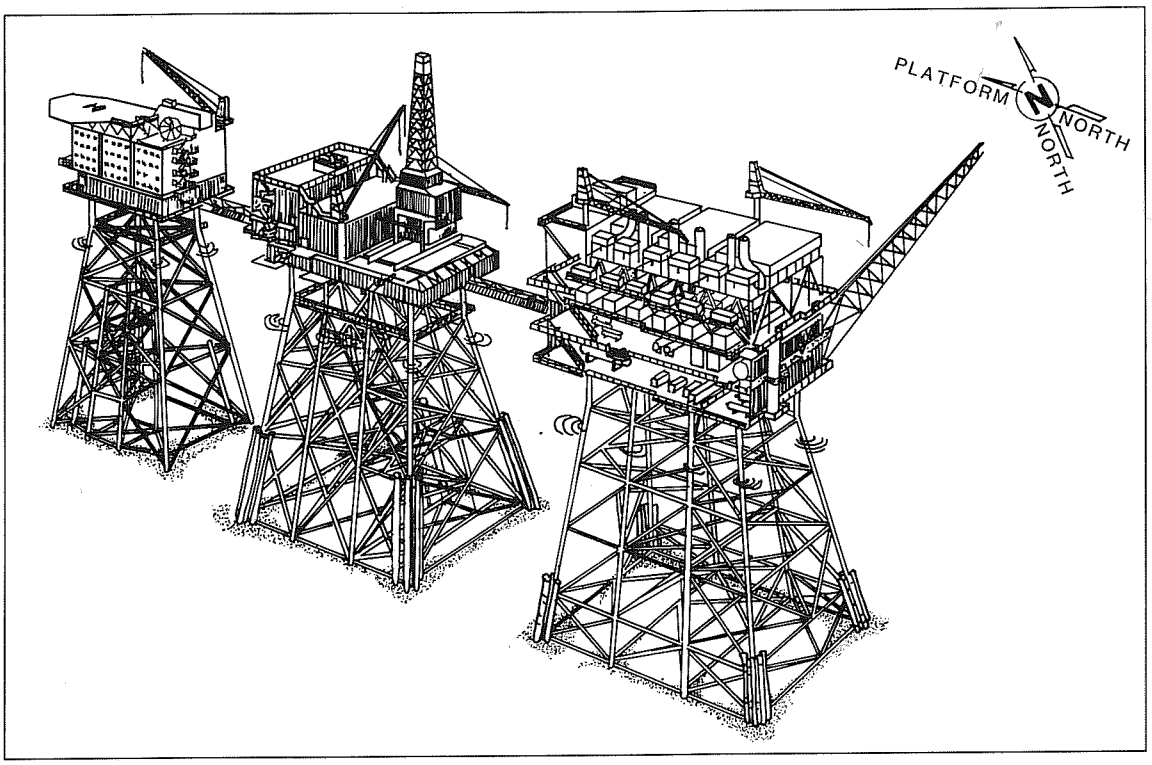
The Valhall field lies mainly within Block 2/8 (Figure 2.3.2.a). The southern part of the block reaches into Block 2/11, production licence 033. In this licence, each of the companies mentioned above have a 25 per cent interest.

Production facilities

Development includes an accommodation, a drilling, a production and a marine riser pipe platform. The three first mentioned platforms are placed on the Valhall field and interlinked with bridge connections. Figure 2.3.1.a shows these installations. The marine 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 metered and sent on via the Emden line. Denser gas fractions of NGL are separated out on Valhall using a fractioning column, and then injected into the oil.

FIG 2.3.2.a
Installations on Valhall



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 Sm^3 oil, 1.3 million tons NGL and 16 billion Sm^3 gas will be depletable from the Valhall A site by pressure amelioration.

Production from Valhall A started on 1 October 1982, and by 31 December 1984 a total of 13 wells had been tied in to the production facility.

The productivity of the wells has been substantially lower than predicted, returning an average rate of approximately 700 Sm^3 oil per day at year's end.

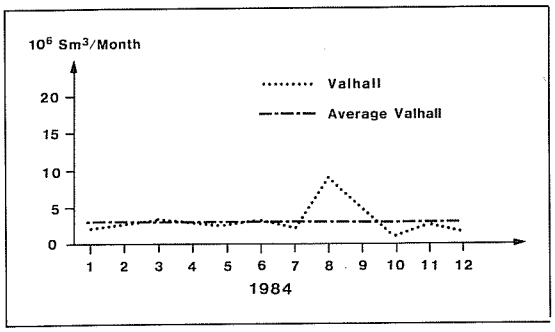
On the Valhall field the rock properties are highly complicated, and this has sometimes caused major difficulties in connection with production from the field, insofar as chalk particles borne by the oil flow cause the wells to clog up. During the year a great deal of work has been done to overhaul and reopen such wells.

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. Definite plans for further development have not been provided.

Gas flaring

The volume of gas flared in 1984 on Valhall was on average 0.10 million Sm^3 per day, corresponding to 5.9 per cent of the total gas production. The field was considered to be in its ordinary operating phase in 1984, so that the flare limit was further reduced to 0.150 million Sm^3 per day. During the year there have arisen few technical process problems, thus providing high process reliability. Even so, problems have arisen in the gas system relating to the replacement of one compressor train with another. Such compressor teething troubles have caused some flaring of gas. The operator has set up a working group with the object of trying to solve the compressor problems. See Figure 2.3.1.b for gas flared on Valhall 1984.

FIG. 2.3.1.b
Gas flared on Valhall



Costs
Total investment costs are assumed to be NOK 6.43 billion in current value and NOK 6.38 billion in fixed 1984-kroner. (For conversion between current and fixed kroner, the Petroleum Outlook's assumptions concerning price escalation and investments have been utilized).

Safety, preparedness and the working environment
Load-bearing structures
Due to a fracture which was discovered on process cum pumping installations, a hyperbaric repair weld was made on nodes to make good the damage.

Crude oil pumps
Problems with the packing boxes have been reported for all crude oil pumps on Valhall. Work is however being done to improve the system.

Compressors
Abnormal vibrations plus instrumental errors on all compressors have caused operating disturbances, including shutdown. The causal relationships are unknown.

Standby vessels and preparedness
On the basis of a total evaluation of efficiency and cost effectiveness, the operator has replaced the standby vessel with two multiservice vessels for supply and preparedness purposes.

2.3.2 The Ekofisk area
Production licence 018; ("Phillips group")

Licensees:

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 %

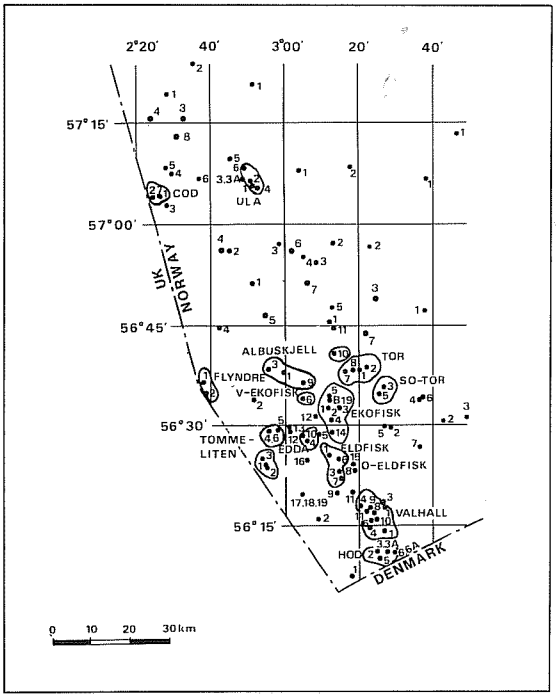
The above companies (the "Phillips group") hold the licences to the Ekofisk, West Ekofisk, Cod, Eldfisk and Edda fields (Figure 2.3.2.a). The two first named fields lie in Block 2/4. Cod lies in Block 7/11 and Eldfisk and Edda in Block 2/7.

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 %

FIG. 2.3.2.a
The Ekofisk area



Tor:

Production licence 018, "Phillips group":	75.3612 %
Production licence 006, "Amoco group":	24.6388 %

Production licence 006; ("Amoco group")
Licensees:

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

The Ekofisk-Emden pipeline. Installations B11 and H7

A replacement of the incoming marine riser on B11 was performed in connection with the shutdown of the Ekofisk field in August. The replacement was performed pursuant to an injunction from Norwegian and German authorities after one had discovered, in connection with the removal of the protective sleeve (monel cover) in 1981, deep fire wounds to the riser. The work was undertaken without encountering significant problems. At the same time, the emergency shutdown valve on the inlet side was also overhauled.

In the area about the gas line (Northern Leg Gas Pipeline), major movements of seabottom masses have continued. This has led to greater exposure and the risk of free spans. The area is the subject of frequent inspections by divers.

The Ekofisk-Teesside pipeline. Installations 36/22 and 37/4

Following legal amendments in Great Britain, these installations have been the subject of joint inspections by Norwegian and British authorities. The inspections have been performed to form the basis for an inspection and control system for both countries' authorities.

To be able to operate the proposed system, Norpipe must be exempted from certain requirements made by the UK authorities. Such exemption has not as yet been forthcoming. The operator performed in 1984 a quite extensive maintenance program on Platform 37/4.

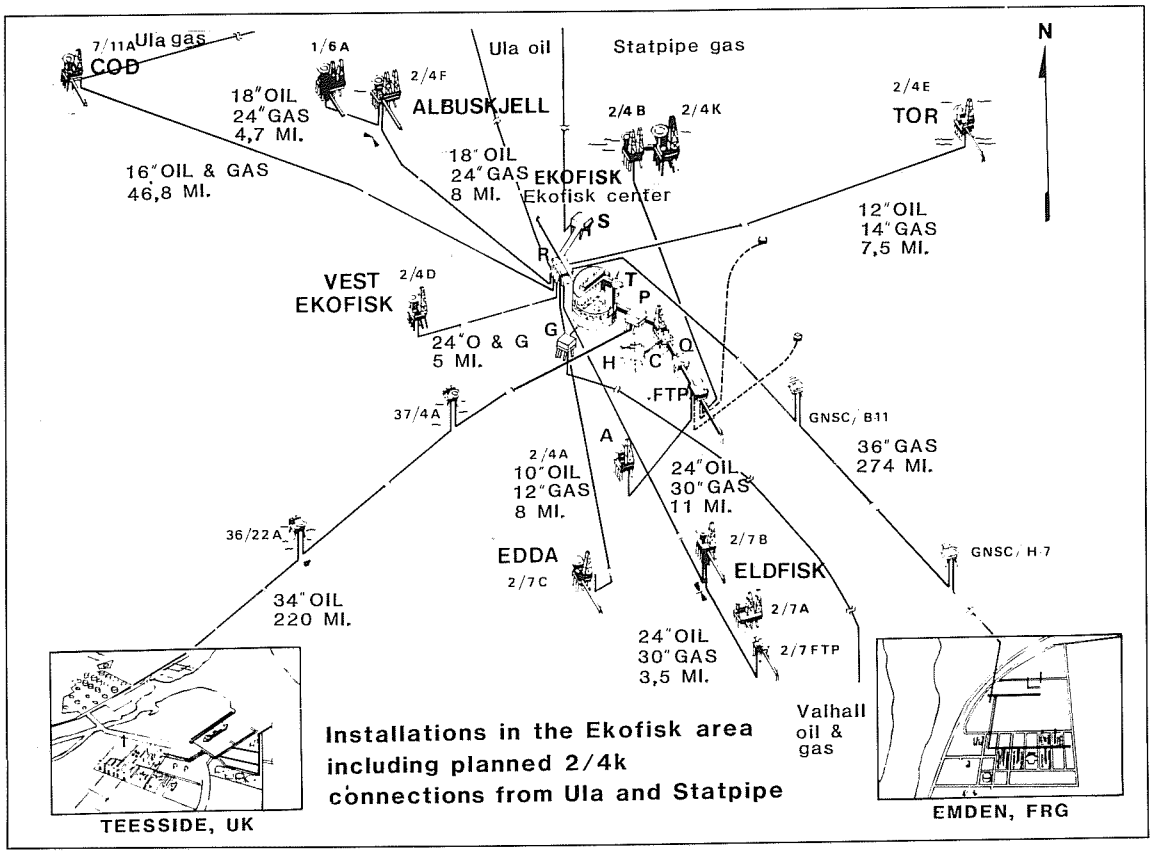
On Platform 36/22 it has only been necessary to make small adjustments to the original inspection and maintenance procedures.

Waterflood project

On the background of the results of existing studies it was planned in 1982 to undertake a project involving the injection of water into the Tor formation and the lower part of the Ekofisk formation, see Figure 2.3.2.c. In 1983 it was decided to realize the project.

The plan for the project involves a new installation

FIG. 2.3.2.b
Installations in the Ekofisk area including planned 2/4 K conncetions from Ula and Statpipe



which shall be tied to the 2/4-B platform. It is assumed that, from such an installation, it will be possible to reach 70 per cent of the reservoir area with injection wells. By injecting into the Tor formation and the lower part of the Ekofisk formation, one will thus cover 35–40 per cent of the reservoir volume.

The pilot waterflood project into the Tor formation, which was initiated in March 1981, was completed in July 1984. Experience gained from this trial project was in the main positive. The tests demonstrate that high injection rates, above the rates planned per well in the main project, can be maintained over long time periods. Furthermore, the trial showed that the injection water not only flows within the fracture system, as some people feared, but is absorbed into the rock and displaces a part of the oil, thus increasing oil production.

At present some uncertainty is attached to water injection into the lower part of the Ekofisk formation. One of the main problems here is whether it is possible to inject at adequately high water rates, and whether the formation can withstand water injection without collapsing. To gain an answer to these questions, an injection test has been planned into the lower Ekofisk formation.

Doubt has also been aired concerning how far the Ekofisk formation is sufficiently capable of absorbing the injected water, thus facilitating the displacement of the oil. The Norwegian Petroleum Directorate has therefore been working with this problem, in that an external project is examining core measurements from the formation. The final conclusion of this work is not yet available.

Development plan

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).

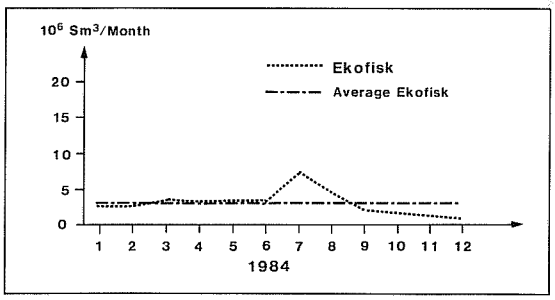
The project will also require there to be implemented a partial modification of existing platforms. These include the installation of a water separator and gas lift equipment on 2/4-B and 2/4-C. Delivery of gas to the latter will take place with the aid of an existing compressor on 2/4-C.

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

Flaring of gas in the Ekofisk area

During Phase I of the Ekofisk development from 1971 to 1974, test production was off-loaded via 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 1984 on the Ekofisk area was an average of 0.10 million Sm^3 per day, and corresponds to 0.3 per cent of the total gas production from the fields. The flare limit has during the whole year remained at 0.40 million Sm^3 per day. The year 1984 has demonstrated that the flare rate is stable and satisfactorily low. The amount of gas flared is shown in Figure 2.3.2.c.

FIG. 2.3.2.c
Gas flared on Ekofisk



Metering system

Inspections of the metering systems on the Ekofisk area have been performed according the the shift arrangement laid down. Inspections of the metering systems at the point of sale of the gas in Emden and of the oil and wet gas in Teesside have been accomplished monthly.

Technical metering procedures in connection with sales of gas in Emden have been discussed with the German authorities. In this connection, two meetings were held between the German authorities and the Norwegian Petroleum Directorate.

Costs

The total costs on the Ekofisk area including Tor, Albuskjell and Norpipe are estimated to amount to about NOK 47.9 billion in current kroner, or NOK 78.2 billion in fixed 1984 kroner. (For conversion, see Valhall).

Safety, preparedness and the working environment

The inspection program during the annual shutdown of Ekofisk has not revealed any serious faults. Some serious corrosion under insulation wadding was noted, and an extensive work program was implemented to check all insulation. In exposed and suspect areas the old insulation was removed and new installed. The main reason for the problem was physical damage to the protective film covering the insulation, plus poorly executed work. These factors had permitted humidity to enter the insulation wadding and cause corrosion.

On the basis of two explosions in the shaft sealing oil system on the gas recompression compressors, a comprehensive examination program was initiated to clarify the causes.

New shaft sealing systems have been requisitioned for installation in 1985. The suction inlet and recircula-

tion pipes have been rebuilt, and the compressors seem now to be functioning satisfactorily.

An extensive maintenance program has been initiated to upgrade the turbines and compressors to receive gas from the Statpipe system.

The system which the operating company has constructed for inspection and follow-up of the safety valve in the production line has shown itself to be highly effective. When problems with the springs were noted, it was possible immediately to state which valves contained valves of the same batch number as the faulty ones, and how long the individual valves had been in place. On the basis of this information, it was then possible to arrange a planned and controlled replacement program.

During the annual shut-down the tying in of the oil line from Ula was accomplished, as well as the gas line from Statpipe on the Ekofisk tank. On Cod 7/11-A preparations were made to tie in the gas line from Ula.

Modifications were also made to the gas flaring system to achieve the extra capacity which the above tying in demands.

During a January storm a huge rogue wave caused major damage to 2/4-A. Walls in the control room were deformed and a hydraulic oil tank was lifted out of position. The safety system functioned well and shut down production.

Towards the end of the year, it was noted that the installations have sunk due to settling of the seabottom. The Norwegian Petroleum Directorate immediately established an inter-disciplinary working group to assess the effects of the subsidence and its possible consequences.

New helideck on 2/4-H

At year's end 1983–84 Phillips Petroleum Company Norway decided to commission helicopters of the type Boeing 234 LR Chinook for two daily flights between Forus and Ekofisk. This meant the replacement of the old helideck on 2/4-H by a new model of the type Safedeck, which was installed in the autumn of 1984. Until the new deck could be taken into use, the old one was given temporary approval following an upgrading of its evacuation routes and fire-fighting equipment.

New accommodation quarters

The work of replacing accommodation quarters on Ekofisk has now been completed. The remaining two of a total of seven installations were equipped with new accommodation modules in 1984, which means that the planned replacement work started in 1981 has now been finalized. The total costs ran to approximately NOK 1,212 million and provide a total capacity of 674 beds. The costs also include the replacement of seven helidecks, of which one is a Safedeck type. The reasons for the replacements are outlined in the Norwegian Petroleum Directorate's Annual Report for 1981.

Clarifying the working environment of catering employees

Following an inspection particularly directed at the working environment situation of catering employees, performed in March 1984, the Norwegian Petroleum Directorate ordered the operating company to "ensure that the necessary clarification of the catering staff's working environment on Ekofisk is performed, to secure sufficient staff capacity to execute the work in a fully sound manner".

Following extensive correspondence and contact activities between the operating company and the Norwegian Petroleum Directorate, the operating company took these questions up for discussion with the catering contractors involved. Additionally, the operating company started preparations for clarification work directed at the working environment conditions which affect catering staff on the Ekofisk field. This work was to include nine installations and cover all the catering contractors involved. The work is expected to be finalized during February 1985.

In this connection the Norwegian Petroleum Directorate has sought to emphasize that the point of departure for the injunction was to secure a sound level of staffing. Further, the Directorate has been at pains to stress that factors which will affect the staff's perceived and actual working strain will be many and complex. This means that not only physically measurable factors such as square meters of floor space, numbers of rooms, ease of keeping rooms clean, technical aids, noise, lighting and ventilation, but equally factors such as the credentials of leaders, service staff and kitchen workers will be crucial. Similarly: management factors, instruction and job security will be of consequence for the quality of the working enviroment.

Preparedness

To seek to obtain an optimalization of preparedness on Ekofisk, Phillips has initiated a major analytical project. The analysis is to encompass individual installations as well as platform constellations and the field as a whole.

Crane accidents on 2/7-B, 2/7-T and 2/7-A

In 1984 there occurred three accidents involving pedestal crane operations on the Ekofisk field.

One of these involved the crane boom falling because the crane had not been shut down in high winds. The accident caused some major damage to both cranes as well as lesser damage to the helideck. The two other accidents involved the uncontrolled falling of the crane cargo due to technical faults in the cranes. No personal injuries resulted from these incidents.

To prevent similar mishaps from reoccuring, the procedure for shutting down cranes in high winds has been made more stringent. Furthermore, technical improvements have been implemented in the inspection and control routines for cranes.

Explosion on Eldfisk 2/7-B
On 18 February there occurred an explosion in a boiler on Eldfisk 2/7-B. The fuel gas for a turbine was misdirected due to a faulty valve into the boiler instrument panel. During start-up of the boiler, this gas mixture became ignited and one person received injuries. Measures have been implemented to prevent similar accidents.

2.3.3. Ula
Production licence 019 A

Licensees:

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 per cent of its previous owner shares to Svenska Petroleum Exploration A/S.

The field lies in Block 7/12 some 70 km northwest of Ekofisk (Figure 2.3.3.a). 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 licenses 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 of recoverable reserves is 30 million Sm^3 oil, 1.3 million tons NGL and 2 billion Sm^3 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. It is planned to drain the field using nine production wells. Pressure support will be available from six injection wells.

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 pipeline was installed on the seabed in the summer of 1984. Its diameter is 508 mm (20 inches) and the length approximately 70 kilometers.

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

FIG. 2.3.3.a
Plànned installations on Ula

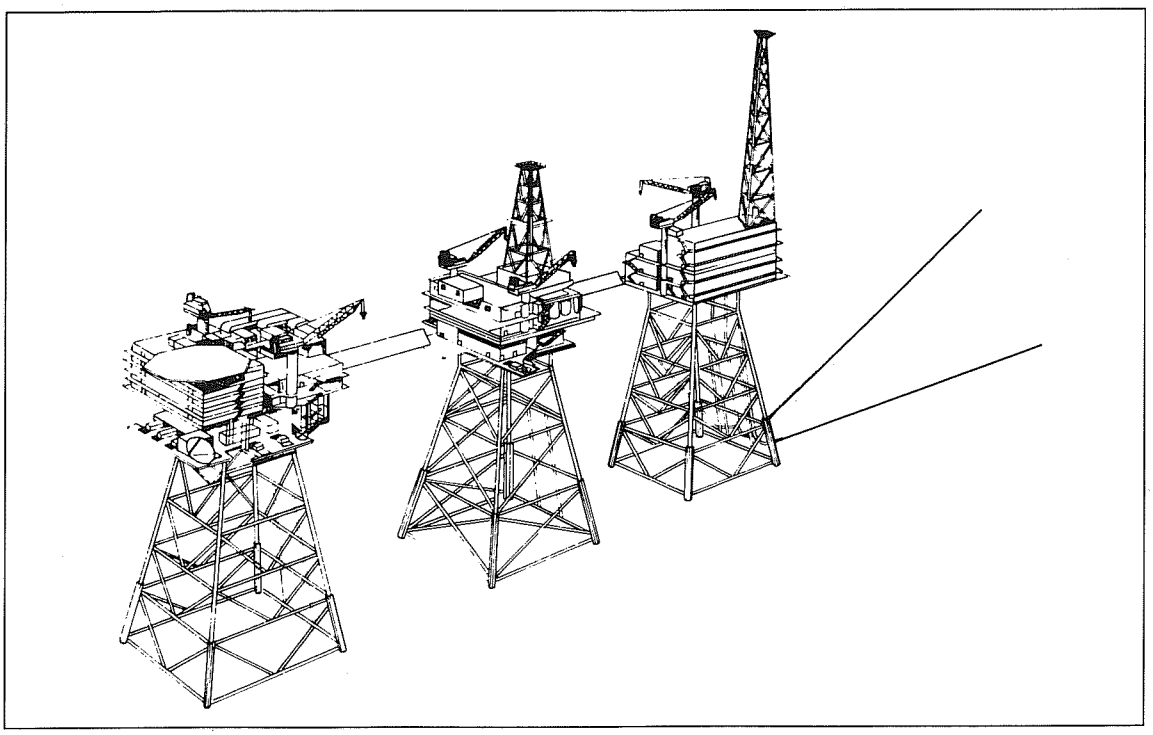
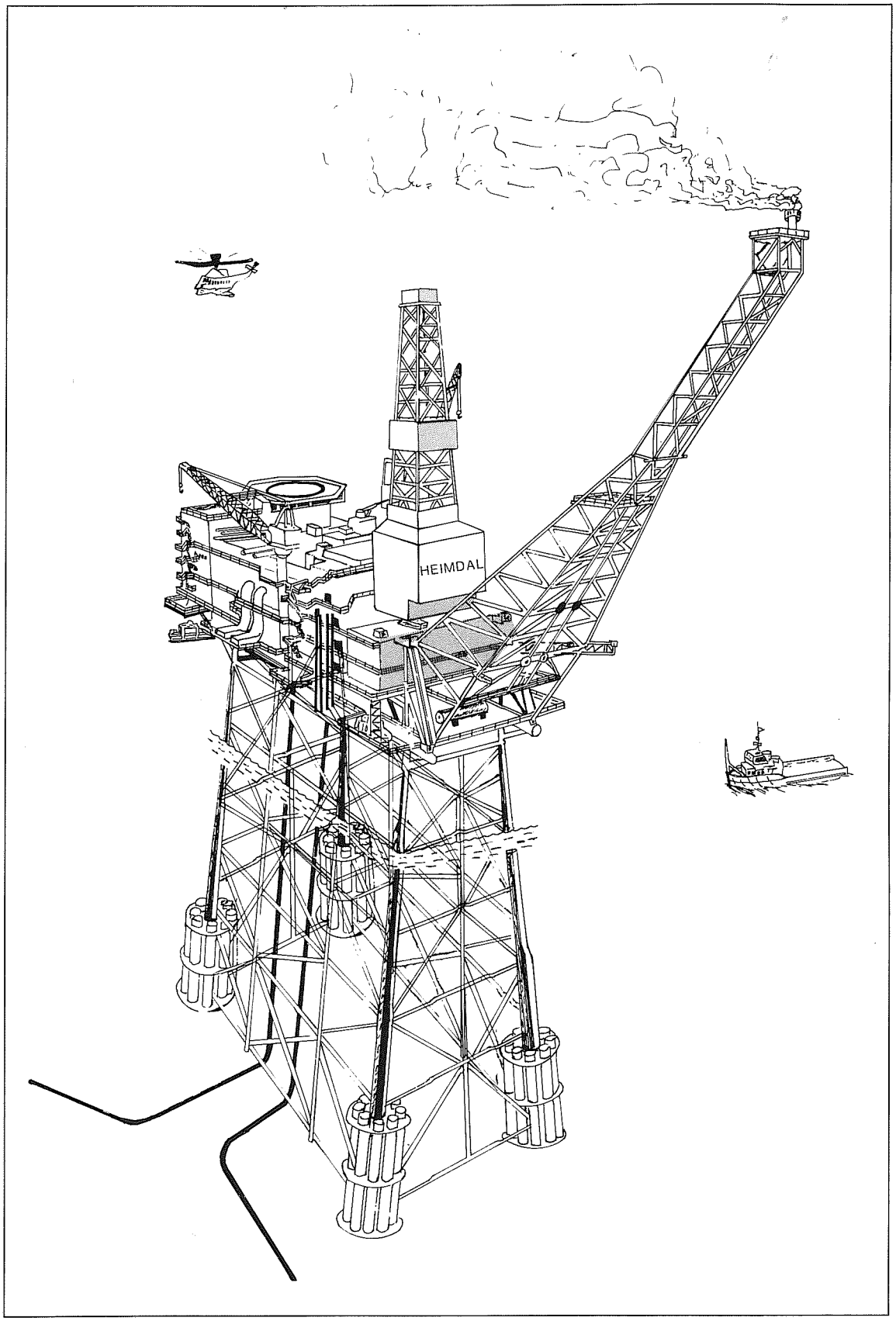


FIG. 2.3.4.a
Installation on Heimdal



pipes were manufactured in the summer of 1984 and coated with rust protection and a gravity collar in the autumn.

Metering system
Tests of the metering system for oil and gas have been performed at the subcontractor's. The metering system for oil and gas is presently under construction by the vendor.

Costs
Total investment costs are expected to be some NOK 8.6 billion (current value), or NOK 7.9 billion in fixed 1984 kroner. (For conversion, see Valhall).

2.3.4 Heimdal
Production licence 036

Licensees:

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 180 km west-northwest of Stavanger (Figure 2.3.4.a). On that part of the licence which includes Heimdal, Statoil 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 market picked up 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. The landing application for condensate was approved in January 1983.

Development
The reservoir lies some 2100 metres below sea level in Paleocenic sand. The total recoverable reserves are estimated at 34 billion Sm^3 gas and 3 million Sm^3 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 started in the summer of 1984, and production is being predicted by the operator to begin in the summer of 1986.

Drilling will start in the spring 1985, after the major part of the offshore hookup and commissioning work has been done.

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
The metering systems for gas and condensate have been put through their final factory tests with the manufacturer. Controls concerning the metering system for condensate were performed with the collaboration of the British Department of Energy.

Costs
The total costs of the development are estimated to amount to about NOK 8.7 billion (current value), or NOK 9.2 billion in fixed 1984 kroner. (For conversion, see Valhall).

Safety, preparedness and the working environment
Loadbearing structures
In connection with the welding of field welds during the installation of the Heimdal platform, the subsequent welding inspection was vetoed because of the operator's lack of control over the subcontractor. This circumstance has been corrected, however.

Vibrations have been observed in the flare stack structure which are reducing its fatigue fracture lifetime substantially. Measures to improve this circumstance have been initiated.

Cranes
After the pedestal cranes had been in use for some three months, the operator decided to shut them down. The decision was taken due to technical problems which had arisen during operation of the cranes. The Norwegian Petroleum Directorate's provisional permit to use the cranes was withdrawn until such time as the operator's report or recommendation for renewal of the operating permit was available.

2.3.5 The Frigg area (Frigg, North East Frigg, Odin, East Frigg)
2.3.5.1 Frigg
Licensees:

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 %

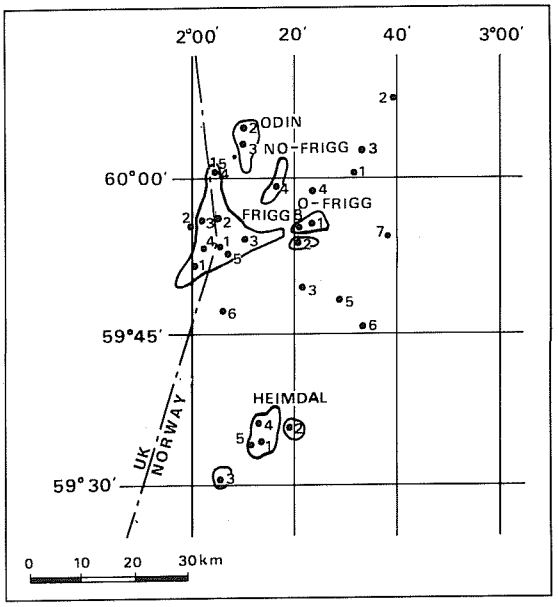
Elf Aquitaine Norge A/S is the operator for the Frigg field, while Total Oil Marine Ltd is the operator for the pipeline system and St Fergus terminal in Scotland.

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 licensees, and the remaining 39.18 per cent to the British licensees. 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 communicate with 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.

FIG. 2.3.5.a
The Frigg area



Phase 2 consisted of one production and one treatment platform on the Norwegian side (DP2 and TCP2). Production from the Phase 2 platforms began in summer 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 Booster 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 advance delivery from the Frigg field.

Recovery of reserves

The gas-liquid contact on the Frigg field is checked several times a year.

Thermal Decay Time (TDT) logging of Observation Well 25/1-A22 in March 1984 indicated that water had risen by 7.7 meters, while the gas-oil contact remained hidden by shale and tight layers of unknown lateral extent.

To be able to measure the contact levels under the platform in the southern part of the field, Production Well 10/1-A12 on the UK side was reassigned in the summer of 1984 to become an observation well with the designation 10/1-A25. The deepening of this well showed that the water level had risen approximately 55 meters since production start, a factor which may indicate earlier water penetration than previously predicted.

To improve the determinations of pressure, contact levels and geology, Well 10/1–5 is now being drilled below the southwestern part of the DP2 platform.

Various possiblilities seem now to exist regarding the geology at the barrier between the water zones, as also for the size and location of a "permeability window" in the barrier zone.

The pressures in both Frigg and Cod sand are in good accord with the operator's provisional updates of the reservoir model.

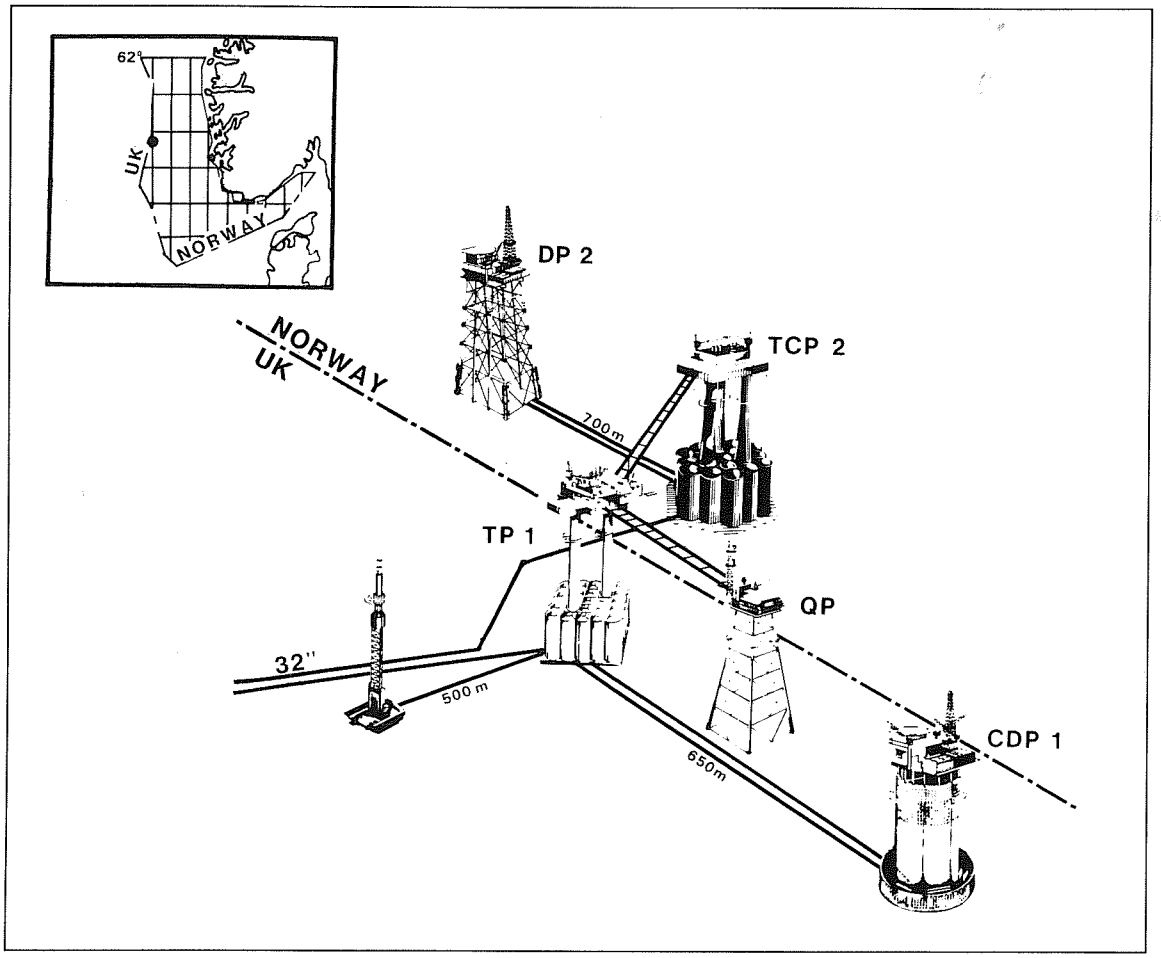
Metering system – Frigg

Inspections of the metering systems on Frigg, MCP-01 and St Fergus were performed regularly in collaboration with the British Department of Energy. The Department of Energy also inspects the Norwegian fields of Northeast Frigg and Odin, as the sum of these fields' production has to be subtracted from the total measured amount flowing into the pipeline to St Fergus. This is done to determine the contribution by the Frigg field.

Metering system – Alwyn

The Frigg Commission has approved the installation of a metering system for gas on the Alwyn field on the

FIG. 2.3.5.b
Installations on Frigg



UK side. The Alwyn gas will be conducted to St Fergus via the Frigg field. Approval has been given on the assumption that the Norwegian Petroleum Directorate's regulations regarding fiscal quantity metering of gas are complied with, and that the Directorate is allowed full access to the Alwyn field installations. Inspection of the design of the metering system has already been initiated in collaboration with the British Department of Energy.

Costs

The total costs for the development of Frigg are predicted to amount to about NOK 22.1 billion in current kroner, or 43.2 billion fixed 1984 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 13.9 billion in current kroner, or 25.9 billion fixed 1984 kroner. (For conversion, see Valhall).

Safety, perparedness and the working environment

Condensate level regulation tank

This year too the condensate surge tank CV3 was opened for inspection. The inspection only revealed minor faults, which can be traced back to manufacturing errors. Improvements have been performed and the tank again brought into service.

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 an assessment of existing flare systems. The results of this uncovered, apart from anything else, 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 was suggested on safety grounds that the traditional safety valves be replaced with advanced, computer-based instrumentation systems. During 1984 the Norwegian Petroleum

Directorate gave its permission for such computerized instrumentation systems to be installed. Following a test period an evaluation will be made as to whether the reliability of these systems can be expected to be so great that the safety valves can be retired from service.

Preparedness
Crack formation was discovered in a welding joint on the drum of the lifeboat winches on DP2. Metallurgical analysis of the crack formation concluded that the crack had formed in the heat affected zone (HAZ) of the weld. Similar crack formation was also discovered on TCP2 and FCS on North East Frigg. This led to all winch drums on the field being replaced.

Cranes
The operator decided to terminate the use of the mobile crane for internal hoisting operations on TCP2. The crane will be replaced by a pedestal crane.

Near miss
The failure of the bolts on a valve due to fatigue corrosion caused a gas leak to occur with subsequent shutdown. Valves from this manufacturer had not been classified for this application, and all valves of this type have been temporarily reinforced and will be replaced. The event has been notified to all operators on the Norwegian Continental Shelf.

Compressor installation
Vibration problems have occurred on the compressor installation on TCP2. The problems turned out upon closer examination to be caused by loose parts from the inlet receiver. Following shutdown and minor repairs and modifications, the installation is again operational.

Glycol regenerator
The facilities on TCP2 include three glycol regeneration units. All three have been plagued by substantial operating problems. The causes have been cracks due, among other causes, to fatigue corrosion. The equipment has been repaired several times and will be refurbished using new internals in the near future.

Drilling rig on DP2
The drilling rig on DP2 will be upgraded during the spring of 1985 in preparation for spudding an exploration well.

Radiation accident involving isotopes
In connection with the improvement of a fire line to the helideck on DP2, radiographs were taken of the welding seams using a 1.8 Curie source. The area was assumed to have been fenced off in the regulation manner (warning lights, signs, etc). It turned out however that there was an office within the exposure area with two people inside. The distance from the source to the office was eight meters. Exposure time was five minutes. To calculate the radiation dose received by the two office workers, a new shot was taken. Exposure outside the door was measured to be 1 – 1.5 mR per hour, whilst inside the office the figure was 0.8 mR per hour. The radiation dose thus did not represent any serious health risk for the personnel involved.

The operating company was ordered to undertake an audit of the existing procedures to prevent a similar accident from reoccuring.

2.3.5.2 North East Frigg

Production licence 024 (Block 25/1)

Licensees:

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)

Licensees:

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 (Figure 2.3.5.a), and a redistribution of the gas reserves in August 1984 assigned 48 and 58 per cent respectively to 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 (Figure 2.3.5.c). 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 is 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 is remotely controlled from the Frigg field.

Sales of gas from North East Frigg initiated on 1 October 1981, which was 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 brief.

Production started on 8 December 1983 from three wells. During the one month shutdown the three last wells were overhauled (May-June 1984). All six wells entered production at the end of July following one and a half months of start-up phase, when three wells were producing.

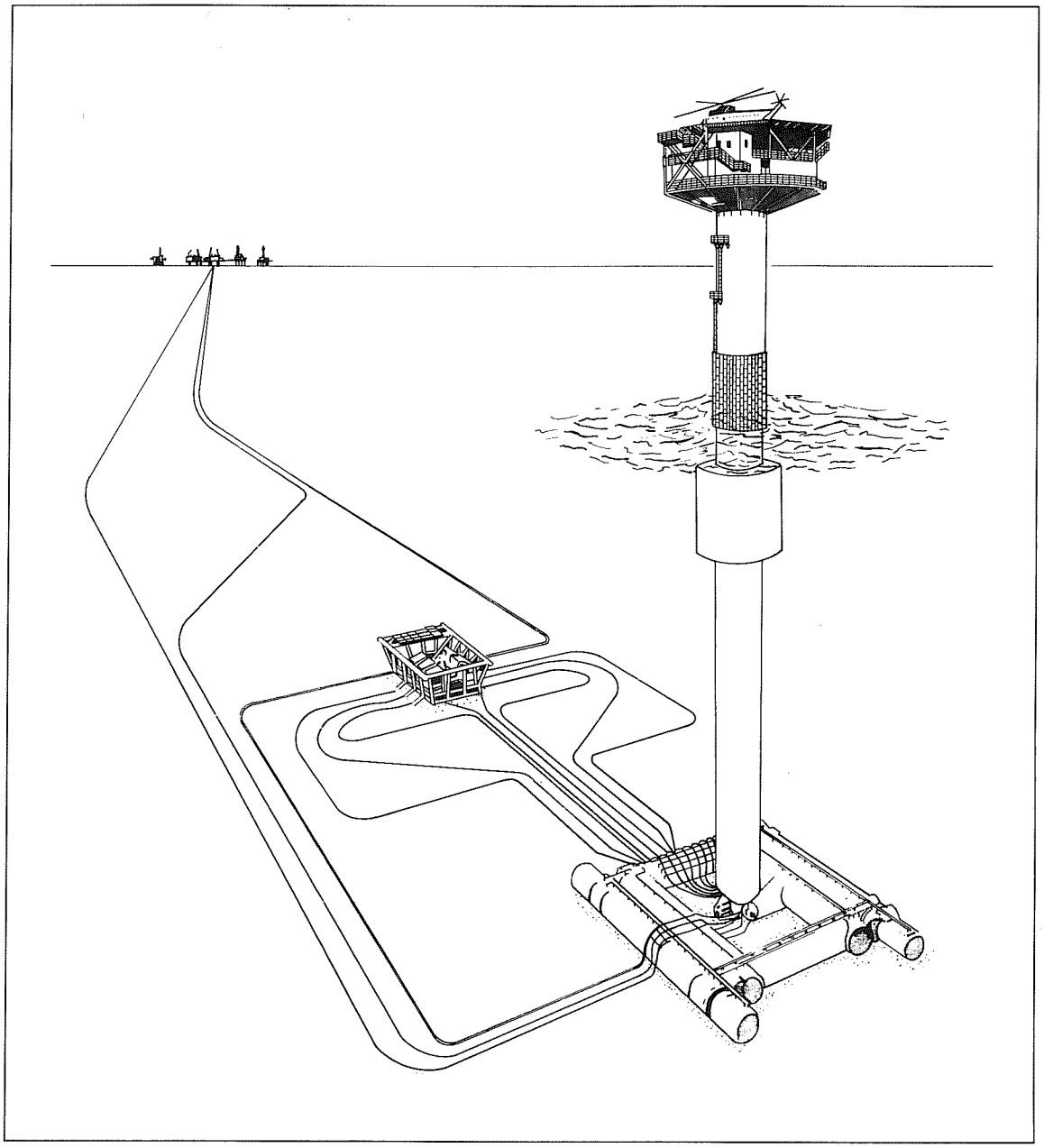
Recovery of reserves

New seismic data caused the licensees to upgrade the top of the reservoir in the northern part of the field. This provided an increase in the total reserves, and a larger part of the reserves were assigned to production licence 030. Recoverable reserves estimates are nevertheless more or less the same as before due to a change in the recovery factor. Pressure measurements performed before production start showed that the reservoir pressure was sinking as a result of communication with the Frigg field through the saddle which lies between the fields.

Metering systems

Regular inspections of the North East Frigg metering system, which is installed on Frigg proper, were perfor-

FIG. 2.3.5.c
Installations on NE-Frigg



med in collaboration with the British Department of Energy.

Costs
The total costs are expected to reach some NOK 2.0 billion in current kroner, or 2.2 billion in fixed 1984 kroner. (For conversion, see Valhall).

Safety, preparedness 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 significance. Packing surfaces for the hook-up of a christmas tree which had been damaged were repaired under water with the help of a newly developed technique.

2.3.5.3 Odin
Production licence 030

Licensee:
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 (Figure 2.3.5.c), 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 jacket platform with four legs and integral deck, plus the semi-submersible Norwegian registered rig Treasure Hunter, Figure 2.3.5.d.

The Treasure Hunter is acting as a Tender Support Vessel (TSV) during the construction and drilling phase. The TSV performs integrated parts of the drilling, accommodation, workshop and warehousing functions of the Odin field, and is connected to Odin by means of a permanent gangway bridge.

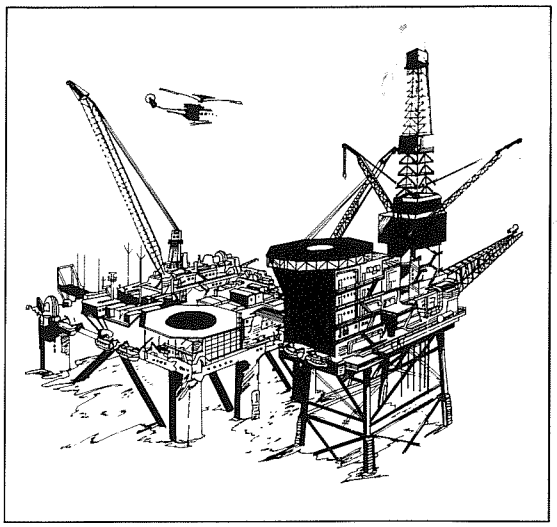
All modules for the platform were completely constructed before the summer of 1982, and the steel jacket was positioned on the field on 4 July of the same year. Hook-up work ran ahead of schedule, such that the platform was completely hooked up as early as 1983. Production drilling commenced in December 1983 with production start in April 1984 from two wells.

Full production from seven wells started on 1 October 1984. The field is to be developed with eleven production wells, with simultaneous drilling and production (SD&P) continuing until the spring 1985.

The production platform is only partially equipped with treatment plant, as the gas will be despatched unprocessed to the Frigg field through a 508 mm line. This pipeline had been laid and tied in to the TCP2 platform on Frigg and the Odin platform by August 1983.

On 1 October, advance sales of gas to the British

FIG. 2.3.5 d
Installations on Odin



Gas Corporation were initiated, in other words, gas from Frigg was sold as if it had been produced on Odin. The "reimbursment" is now taking place insofar as Odin is supplying gas on behalf of Frigg, in addition to Odin's own contract amount.

Recovery of reserves
The reserves estimate for Odin has now been increased due to the new map survey of the field, and the operator believes there will be more gas for sale than the contracted amount. The sale of superfluous reserves will depend on a satisfactory agreement being reached with the Frigg Norwegian Association (FNA) group regarding transportation and treatment services. Pressure measurements prior to production start show that the reservoir pressure has fallen off as a result of communication with the Frigg field through the saddle which separates Odin from Frigg.

Metering system
Regular inspections of the Odin metering systems, which are installed on Frigg, have been performed in collaboration with the British Department of Energy.

Costs
The total costs of development are expected to be some NOK 2.75 billion (current value), or, in fixed-1984 values, some NOK 2.73 billion. (For conversion, see Valhall).

Safety, preparedness and the working environment
The hook-up work on the Odin installations was completed earlier than planned, and permission to start operation was given on 28 February 1984 when the installation was ready for production.

Operation of the field has in the first year proceeded without major difficulty. Some underwater pile guides

were removed because insufficient attention had been paid during the engineering phase to their cathodic protection.

2.3.5.4 East Frigg
Production licence 024 (Block 25/1)

Licensees:

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 026 (Block 25/2)

Licensees:
As for production licence 024.

Previously relinquished part of production licence 026 (Block 25/2)

Licensees:

Elf Aquitaine Norge A/S	21.80 %
Norsk Hydro A/S	17.30 %
Total Marine Norsk A/S	10.90 %
Den norske stats oljeselskap a.s	50.00 %

The previously relinquished part constitutes 7 per cent of the East Frigg field, and the total allocations are therefore as follows:

East Frigg as a whole
Licensees:

Elf Aquitaine Norge A/S	40.0466 %
Norsk Hydro A/S	31.7801 %
Total Marine Norsk A/S	20.0233 %
Den norske stats oljeselskap a.s	8.1500 %

A part of Block 25/2 which was relinquished in 1975 and 1978 seems to contain a small fraction of the Frigg reserves. This part has now again been allocated to the licensees, though with a different distribution.

Production facilities
East Frigg consists of two main structures, previously designated East Frigg and South East Frigg, now called East Frigg Alpha and East Frigg Beta respectively. They are a part of the same pressure system as the Frigg field proper, and the gas will be sold to the British Gas Corporation within the existing sales agreement.

The East Frigg Alpha field was discovered in 1973 and the Beta field in 1974. Both fields extend into Blocks 25/1 and 25/2, besides extending a small distance into the previously relinquished areas.

The field was declared commercial in August 1984 and the landing application was dealt with by the Storting on 14 December 1984. The development plan is expected to be ready during April 1985, and the construction phase is scheduled to start on 1 May 1985. According to plan, production will start in October 1988, though advance sales of gas will probably be made over a two year period. Recoverable gas reserves are estimated to be 9.3 billion Sm^3 on East Frigg Alpha and 3.2 billion Sm^3 on East Frigg Beta, in all 12.5 billion Sm^3.

The sales agreement involves a production period of approximately 13 years, though the operator believes it may be possible to shorten this to five years. The development will be based on subsea technology.

Provisionally, plans include three identical subsea production systems to be remotely controlled from Frigg, two of them on Alpha and the other on Beta. A central manifold will tie the two system subgroups together, from whence the gas will be transported by pipeline to TCP2. Here the gas will be processed and tied into the Frigg field's transportation system.

Metering system
The Norwegian Petroleum Directorate has been informed orally about the plans for installation of a metering system for East Frigg.

2.3.6. Gullfaks
Production licence 050

Licensees:

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 exploration phase. Conoco has been engaged as technical assistant for the development phase.

Production facilities
The first discovery 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.a). Platform A will be an integrated drilling, treatment and accommodation platform with a capacity of about 39,000 Sm^3 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 of concrete construction with a T-shaped deck frame of steel.

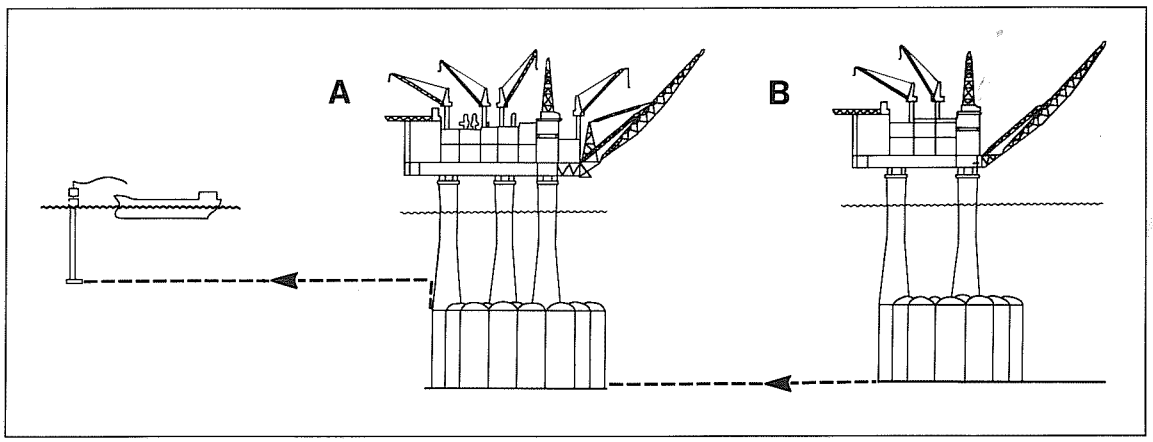
Platform B will be a drilling, accommodation and water injection structure with a concrete base, equipped with some process machinery. The B platform will be sited on the northwest part of the Delta East structure where the water is also about 135 metres deep.

Oil from the field will be off-loaded via field loading buoys to tankships.

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

FIG. 2.3.6
Planned installations on Gullfaks phase 1



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 fairly consistently to the west. In the east, the field has a more uncertain 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 is probably too low. Until new figures become available, Statoil's claims of 135 million Sm^3 oil, 8 billion Sm^3 gas and 1 million tons NGL will be used.

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 discovery in Triassic strata. The reservoir rocks are rather similar to Statfjord and Murchison, which is to say 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. Gas injection has also been evaluated as a method of recovery. 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, and the systems have been despatched from the manufacturer.

Costs

The total costs for development are expected to run to about NOK 38.4 billion in current kroner, or approximately NOK 28 billion in fixed 1984 prices. (For conversion, see Valhall). Consideration has not been given to the consequences which would follow as a result of a tie-in to any new oil transport pipeline system.

Safety, preparedness and the working environment

To undertake safety control of the deck installations on Gullfaks A, an internal project group was appointed in the Norwegian Petroleum Directorate. The group's main efforts have been focused on quality assurance in accordance with the Norwegian Standard NS 5801, which Statoil has implemented for 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 work on Gullfaks A has mainly consisted in 1984 of following up the building works. It has proven to be more time-consuming than anticipated to build up and implement a quality assurance system. An implementation time of 2–5 years has been intimated.

As the first oil field on the Norwegian Continental Shelf, Gullfaks A will be tied in to five subsea production wells. This is a project which requires a good deal of development work, the object of which is to operate and maintain the subsea systems without the assistance

of divers. An integration test lasting one year is planned to test the system and make personnel familiar with the operations to be performed.

The hydrocarbon transportation lines will be drawn through J-shaped conductors into the Gullfaks A platform. As the production wells will remain outside the safety zone of the installation, fishery activities will take place in the area. Statoil has therefore decided to construct a shroud over the production wells to protect them from fishing gear.

The Gullfaks A concrete base was towed from dock in May 1984 and the storage cells are presently being completed in Gandsfjord near Stavanger. The erection of the shafts will start early in 1985.

Statoil has laid a 22 kilometer long 14 inch gas pipeline between Gullfaks A and Statfjord C, in addition to a 36 inch oil line between Gullfaks A and the loading buoy. Due to the potential danger of the gas line being damaged by trawling gear, the gas line has been laid in a trench.

The Gullfaks B installation is of the Condeep type with a concrete gravity base consisting of 19 cells and three shafts. The steel deck frame is shaped like a letter T and will weigh 23,000 tons during the tow out operation.

The Gullfaks B deck consists of six modules additional to the drilling derrick and accommodation quarters with helideck. The installation is designed to drill the production wells and process the oil and gas in a single-stage separator system.

Partially stabilized crude oil is then transferred to the A platform via a 20 inch pipeline before being finally subject to dehydration and full stabilization. The gas which separates out in the one-stage separator on Gullfaks B will be dried before leaving the installation via an eight inch line tied to the compressor system for export gas on Gullfaks A.

Injection water will be transferred from Gullfaks A following full treatment, through a 20 inch pipeline under full injection pressure.

The B installation will receive electrical main power from the A platform via a sea cable. The necessary emergency power, however, will be installed on Gullfaks B itself.

The majority of the building contracts will have been signed by the first half 1985.

2.3.7 The Statfjord field

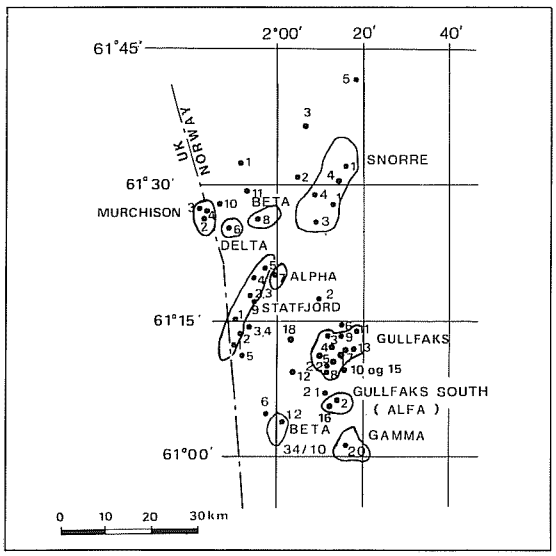
Production licence 037.

Licensees:

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 licensees on the Statfjord field were allocated production licence 037. This includes Blocks 33/9 and 33/12 (Figure 2.3.7.a). Mobil is the operator until the period from 1 January 1987 to 1 January 1989, during which Statoil will take over operatorship.

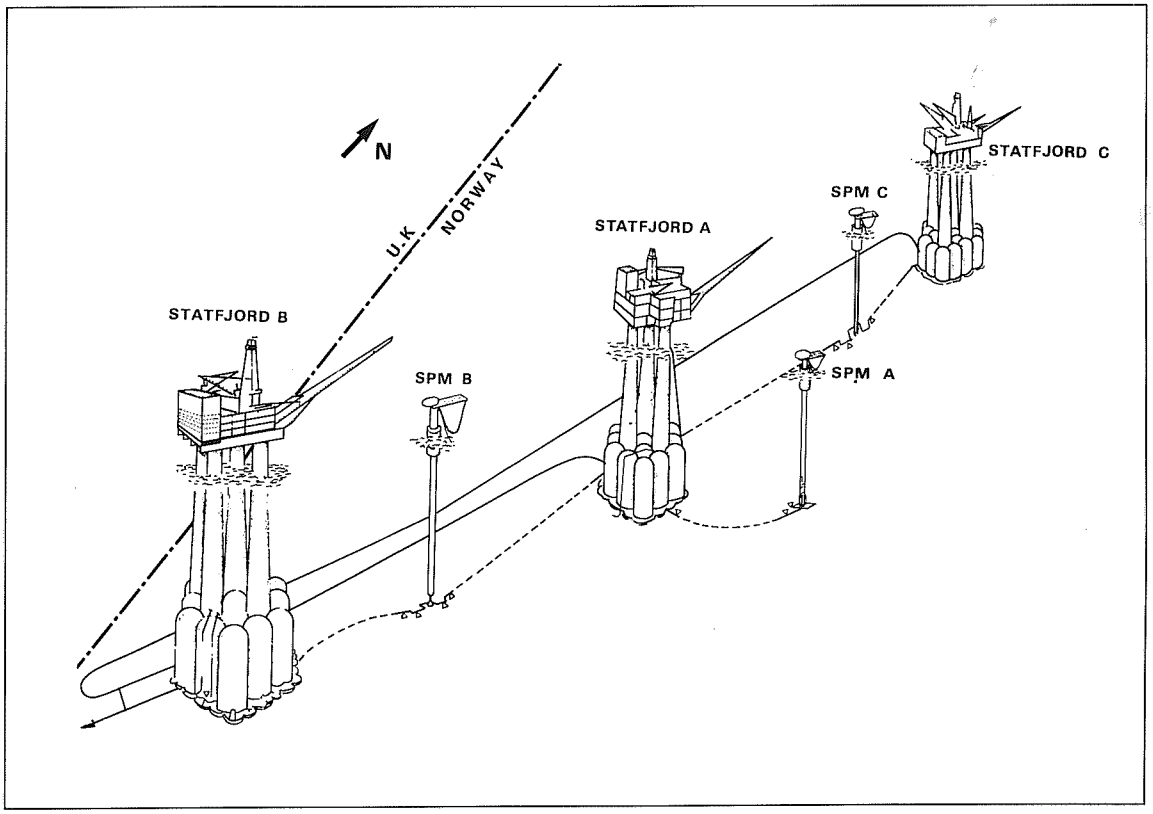
FIG. 2.3.7.a
The Gullfaks, Statfjord and Snorre area



The Statfjord field itself was discovered in the spring of 1974, and declared commercial the same year. Statfjord extends onto 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.

By injecting water into the Brent reservoir and gas into the Statfjord reservoir, the Norwegian Petroleum Directorate expects to attain a recovery factor of some 50 per cent. This means that the total recoverable amounts of oil are 333.8 million Sm^3, including the

FIG. 2.3.7.b
Installations on the Statfjord field



British share. The amount of recoverable associated gas has been estimated at 48.8 billion Sm^3 dry gas, and 12.5 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 license 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 new assumed production capacity is 50,900 Sm^3 per day. This capacity has been the subject of upgrading during the latter half of 1984 due to fine tuning of the process equipment. This fine tuning has enabled the platform to process larger quantities of petroleum. The average capacity utilization of the process equipment during the autumn of 1984 was very high, about 90 per cent. The platform started production on 24 November 1979 and, according to the operator's latest drilling program, will have 21 production and 15 injection wells.

Statfjord B

Statfjord B, sited in the southern part of the field, consists of four columns and 24 cells, all of concrete. Its production capacity has also increased due to fine tuning of the process trains. The new maximum capacity is rated at 36.600 Sm^3 per day. Production started on 5 November 1982, and capacity is now being almost fully exploited. The reliability of production on the B platform in the autumn of 1984 was also very great, being about 90 per cent.

The drilling program, which consists in all of 31 wells, will comprise 21 for oil production and 10 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 have 42 well openings, and will make it possible to tie in nine sea-bottom completion wells.

Statfjord C was towed out to the field in June 1984. In December the drilling of the production wells was

initiated. This occurred two months before schedule. Production start will probably be brought forward from December 1985 to August 1985.

Recovery of reserves

The gas injection installations on both the A and B platforms have settled into normal operations. During 1983, 89 per cent of the gas produced has been put back into the Statfjord reservoir.

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

The injection of water into the Brent formation started in 1982 on the A platform and in 1984 on the B platform.

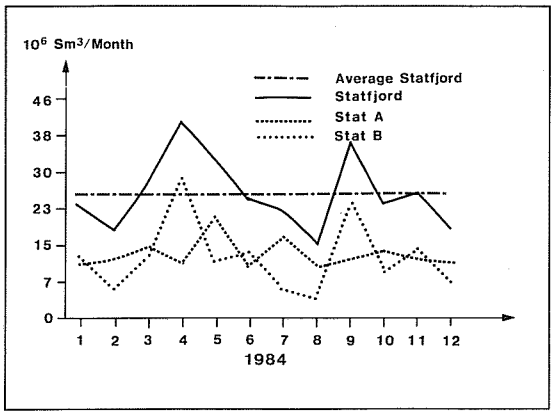
Water is being produced from several wells on the Statfjord field. During 1984, however, water production from several wells has been greatly reduced. This is because the wells now produce higher up in the reservoir. At the same time, water penetrations in other wells have been registered. So far, water production has not led to limitations in oil production on the field.

Gas flaring in the Statfjord area

The amount of gas flared on Statfjord A in 1984 was some 0.30 million Sm^3 per day on average, corresponding to 3.7 per cent of the total gas production from the platform (Figure 2.3.7). Statfjord A has entered a stable operative phase, such that the amount of gas flared is well below the flaring permit of 0.50 million Sm^3 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, 0.29 million Sm^3 per day, which corresponds to 5.3 per cent of the total gas production, was flared on average. Statfjord B is also considered to be in a stable operating phase. Gas flared remained well under the flaring limit of 0.5 million Sm^3 per day. Compressor troubles have been the main reason for flaring.

FIG. 2.3.7.c
Gas flared in the Statfjord area



Metering system

The metering system for oil produced by Statfjord A and B has been inspected monthly. Further control and testing of the metering system for Statfjord C still remains. This will take place when the platform starts producing in the autumn of 1985.

The metering system for gas from Statfjord A, B and C, together with the gas meter system to be delivered to Great Britain, has been put through its final tests with the manufacturer.

Controls and inspection have been 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 54.7 billion (fixed 1984 kroner). The Norwegian share of this is NOK 41.2 billion, or NOK 46.0 billion, respectively. (For conversion, see Valhall).

Safety, preparedness and the working environment

Underwater work

To be able to deliver Statfjord gas to the Statpipe system in the spring of 1985, Mobil Exploration Norway Inc has carried out extensive underwater work on the Statfjord field during 1984. Having laid the necessary pipelines in 1983, work has been done during the report period to weld together subsea pipeline joints, install a protective shield over the valves, and entrench some parts of the lines.

The object of installing emergency shutdown valves is that, in the case of any break in a gas line close to an installation, these ESD valves will protect the installation from damage.

Protective shields over the valves have been installed to enable fishing vessels to trawl over them and protect the valves from fishery activities in general. The trenching of parts of the pipelines is designed to protect the lines from anchor chains.

The British gas on the Statfjord field will be transported to the British gas pipeline system. Conoco, the operator, has therefore constructed and laid a 12 inch pipeline from the Statfjord field to the Northern Leg Gas Pipeline.

Statfjord A loading buoy

Due to defects in the main buoyancy tank coupled with abnormally large movement in the universal articulation joint for the Statfjord A loading platform, Mobil Exploration Norway Inc decided to tow the platform inshore for repairs and modification. The loading buoy will be reinstalled on the field by the end of May 1985.

Deck-to-shaft connection

Crack indications have been discovered in the transitional rings between the deck and the shafts on both

Statfjord A and Statfjord B. Similarly cracks in the concrete structure have been discovered in some of these areas on Statfjord A.

Preparedness
At the same time as the Statfjord field platform concepts were approved by the Norwegian Petroleum Directorate, the operator was given an injunction to develop a satisfactory arrangement for evacuation. Pursuant to the injunction, Mobil Exploration Norway Inc has been working to upgrade the evacuation system.

Upon review of the likely evacuation concepts, Mobil Exploration Norway Inc has implemented the develpment of a gondola system for dry evacuation from the platform to a standby vessel. A prototype is being built and will be tested on the field in the spring of 1985.

In order, apart from anything else, to prepare for and rationalize the receipt of evacuation units, as well as to upgrade and reinforce preparedness on the field, the operator has chartered two new multifunction vessels. The first MFV will probably become operational during May 1985.

On the Statfjord field a dedicated rescue helicopter is also stationed.

Accommodation quarters
In 1984 mobile living quarters units were connected to all three production installations on Statfjord. The living standard has been improved by Statfjord A being assigned the purpose-built accommodation rig "Polycrown". At Statfjord B, the "Safe Gothia" has been replaced by the recertified and upgraded "Polymariner". Furthermore, Statfjord C has been connected to the new mobile accommodation rig "Kosmos".

Gas transport, the Statpipe system
The gas transportation pipeline company Statpipe was formed with the following licensees:

Licensees:

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
- dry gas lines from Heimdal and Kårstø to a riser platform in Block 16/11, and a pipeline to the marine 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, except that during Easter 1984 the work stopped for one week. This delay was caused by a first world war minefield. Some clearance and detonation work was needed before pipelaying could continue. The pipeline works were completed in the early summer of 1984.

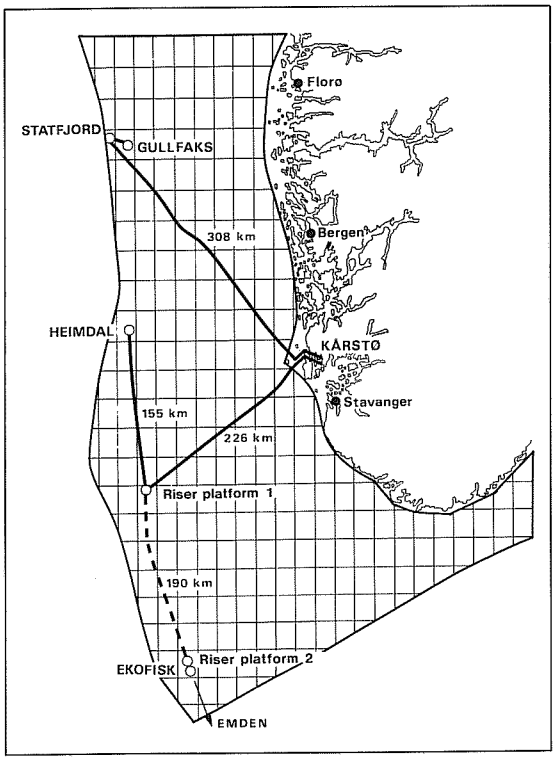
The deck frames and equipment modules were installed on the marine riser platforms in 1984. The living quarters on 16/11-S were brought into use in December.

The total progress of the project was on schedule at year-end. Emptying and drying of the pipelines will start in March 1985. The system will gradually become operational during 1985. From 1 January 1986, the gas sales agreement begins to run, with gas sales to the continent.

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

The transport capacity from Statfjord to Kårstø is 9 billion Sm^3 gas annually, and from Kårstø to the marine riser platform south of Heimdal, some 7 billion Sm^3 per year. The pipelines between Heimdal and the riser platform, and between the two riser platforms, have been designed to transport maximum 14 and 20 billion Sm^3 per year, respectively. This exceeds the capacity requirement for Statfjord, Gullfaks and Heim-

FIG. 2.3.7.d
The Statpipe transport system



dal, 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 blanket 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 licensees on Statfjord, Heimdal and Gullfaks have also entered into sales agreements for the gas with buyers on the continent.

2.3.7.1 Statpipe/Kårstø

Metering system

Design checks on the metering system for gas and condensate at Kårstø have begun. The metering system for gas has been delivered to Kårstø. The LPG metering system has been delayed due to technical difficulties with fabrication of the pipe gauging jigs.

Costs

The transport system is scheduled to be ready for operation in the autumn of 1985. Sales gas shall be despatched to Emden from 1 January 1986. Total investment costs, including the terminal installations, are estimated to reach some NOK 17.0 billion at current kroner value.

2.3.8 Murchison

Licensees:

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 licensees 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 (Figure 2.3.8.a). Development of the Murchison field was started in 1976 by the British licensees. The 037 group declared the field commercial in the summer of 1977, and Statoil acceded to the declaration in the summer of 1978.

New re-distribution negotiations have now been started. These are scheduled for completion by summer or autumn 1985. It is not expected that they will involve great modifications to the Norwegian holding. Reimbursement from the last re-negotiations will be completed by April 1985 for oil, the gas being reimbursed by May 1984. The recoverable reserves for the whole field are estimated to be 53 million Sm^3 oil and 2 billion Sm^3 gas.

Production facilities

The field has been developed with an integral steel platform with a production capacity of 26,200 Sm^3 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 Sm^3 per day.

The drilling program consists of a total of 27 wells. To date, 26 wells have been completed as follows: 13 oil production wells, two satellite production wells, nine water injection wells and two gas injection wells.

Recovery of reserves

Well drilling proceeded very quickly on Murchison. The field has therefore been producing at almost maximum treatment capacity since 1981. 1984 was the last year of plateau production, and water production has risen to 17 per cent. As a result of this, the water injection capacity has been increased to 25,500 Sm^3 per day. Further increases are planned.

The Government consented by King's Resolution of 24 September 1982 to land the Norwegian Murchison gas via NLGP, the 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 entered 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 14.2 billion (fixed 1984 kroner). The Norwegian share of this is respectively NOK 2.2 and 3.6 billion. (For conversion, see Valhall).

Flaring of gas

An average of 12.2 per cent of the total gas production was flared in 1984, or 0.21 million Sm^3 per day. The regularity of the gas system lay at about 86.8 per cent, which was mostly because of problems with the gas injection compressors. (Figure 2.3.8.b).

2.3.9 Oseberg

The Oseberg field stretches into two production licences, Licence 053 on Block 30/6 which was allocated in

FIG. 2.3.8.a
Installation on Murchison

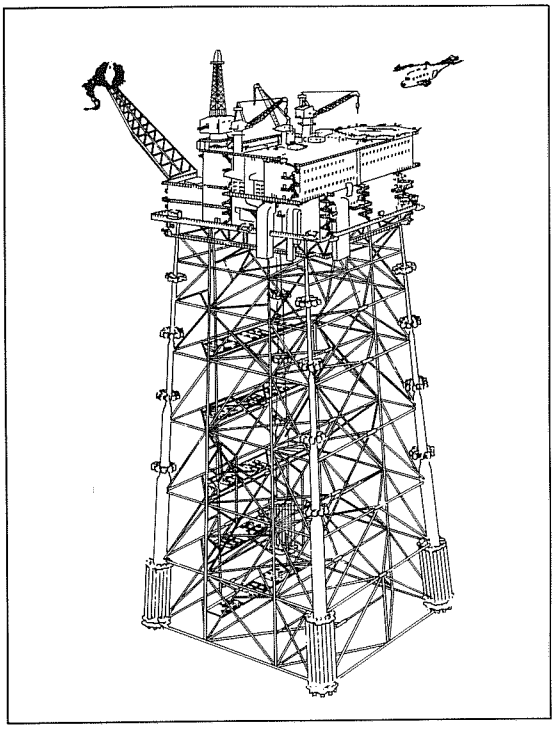


FIG. 2.3.8.b
Gas flared on Murchison

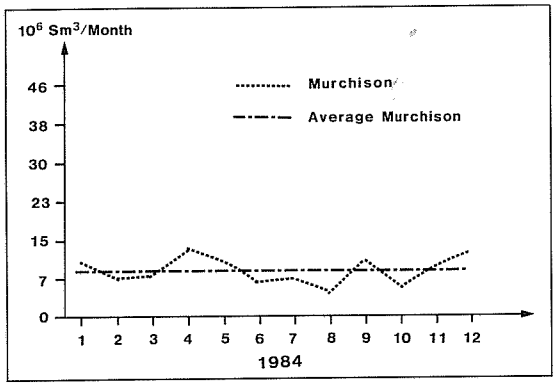
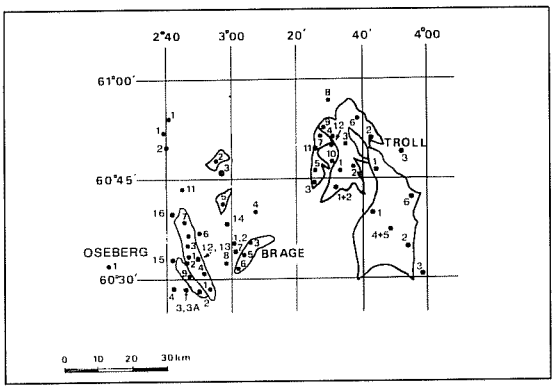


FIG. 2.3.9
The Oseberg and Troll area



1979, and Licence 079 on Block 30/9 which was allocated in 1982 (Figure 2.3.9).

Production licence 053

Licensees:

Statoil	50.00 %
Elf Aquitaine Norge	13.33 %
Total Marine Norge	6.67 %
Norsk Hydro Produksjon A/S	12.50 %
Mobil Exploration Norway	10.00 %
Saga Petroleum A/S	7.50 %

Statoil was operator from the start, though the operatorship was transferred to Norsk Hydro in April 1982. Elf Aquitaine Norway is the technical assistant.

Production licence 079

Licensees:

Statoil	73.50 %
Norsk Hydro Produksjon A/S	16.00 %
Saga Petroleum A/S	10.50 %

Norsk Hydro is the operator with Elf Aquitaine Norway as the technical assistant.

Ownership distribution using sliding scale
The concessionaires have assumed an interim distribution of the reserves on the Oseberg field which stipulates 60 per cent in Block 30/6 and 40 per cent in Block 30/9. Statoil's share has now been increased to 63.24 per cent on Oseberg following application of the sliding scale with respect to the foreign participants. Ownership statistics of the Oseberg field now stand as follows:

Licensees:

Statoil	63.24 %
Elf Aquitaine Norge	6.40 %
Total Marine Norge	3.20 %
Mobil Exploration Norway	4.80 %
Norsk Hydro Produksjon A/S	13.75 %
Saga Petroleum A/S	8.61 %

Field history
The initial discovery was made in 1979 and proved gas. Subsequent discoveries have shown that the reservoir is an oil bearing layer topped by a gas cap. The declaration of commerciality was presented in June 1983. The Norwegian Storting dealt with the development application in its spring session 1984.

Development concept
The field shall be developed stepwise using three platforms. Two of these, a drilling and a process platform of concrete, and a drilling and injection platform of steel, constitute the field center and will be situated in the south of the field. This field center has capacity enough to process the production from the whole field. The third platform is a satellite housing equipment for limited processing which shall be situated in the northern part of the field. The middle area is to be developed with the aid of subsea completion wells.

The field center shall be ready for production by the spring of 1989.

Transportation systems
A transportation line will be constructed for stabilized oil from Oseberg to a terminal at Sture in Øygarden. The pipeline is planned to have a capacity making it possible to tie in other fields in the area for the landing of oil. A participating company to own, build and operate the transportation system has been founded, the participants being licensees on the Oseberg field.

Three alternative gas transportation systems are under consideration:
– Wet gas via Statpipe to Kårstø
– Dry gas via Heimdal to Statpipe
– Pipeline to Frigg plus despatch via Frigg pipeline.
The Oseberg projecct is now in its detail engineering phase and is progressing more or less according to schedule.

Production drilling, reserves, recovery
Production drilling
Drilling of the first production wells will start towards the end of 1985. Five production and five injection wells will be ready when production from the field center starts.

Reserves
The Norwegian Petroleum Directorate's reserves estimates amount to 172.4 million Sm^3 oil and 70.9 billion Sm^3 gas, which is slightly above what the operator is assuming. The reason for the discrepancy is that the Directorate has included the reserves in all three reservoir formations in Directorate figures, while the operator has not included them all.

Discoveries in several structures have been made on Oseberg during the spring and summer, including on the front block to the west of Oseberg. The latest discoveries have increased our expectations regarding the remainder of the front blocks, and plans exist to drill into these. For several of these potential prospects, it will be possible to tie in to Oseberg. The Oseberg field center will have idle capacity from about the year 2000.

Recovery
The upgrading of the reserves estimates has caused the Norwegian Petroleum Directorate to assume a rather longer production period than the operator. Plateau production is limited by processing capacity and will not be changed.

All gas produced in conjunction with the oil will be reinjected into one of the structures. This gas will then be produced simultaneously with the gas cap following complete depletion of the oil.

Metering system
Design inspection of the oil metering system on the Oseberg field started in the summer of 1984. The specifications for the metering system were finally ready for invitations to tender in the autumn of 1984.

The metering system for the loading meter station on Sture is at the planning stage.

Costs
Total costs are estimated by the Norwegian Petroleum Directorate to be approximately NOK 34.3 billion 1984-kroner. (For conversion, see Valhall).

Safety, preparedness and the working environment
The Norwegian Petroleum Directorate has stated to the operator that the plans submitted for the living quarters on Oseberg seem to represent a clear step in the right direction regarding living standards on production installations.

Several meetings have been convened with the Oseberg project management at which the Directorate has been informed of the project work and has made its views known.

On the basis of a total evaluation of the documentation submitted, the operator's selection of concept seems to satisfy the Norwegian Petroleum Directorate's acceptance criteria, and the cooperation between the authorities and the company has been constructive.

2.3.10 Regulations on oil and gas metering
The Norwegian Petroleum Directorate's regulations relating to fiscal quantity metering of oil and gas entered into force on 2 April 1984. The objective of the regulations is to ensure that exact measurements form the basis of the calculation of royalties and taxes by making technical requirements of the metering equipment and standardizing the approval procedures. The regulations find application for the quantity measurements which are necessary in order to compute government taxes and the licensee's income. The regulations will apply on all new installations, although some parts of the regulations may also be applicable for existing installations.

2.4 Petroleum resources
2.4.1 Resource accounts
Petroleum resources belong to the group of non-renewable energy resources and include all technically recoverable oil and gas quantities. Possible exploitation of these resources is decided by commercial and/or socio-economic criteria.

Petroleum resources are classified according to the certainty of the resources estimates and the certainty of

commerciality (Figure 2.4.1.a). The certainty of resources estimates is determined by the degree of geological control (horizontal axis). For undiscovered resources the degree of seismic control and knowledge of geological factors will form the basis for the classification. For discovered resources the degree of well control will determine the classification. Prices and costs estimates for a resource quantity are included in the commerciality criteria to determine if the resource is developable (vertical axis). For resources which have been declared economically viable, the work schedule for the project will be decisive for the classification.

Petroleum reserves are those parts of the discovered resources which are recoverable under given technical and economic conditions and which the licensees have declared developable. This is a tightening of the reserves concept used in the 1983 Annual Report, which means that proven resources south of Stad have fallen from 3.4 to 2.2 million t.o.e, without this affecting the proven resources. The total resources accounts are shown in Figure 2.4.1.b.

FIG. 2.4.1.a
Classification of technically recoverable petroleum resources

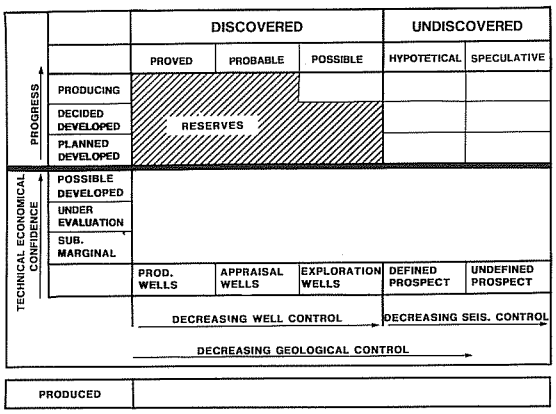


FIG. 2.4.1.b
Resource account related to The Norwegian Continental Shelf

		DISCOVERED						UNDISCOVERED	
	OIL/NGL x $10^6 Sm^3$ GAS $10^9 Sm^3$	PROVED		PROBABLE		POSSIBLE		HYPOTETI-CAL	SPECULA-TIEVE
		OIL NGL	GAS	OIL NGL	GAS	OIL NGL	GAS		
PROGRESS	PRODUCING	450	271						
	DECIDED DEVELOPED			346	128				
	PLANNED DEVELOPED			141	649				
TECHNICAL ECONOMICAL CONFIDENCE	POSSIBLE DEVELOPED			212	1091	279	421		
	UNDER EVALUATION								
	SUB. MARGINAL			17	41	20	23		
		PROD. WELLS		APPRAISAL WELLS		EXPLORA-TION WELLS		DEFINED PROSPECT	UNDEFINED PROSPECT
		DECREASING WELL CONTROL						DECREASING SEIS. CONTROL	
		DECREASING GEOLOGICAL CONTROL							
PRODUCED		260 X $10^6 Sm^3$ oil ind. NGL 158 X $10^9 Sm^3$ gas							

For presentation in the Annual Report, resources on the Norwegian Continental Shelf have been displayed in Tables 2.4.2, 2.4.3 and 2.4.4.

I Declared – Reserves connected with development projects for which approval to start has been given, are under development or in production (Table 2.4.2).
II Other, south of Stad – Other reserves south of Stad (Table 2.4.3).
III Other, north of Stad – Resources north of Stad (Table 2.4.4).

2.4.2 Resources base for declared fields

As of 31 December 1984, decisions had been taken to carry out 18 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 1 December 1984, 0.37 billion t.o.e had been produced on the Norwegian Continental Shelf.

2.4.3 Other resources south of Stad

Table 2.4.3 shows the other resources proven south of Stad. Of these, the Sleipner Gamma and Troll West fields have been declared commercial. The resources amounts in these two fields together make up 0.76 billion t.o.e. The Norwegian Petroleum Directorate assumes that a number of the other finds too will be developed, both for reasons of size and proximity to other fields. Additionally, hydrocarbons have been proven in Wells 1/3–3, 2/1–5, 2/2–1, 2/6–2, 2/7–11 and 7/12–6; the Blocks 18/10 and 34/10 Beta; and the front structures west of Oseberg in Blocks 30/6 and 30/9. (See Table 2.4.3).

2.4.4 Discoveries north of Stad

Provisionally some 0.44 billion t.o.e have been proven by drilling north of Stad. Of this quantity, 0.23 billion t.o.e are on Haltenbanken and 0.21 billion t.o.e off Troms. Furthermore, a major gas find has been made in Block 6506/12 with associated oil. (See Table 2.4.4).

2.4.5 Updates in resource estimates from previous Annual Report

Table 2.4.5 shows the most important changes from the previous annual report (1983).

Fields decided to be developed

For Albuskjell, Cod, Edda, Ekofisk, Eldfisk, Tor, West Ekofisk and Statfjord, minor adjustments to the prognoses have been made due to small changes in the production history.

Frigg

Condensate from Frigg gas has a density of 0.85 and was wrongly assigned as NGL in the 1983 resources table.

TAB 2.4.2
Proven petroleum reserves in fields declared commercial

	ORIGINALLY			REMAINING		
	OIL 10^6Sm^3	GAS 10^9Sm^3	NGL 10^6tonn	OIL 10^6Sm^3	GAS 10^9Sm^3	NGL 10^6tonn
Albuskjell	8,0	16,0	1,0	2,6	6,7	0,4
Cod	2,5	6,2	0,4	0,6	2,1	0,1
Edda	3,7	1,9	0,2	0,8	0,4	0,1
Ekofisk	193,0	129,0	8,0	72,8	86,2	5,0
Eldfisk	48,0	31,0	2,2	24,9	23,6	1,4
Frigg[2])	1,0	127,0		0,7	64,8	
Gullfaks f.l[1])	135,0	8,0	1,2	135,0	8,0	1,2
Heimdal	3,0	34,0		3,0	34,0	
Murchison[3])	13,0	0,3	0,5	7,9	0,2	0,3
Nord-øst Frigg	0,1	8,0		0,1	5,4	
Odin	0,1	22,0		0,1	18,9	
Oseberg[4])	173,0	71,0		173,0	71,0	
Statfjord[5])	341,0	41,0	10,5	280,7	41,0	10,5
Tor	17,0	10,0	1,0	2,6	2,8	0,3
Ula	30,0	2,0	1,3	30,0	2,0	1,3
Valhall A	19,0	16,0	1,3	15,6	15,5	1,2
Vest Ekofisk	11,0	21,0	1,0	1,2	3,7	0,3
Øst-Frigg		13,0			13,0	
Total	998,4	557,4	28,6	751,6	399,3	22,1

1) Operators estimate
2) This is the Norewgian part: 60.82 %
3) This is the Norwegian part: 25.1 %
4) Includes the structures Alfa, Alfa North and Gamma
5) This is the Norwegian part: 84.09 %

Tab 2.4.3
Proven petroleum reserves south of Stad decided not to be developed

	Oil 10^6Sm^3	Gas 10^9Sm^3	NGL 10^6t.
Balder	35,0		
Brage	29,0	6,0	
Gullfaks fase 2[1])	75,0	9,1	
Gullfaks Sør	37,0	93,0	
Hild		51,0	
Hod	7,2	5,4	
Huldra[1])		18,0	
Sleipner + Gamma[2])	45,0	186,0	19,0
Sleipner satelitter[3])	0,5	32,0	
Snorre[4])	99,0	27,0	
SØ-Tor	4,0	3,0	
Tommeliten	6,0	23,0	
Troll Vest	58,0	463,0	
Troll Øst		825,0	
Veslefrikk	24,0	8,0	
Valhall rest	14,5	12,0	
2/1	18,0	2,0	
15/3–1,3	2,0	29,0	
15/3–4	12,0	5,0	
15/5–1	1,0	4,0	
16/7–4	1,4	9,0	
24/9	3,0		
25/2–4	4,0	12,0	
30/6,Beta[1])	20,0		
33/9,Alfa	19,0	2,5	
33/9,Beta	39,0	2,0	
34/4–1	3,0		
35/8	1,0	10,0	
Total	557,6	1 837,0	19,0

1) Operator's estimated
2) Includes Alfa, Beta, Epsilon, Delta, Gamma tertiary and Gamma Jura
3) Includes 15/8 Alfa, 15/9 My og 15/9 Theta
4) Includes the Epsilon-structure in Blocks 34/7 and 34/4

TAB 2.4.4
Proven petroleum resources north of Stad

	Oil 10^6Sm^3	Gas 10^9Sm^3
Haltenbanken		
Midgard	22,0	103,0
Tyrihans	12,0	51,0
6407/09	39,0	
Troms		
Askeladd		41,0
7119/12[1])		3,6
7120/07		23,0
7120/09		35,0
7120/12		16,0
7121/04		114,0
Total	73,0	386,6

1) Operator's estimate

Gullfaks Phase I
The Norwegian Petroleum Directorate resources estimate for Gullfaks Phase I is now out of date. New wells have demonstrated that the resources are larger than the Directorate's old estimate. The operator's estimate has been quoted in the resources summary.

East Frigg
The resources estimate encompasses two small structures previously designated East Frigg and South East Frigg. New drillings and mapping have shown that the resources are larger than previously assumed.

Other finds north and south of Stad
Gullfaks Phase 2
New well information has shown that the find is smal-

ler than assumed. The Norwegian Petroleum Directorate has not had the capacity to review the resources estimates, which means that the operator's figures are used in the table.

Gullfaks South
The Norwegian Petroleum Directorate has undertaken a new mapping of the structure which has caused an increase in the reserves estimates.

Hod
New mapping and reserves estimates have led to a decrease in the estimates.

Sleipner with Gamma
New prognoses have been undertaken and the Gamma Jurassic resources have been included in the resources estimates. The resources are split into gas, associated oil and NGL and show an increase compared with 1983.

Sleipner satellites
A minor adjustment of the prognoses has been made. Associated oil has been split off as a separate phase.

Snorre
This is a new find, proven by drilling of Wells 34/4–4 and 34/7–1 to 3. The resources estimates cover the entire structure in both Block 34/4 and 34/7.

Block 16/7–4
The estimate is the operator's. The resources basis has not previously been stated in the Annual Report.

Midgard
A new well and new seismic interpretation have shown that the find is larger than previously assumed. The associated oil has been split off as a separate phase.

Tyrihans
New resources estimates include the northern and southern parts alike. In the Annual Report for 1983, only the southern part was included.

Block 6507/09
A new find was proven by Well 6407/09–1. The resources estimate was highly uncertain and should not be used uncritically before a new well has been drilled.

Askeladd
A new resources estimate is for a slight down-grading of the resources base.

Block 7119/12
Minor finds not previously included in the Annual Report. The estimate is the operator's.

Block 7120/12
A new resources estimate has been undertaken and has led to a slight upgrading of the estimate.

TAB 2.4.5
Changes in resource estimates in annual reports 83–84

	Annual report 83			Annual report 84		
	Oil 10^6Sm^3	Gas 10^9Sm^3	NGL 10^6tonn	Oil 10^6Sm^3	Gas 10^9Sm^3	NGL 10^6tonn
Field resolved for development						
Albuskjell	9,0	16,0	1,0	8,0	16,0	1,0
Cod	3,0	6,0	0,4	2,5	6,2	0,4
Edda	3,0	2,0	0,2	3,7	1,9	0,2
Ekofisk	192,0	125,0	8,0	193,0	129,0	8,0
Eldfisk	44,0	31,0	1,9	48,0	31,0	2,2
Frigg		127,0	0,8	1,0	127,0	
Gullfaks fase 1	91,0	6,0	1,1	135,0	8,0	1,2
Statfjord	341,0	40,0	13,0	341,0	41,0	10,5
Tor	17,0	11,0	1,0	17,0	10,0	1,0
Vest Ekofisk	10,0	22,0	1,0	11,0	21,0	1,0
Other fields						
Gullfaks fase 2	102,0	12,0		75,0	9,1	
Gullfaks Sør	19,0	77,0		37,0	93,0	
Hod	9,0	7,0		7,2	5,4	
Sleipner + Gamma	27,0	179,0		45,0	186,0	19,0
Sleipner sat.		34,0		0,5	32,0	
Snorre	–	–		99,0	27,0	
Øst Frigg		5,0			13,0	
16/7–4	–	–		1,4	9,0	
Midgard		40,0		22,0	103,0	
Tyrihans	7,0	23,0		12,0	51,0	
6407/09	–	–		39,0		
Askeladd		46,0			41,0	
7119/12		–			3,6	
7120/12		12,0			16,0	
7121/04		–			114,0	

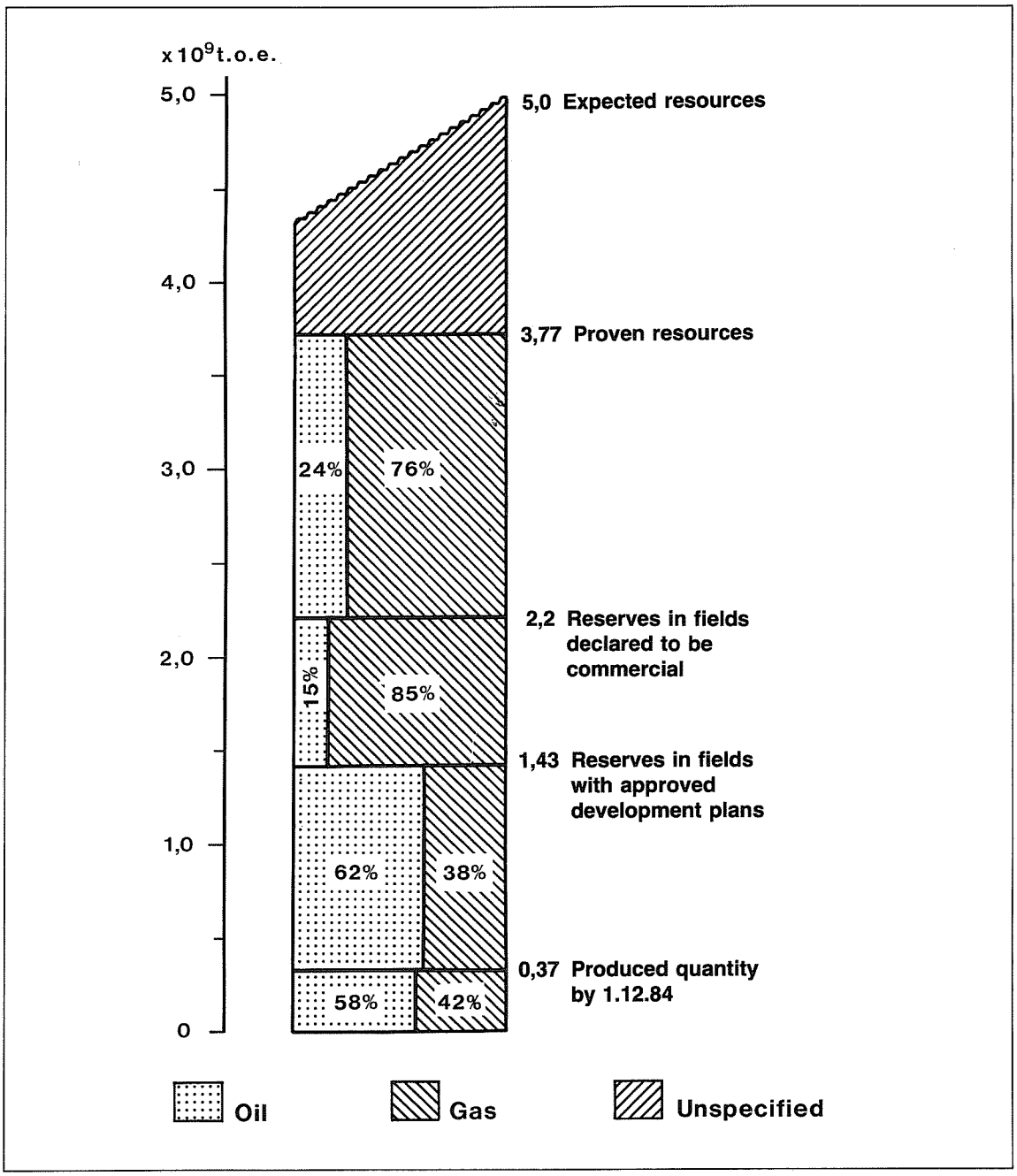
Block 7121/04
A new find was proven in Well 7121/04–1. Additional to the gas, small amounts of oil have been proven in a thin sand zone. It is possible that the oil zone continues into the main reservoir. A new well will confirm or disprove the presence of oil in substantial quantities in the structure.

2.4.6 Resource potential south of Stad

The Norwegian Petroleum Directorate has estimated that the probable recoverable resources potential south of Stad is about 5 billion t.o.e (Figure 2.4.6).

Until now, 3.8 billion t.o.e have been proven by drilling. In undrilled structures a hypothetical resources potential of 1.2 billion t.o.e has been calculated. In addition to the hypothetical resources, there may also exist some speculative resources. This last category includes for example deep-lying Permean prospects.

FIG. 2.4.6
Expected total recoverable resources south of Stad



3. Safety control

In 1984, the Norwegian Petroleum Directorate had a number of major assignments and challenges in the field of safety. The results from work carried out during the last year have to a particular extent reflected the great developments which the Norwegian Petroleum Directorate has gone through in this field during recent years.

In the report period, a number of system audits of all operating companies have been performed. In the course of these audits, major or minor deviations were detected in relation to the intentions of Norwegian authorities as reflected in laws, regulations and guidelines. In this context, the operating companies have introduced a number of corrective measures. The Norwegian Petroleum Directorate has taken special account of this in connection with its recommendations to the Ministry of Local Government and Labour and the Ministry of Petroleum and Energy in connection with the ninth licensing round.

In the report period, the Norwegian Petroleum Directorate's follow-up of shipowners' internal control systems has been limited to its audits vis-a-vis the operating companies in connection with drilling activities.

There seems to be a great difference between the various shipowners concerning how far they have come in the development of their internal control systems, and a lot still remains to be done. However, the defects in the shipowners' quality assurance systems shall be corrected through a system whereby the operating companies are obliged to compensate for defects in the quality assurance system of sub-contractors.

The Norwegian Petroleum Directorate also has control responsibility pursuant to the Seaworthiness Act vis-a-vis drilling installations registered in Norway and operating on a foreign continental shelf with respect to technical drilling equipment. The Norwegian Petroleum Directorate's requirements concerning internal control have also been made applicable here. However, the Norwegian Petroleum Directorate cannot demand that operating companies shall compensate for any defects.

In 1985, the Norwegian Petroleum Directorate will reinspect some shipping companies to see to it that the preconditions for the shipowners' own confirmation in connection with the 1984 issue of certificates have been secured.

The development structure, with associated transport solutions, which has been established and planned has gradually led to the production from some fields becoming continually more vulnerable with respect to operational interruptions caused by failure in transport systems and appurtenant facilities. The Norwegian Petroleum Directorate has appointed a task force whose objective it is to prepare a model which the authorities can use when evaluating developments and new transport solutions and measures to reduce the vulnerability of existing facilities.

As a receiver of information from all fields on the Norwegian Continental Shelf, the Norwegian Petroleum Directorate at present contributes to a useful exchange of experiences among the operating companies, and from existing fields to new ones. This takes place through the updating of regulations and guidelines and through the Norwegian Petroleum Directorate's current contact with operating companies, both in the development phase and the operating phase.

However, it is desirable to strengthen this part of the Norwegian Petroleum Directorate's activity, not only on the basis of safety-related considerations, but also by providing the operating companies with data which can help them choose equipment which requires less maintenance and gives a better overall economy and operating availability. How this can best be achieved with the resources available to the Norwegian Petroleum Directorate is currently being evaluated.

REGULATIONS AND GUIDELINES

The Norwegian Petroleum Directorate's "Regulations for Manned Underwater Operations" which shall replace the present "Temporary Regulations for Diving" are expected to be published in the first half of 1985.

In collaboration with the Department of Energy, the Norwegian Petroleum Directorate has prepared "Draft guidelines for minimum performance requirements and standard unmanned test procedures for underwater breathing apparatus". The draft has been sent out, encouraging users to notify the Norwegian Petroleum Directorate of experiences won through usage.

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 site. The Norwegian Petroleum Directorate is working on further rules to § 21 "Employer's Reporting Duty" and to § 22 "Doctor's Reporting Duty". The rules for "Doctor's Reporting Du-

ty" will be coordinated with the Directorate of Labour Inspection.

In the "Regulations relating to Qualifications for Drilling Personnel", § 10, the reporting requirement has been waived. The final sentence has been deleted so that the wording is now: "If the licensee is planning to use drilling personnel who have not gone through training as described under § 8, the company shall perform an overall evaluation of the professional practice and theoretical education of the person in question to make sure that the qualification requirements have been satisfied".

The Norwegian Petroleum Directorate has prepared the "Regulations relating to Noise etc in Connection with the Petroleum Activity". These regulations embrace the recommendations of the guidelines prepared earlier concerning increased efforts for noise reduction in accordance with the technological and social development of the community. The regulations, as well as guidelines describing measurement principle/methods etc have been so built up as to enable the Norwegian Petroleum Directorate to perform its control function in an expedient manner. The regulations are expected to be stipulated in the beginning of 1985.

In 1983, the Norwegian Petroleum Directorate carried out a safety evaluation of the needs, usefulness etc of safety zones. The evaluation was initiated on the basis of the fact that the draft for a new Petroleum Act is aiming towards cancellation of the King's Resolution of 8 December 1972, which, among other things, stipulates provisions concerning the extent of safety zones. The draft act and regulations do not propose hard and fast new provisions for the stipulation of the extent of safety zones, etc. On the basis of an overall evaluation of safety-related factors, it was found expedient that general regulations be prepared concerning safety zones as well as limitation zones for fishing, anchoring and other activities. The regulation work will presumably be concluded in the middle of 1985.

After many years of study and development work, a number of subsea production facilities are now being prepared for the Norwegian Continental Shelf (East Frigg, Gullfaks A, Oseberg, etc). Most of the equipment which is necessary for such installations is covered by existing regulations and guidelines. However, the industry has given clear signals that it is desirable that the Norwegian Petroleum Directorate clearly states its opinion on conditions which are special for subsea production facilities. A draft for "Guidelines for Subsea Production Facilities" has been prepared which refers to the relevant existing regulations, in which the Norwegian Petroleum Directorate's attitude, for example to risk evaluations, testing and monitoring of facilities etc has been described. The draft is expected to be submitted for external hearing in the course of the first quarter of 1985.

The "Regulations for Production and Auxiliary Systems on Production Installations etc." are being revised and are expected to be ready in 1985.

The "Regulations for Drilling etc for Petroleum in Norwegian Internal Waters, in Norwegian Territorial Waters and on the Continental Shelf which is under Norwegian Sovereignty" are expected to be published in a revised edition in 1985.

The "Provisional Safety Regulations etc for Exploration and Drilling for Petroleum Resources etc on Svalbard" are currently being revised.

The preparation of regulations and guidelines for subsea pipelines and risers has been more time-consuming than predicted, but is expected to be concluded in the course of 1985. The regulations will be somewhat modified so that they are adapted to the principle of internal control and the new Petroleum Act.

The "Regulations for Fixed Loadbearing Structures" have been revised, and the revised regulations were laid down on 29 October 1984 with the title "Regulations for Loadbearing Structures for use in the Recovery or Exploitation of Petroleum Resources". The work associated with the appurtenant guidelines is in process and is expected to be concluded in 1985.

In 1983, the work of updating the "Regulations for Safety Evaluation of Platform Conceptual Design" was initiated to make them conform with the forthcoming Petroleum Act. This work will be concluded when the Petroleum Act and delegation resolution are available.

In 1984, the draft for new "Regulations for the Collection and Processing of Environmental Data" was prepared. The further work with these regulations will be taken up when the Petroleum Act and delegation resolution are available.

THE WEATHER SHIP "AMI" – COLLECTION OF ENVIRONMENTAL DATA

In 1976, in connection with planned drilling activities on Tromsøflaket, an extensive data collection project was started under the direction of the Norwegian Petroleum Directorate. The background for the project was to learn about the meteorological and oceanographic conditions before commencing test drilling. Furthermore, one wanted to obtain as long a series of measurements as possible so that it would be possible to estimate extreme values with reasonable accuracy.

The weather ship "AMI" was chartered from Kåre Misje Co Rederi A/S in Bergen. This ship has maintained a steady position at 71 degrees 30 minutes north, 19 degrees east from September 1976 and has taken measurements and tended the instruments which have been placed in the sea. The ship has left its position only once a month to effect crew change and the maintenance of instruments.

The operation of the ship and the analyses of the collected data were funded 100 per cent by the Norwegian Petroleum Directorate during the first few years. In the period 1981–1983, Statoil carried out some investigations from the "AMI" and then supported the operation with NOK 1 million per year. Since 1983, the ODAP, or Oceanographic Data Collection Project, supported the operation of the "AMI" with 50 per cent of the costs.

Several Norwegian institutions have participated in the project:
- the Norwegian Hydrodynamic Laboratory has measured waves and currents and has been responsible for project coordination and reporting
- the Norwegian Meteorological Institute has been responsible for the meteorological measurements which are taken every three hours and reported to onshore facilities
- the Oceanographic Research Institute in Bergen has been in charge of hydrographic measurements (temperature and salinity) as well as biological measurements.

In addition to these permanent activities the vessel has been used by several other institutions, e.g. in connection with corrosion measurements, icing, oil drift, satellite remote measurements, etc.

Data from this project, which are freely available, are now used by everybody operating in northern waters in connection with the oil activities. A large number of research projects have used and are still using these data.

Moreover, telegraphic weather reports are sent to the Weather Reporting Service in Tromsø every three hours. They have formed part of the basis for the daily weather forecasts for Finnmark, Troms and surrounding waters.

In the end of the report period it was decided that the measurement station on Tromsøflaket should be moved a little to the north-east. It then became possible to locate the data buoy within the safety zone of a drilling rig and thus there was no longer any need for keeping a ship on station near the buoy. The measurement activities on Tromsøflaket are expected to last a few years more.

COLLECTION OF ENVIRONMENTAL DATA IN THE BARENTS SEA

In connection with the 1985 National Budget, the Norwegian Petroleum Directorate has applied for funds to collect data in the Barents Sea. In addition to the buoy on Tromsøflaket, the new measurement program will include a buoy near Bear Island as well as a weather ship with a data buoy on Sentralbanken. Efforts are being made to start this measurement project early in 1985.

The Norwegian Petroleum Directorate considers it very important to initiate measurements in the Barents Sea as soon as possible, as it is of considerable importance for safety that one has a certain degree of knowledge of the marine environment before the area is opened for exploration drilling.

CONSTRUCTIONAL STEEL

The 1983 Annual Report mentioned that the development of new constructional steels had spurred new research in the steel sector. We were here referring to the new micro-alloy, low carbon steels which under certain conditions show brittle areas in the heat affected zone close to the weld.

It should be mentioned that this research work has provided the impulse for new and more thorough material research both domestically and abroad.

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 causes and to evaluate the importance of the severity of the attacks.

SYSTEM AUDITS IN THE DRILLING ACTIVITY

In the period 1 May to 1 November 1984, the Norwegian Petroleum Directorate performed system audits of the various operating companies on the Norwegian Continental Shelf. This was done to be able to evaluate the companies' control systems, with special emphasis on the exploration drilling activity, on the basis of the Norwegian Petroleum Directorate's regulations, guidelines and individual resolutions. The requirements which the operating companies make to themselves in their superordinate quality assurance systems were also taken into account, to see whether the main features of these requirements had been made applicable in the subordinate systems for the drilling activity.

The system audits were carried out in a downward line through the organization through meetings with the main, operations and platform management. A representative from the company in question attended all meetings so the company could evaluate its own drilling organization and systems. The purpose was to implement definite measures.

The reports which have been prepared on the basis of the system audits show to what extent the companies have lived up to the requirements and expectations of the Norwegian Petroleum Directorate and themselves, and are thus useful for the Norwegian Petroleum Directorate in that they show where some of our resources should be invested.

UNDERWATER PRODUCTION SYSTEMS

For the Norwegian Petroleum Directorate, underwater production systems represent an interesting development and special challenge.

Following from the developments during recent years, certain groups of development concepts and production equipment have grown up. For the Norwegian Petroleum Directorate it has thus become possible to work out a more definite safety philosophy and better routines for the review of underwater concepts.

With the relatively quick development of underwater

technology and ever new spin-offs in new subject areas, for example fiber optics, advanced metallurgy etc, it is a special challenge for the Norwegian Petroleum Directorate to attain and develop sufficient professional expertise in the special fields required.

MOBILE PRODUCTION INSTALLATIONS

In 1984, the petroleum industry was heavily engaged in the development of mobile production installations. This has been noted in the Norwegian Petroleum Directorate through all the enquiries from shipowners, drilling and operating companies. The enquiries have been difficult to answer because there are no regulations which specially cover such installations. The fact that the new Petroleum Act has not entered into force also makes it difficult to give any accurate answers.

The Oseberg project wants to use such an installation for long-term testing of a well. The installation is under construction in Japan, and Norsk Hydro is working intensely to evaluate it for its own application.

This fact has made it necessary for the Norwegian Petroleum Directorate to apply the existing laws, resolutions and rules to this installation.

This process has demonstrated that there is a great need for a better adaptation of our regulations for this type of activity.

In this connection, some areas have received special attention:

- requirements concerning structures (hulls), especially with respect to fatigue strength
- loading and connecting systems for tankers (oil and gas)
- process equipment such as separators, columns, and gas flare systems
- positioning and mooring systems
- production pipe/risers between the seafloor and installation
- propulsion machinery used as energy source for production and power generation
- area classification
- fire protection
- shut-down systems
- situational factors for disconnection from the well and loading interruption
- definition of the activity with respect to barrier requirements in connection with all activities.

This work will be initiated in 1985.

PROCESS EQUIPMENT, ELECTRICAL EQUIPMENT AND SAFETY SYSTEMS

The quality control of process equipment during fabrication and start-up is satisfactory. The routines which have now been established by the operating companies to secure quality in accordance with the internal control principle seem to function well.

The status control of process equipment in operation is acceptable for most operating companies. Many of today's problems can be traced back to unfortunate selection of equipment or materials in the design phase, and to the fact that insufficient or erronous data have formed the basis of equipment specifications.

Damage, particularly caused by corrosion, on electrical facilities has resulted in considerable improvement of such facilities.

DIVING

In the report period, the diving activity on the Norwegian Continental Shelf concentrated on the laying of pipelines for the Statpipe and Ula projects, as well as maintenance work and inspection of the individual installations on the Norwegian continental shelf. A total of 1946 surface-oriented dives and 386,136 saturation manhours were logged. For surface-oriented diving this represents a 19.5 per cent decrease and for saturation diving a 44 per cent increase in the activity compared to 1983.

When laying the pipeline from Kårstø to Statfjord, operational diving down to approximately 250 meters was performed. This is the greatest depth at which operational diving has been performed on the Norwegian Continental Shelf so far.

As part of the planning for this diving operation, a dive was made down to 350 meters at the Norwegian Institute of Underwater Technology in Bergen. The purpose of the dive was to evaluate equipment, procedures and personnel to be used in a possible operation under controlled conditions. In order to verify the experiences gained during this test dive, a qualification dive was also made down to 300 meters in sheltered waters. The documentation from these test dives has formed the basis for the planning of the operational dives, and has been of decisive importance to the Norwegian Petroleum Directorate's evaluation of the operating company's plans for the implementation of dives down to the depths discussed here.

The subsequent work after the tragic accident onboard the Byford Dolphin, where five persons lost their lives and one person was seriously injured, has been very resource consuming. In its report (NOU 1984:11), the commission which was appointed after the accident evaluated some measures which may help prevent similar accidents in the future.

The diving personnel's knowledge of existing procedures and operation of the diving system is of great importance to a safe implementation of a diving operation. The Norwegian Petroleum Directorate has taken the initiative for the formation of a working group consisting of representatives from organizations for employees, diving contractors, operating companies and the educational sector. This group shall evaluate measures for the systematic training and maintenance of knowledge and skills for personnel tied to the diving operation.

The new regulations outlined a permanent arrangement whereby the Norwegian Petroleum Directorate, on behalf of the Maritime Directorate, was to perform the bulk of the public control of diving systems pursu-

ant to the Seaworthiness Act. The background for this was the wish that the same institution should take care of the authorities' responsibility for the control of diving systems and operation. It was later decided that the old arrangement with partial double checking shall be maintained. The result of this was that the Norwegian Petroleum Directorate's responsibility for inspection of diving systems covered by the Seaworthiness Act was cancelled from 1 June 1984.

The Norwegian Petroleum Directorate has established an arrangement with separate monthly meetings with operating companies which are engaged in or are planning to start underwater operations. These meetings have been of mutual usefulness for information exchange and the clarification of relevant problems.

The Norwegian Petroleum Directorate's draft for new regulations for manned underwater operations which was submitted for public hearing in the spring brought about comments of such a nature that further work was required. The greatest problem has been limitation of the time which divers spend in compression. The applicable regulations give the following limitations: "Must normally not exceed 16 days. The Norwegian Petroleum Directorate may, when the parties involved agree, consent to periods up to 24 days, and exceptionally 32 days".

The new draft sets an upper limit of 30 days. It was a prerequisite that the parties involved should agree on the length within the absolute framework in the same way as previously.

During the last four years on the Norwegian Continental Shelf, periods in compression of between 16 and 24 days' duration have been usual, with the main bulk approaching 24 days. Only in a few and very special cases has permission been granted to exceed 24 days.

At present, some operators are preparing possible dives approaching 390 meters in connection with the development of Oseberg and Troll. In connection with dives approaching 390 meters one reckons it will take 2–3 days to bring a diver down to this depth and 14–16 days to bring him back to the surface. It is claimed that if the regulations are to stipulate any absolute upper limit, it should be set to 30 days. Meetings have been held with representatives for the divers' organizations, diving contractors, operating companies and medical experts to find acceptable limits, if possible.

EMERGENCY PREPAREDNESS EXERCISES

In the course of the year, six operating companies have performed exercises in which the Norwegian Petroleum Directorate has participated. The 1984 exercises have generally given positive impressions, and the operating companies have been asked to report all exercises planned for 1985.

BASIC SAFETY AND EMERGENCY PREPAREDNESS TRAINING

In the course of the year, the Norwegian Petroleum Directorate, in a letter to the operating companies, emphasized that personnel covered by the Norwegian Petroleum Directorate's rules and regulations shall receive satisfactory safety and emergency preparedness training. In principle, the general part of the training shall be performed before their first tour offshore. In exceptional cases, situations may arise when personnel have to stay on installations in the North Sea without having gone through safety training. In such instances, a thorough introduction to emergency preparedness and safety measures shall be given, with special emphasis on escape routes, means of evacuation, etc on the installation. The operating company is responsible for continual backing-up of personnel who can assist in the event of an accident.

INTRODUCTION OF MARITIME VHF RADIO

The Norwegian Petroleum Directorate has pointed out to the operating companies that a maritime VHF radio in transport helicopters will be of great importance in a rescue action. By the end of the report period, all relevant transport helicopters will have such equipment installed onboard.

LITTERING AND POLLUTION BY THE PETROLEUM ACTIVITY

In 1984, the control of the operating companies' compliance with these regulations was stepped up. The result of this is that some companies have prepared – and others are in the process of preparing – detailed procedures for sound treatment of waste.

The ever stronger focusing on "substances which are hazardous to health" has made the Norwegian Petroleum Directorate place high priority on the control of these same substances in the form of waste.

The Norwegian Petroleum Directorate, in collaboration with other control bodies, has helped establish several receiver stations for "hazardous waste" at shore bases. Authorized contractors see to it that offshore waste which is brought to the shore is handled properly with respect to storage, transport, destruction or recycling.

Routines have been prepared so that the operating companies will report via telex:
- Notification of encumbrance (junk)
- Notification of clearing.

SAFETY INSPECTION OF SERVICE VESSELS, CONSTRUCTION VESSELS AND PIPE-LAYING VESSELS, ETC. WHICH ARE REGISTERED ABROAD

As a continuance of the Ministry of Local Government and Labour's delegation resolution of 5 October 1983 concerning safety inspection of vessels registered abroad (see the Norwegian Petroleum Directorate's 1983 Annual Report), the Norwegian Petroleum Directorate, in collaboration with the Maritime Directorate, has prepared procedures for the practical control.

MARITIME OPERATIONS ON THE NORWEGIAN CONTINENTAL SHELF

The summer season of 1984 was one of quite high acti-

vity on the Continental Shelf, which involved a large number of vessels registered abroad.

The tow-out and placement of Statfjord C was perhaps the single largest maritime operation. Of other activities we can mention pipe laying, trenching, diving, maintenance, inspection, crane lifting, seismic surveys, tugging and anchor handling. In addition, three more flotels were brought into use for the accommodation of personnel.

In connection with the execution of the above mentioned activities, vessels registered in the USA, Great Britain, Panama, France, Sweden, the Bahamas, the Netherlands and Germany were used in addition to vessels registered in Norway.

OCCUPATIONAL HYGIENE

Labelling regulations

The "Regulations relating to the Labelling, Sale etc of Chemical Substances and Products which may be Hazardous to Health" and the "Regulations relating to the Labelling of Flammables and Explosives" prepared by the Ministry of the Environment and the Ministry of Local Government and Labour, have been implemented also for the petroleum industry. The regulations entered into force on 1 March 1984.

The Norwegian Petroleum Directorate's general impression is that the labelling rules are complied with for the most part.

Prohibition against the use of products which are hazardous to health

The Working Environment Act gives the Norwegian Petroleum Directorate the authority to forbid the use and storage on the installations of substances or products which are hazardous to health, and also states that the Norwegian Petroleum Directorate can stipulate further conditions for a substance to be allowed to be taken into use or manufactured.

On the background of the occupational medical experience which has been gained in connection with exposure to fibrous asbestos materials, the Norwegian Petroleum Directorate placed a general ban on the use of asbestos and materials containing asbestos on 27 March 1984.

At the request of the Norwegian Petroleum Directorate, the Institute of Occupational Hygiene performed a literature research of the health risk associated with attapulgite (palygorskite) and sepiolite. These are fibrous clay particles used in certain types of drill mud.

The conclusion of the Institute of Occupational Hygiene was that until supplementary results from examinations of workplaces are available, attapulgite and sepiolite should be considered and handled in the same way as asbestos from a health point of view.

This conclusion means that the Norwegian Petroleum Directorate will forbid the use of attapulgite and sepiolite on the Norwegian Continental Shelf.

Precautions against exposure to drill mud

The Norwegian Petroleum Directorate has registered a positive trend concerning measures implemented by the industry to achieve a safer use of drill mud and the chemicals which are added to it. Some concepts for new production installations are based on the shutdown of the mud process as well as computerized dosage systems for drill mud chemicals.

THE WORKING ENVIRONMENT OF CATERING PERSONNEL

Inspection activity

During the first six months of 1984, inspections geared towards the catering activity were carried out on all North Sea fields in operation. The inspections confirmed the impression that this personnel group seems to have a considerable work load, which is aggravated by the lack of job security and insufficient manning on a number of installations.

Guidelines for the operation of the catering activity

In accordance with the recommendation made by the Ministry, the Norwegian Petroleum Directorate evaluated the need for preparing further criteria for the quality of working environment factors in the catering activity. Against this background, the Norwegian Petroleum Directorate set forth a proposal to the Ministry of Local Government and Labour in May 1984 concerning the preparation of guidelines for the operation of the catering activity. The intention of this work was, for one thing, to describe the criteria which can form the basis of quality assessments in the catering activity. Furthermore, the guidelines should contain descriptions of different methods of charting or "measuring" whether quality has been achieved and is being maintained.

The Ministry has not made any final decision as to whether or not such a project should be recommended for implementation. In the first instance, the Ministry wants to evaluate the follow-up measures which are expected to be implemented by the operating companies as a result of contact between the Ministry and the Norwegian Employers' Confederation for Operating Companies in the course of 1984.

ORGANIZED SAFETY AND ENVIRONMENTAL WORK

The Norwegian Petroleum Directorate's supervision of the activity under the auspices of organized safety and environmental work on North Sea installations has shown that the obligations, requirements and recommendations which have been described in the Working Environment Act and regulations pursuant to it, have not been satisfactorily followed up in areas associated with action programs, charting of the working environment and psychosocial working environment relations.

Annual reports by working environment committees connected with the production activity on the Norwegian Continental Shelf

The Norwegian Petroleum Directorate is engaged in focusing on the quality of the activity which is referred to as "organized safety and environmental work". The

reported material for the 1983 activity in the committees will only give a rough indication of the activity level and quality of these efforts. As early as in the reporting from the 1982 activity, the Labour Research Institutes uncovered a number of circumstances which give reason to claim that the activity does not satisfy the quality requirement.

Against this background, the Norwegian Petroleum Directorate established a joint project with Rogaland Research to systematize and analyze the contents of the reported material from the many working environment committees connected with activity which is subject to the Norwegian Petroleum Directorate's supervision. Furthermore, one wanted the analysis of the reports to materialize as a handbook for action programs to ensure systematic work in this area.

Discussions on the establishment of integrated working environment committees on fields on the Norwegian Continental Shelf

On the basis of the request made by the Ministry of Local Government and Labour, the Norwegian Petroleum Directorate worked in 1984 to obtain evaluations, views and experiences from parties involved in the industry concerning the need to establish field-wide working environment committees, to be able to present an outline of how any such committees should be organized.

Against this background, the meeting activity with the employee associations: OFS, the Joint Association of Oil Workers, and the Norwegian Federation of Trade Unions' Oil Cartel, was followed up by correspondance to the Norwegian Employers' Confederation for Operating Companies to receive the employers' evaluation and any proposals for a solution. In a letter of 19 January 1984, the following status was summarized by the Norwegian Petroleum Directorate:

"– The safety work on North Sea production fields is of varying quality in relation to the requirements made in the Act relating to Worker Protection and the Working Environment.
– Corrective and improving measures should be able to be implemented without too great consequences for the established arrangements".

The following main principle was recommended to form the basis of further discussions among the parties:

"– One is trying to find a concept for safety cooperation which will secure a real opportunity for participation and influence by employee groups in relation to safety and environmental work on the individual field. This relationship shall be secured regardless of whether employment is inside or outside an operating company".

Due to the complexity of the matter and the considerable objections presented by some of the operator employee organizations concerning the establishment of an arrangement whereby contractor and operator personnel are represented on the same committee, the Norwegian Petroleum Directorate accepted the request made by the Norwegian Employers' Confederation for Operating Companies to postpone the follow-up of the case until after the tariff negotiations have been concluded. On the basis of the evaluations and views presented by the employee side in this matter and finally by the employers, the Norwegian Petroleum Directorate will, in the first quarter of 1985, present a summary, evaluation and possible recommendation to the Ministry.

LIVING QUARTERS ON PRODUCTION INSTALLATIONS

In the years after the "Provisional Regulations for Living Quarters on Production Installations etc", were stipulated by the Norwegian Petroleum Directorate on 2 April 1979, the development of the accommodation standard and environment on North Sea installations in many ways seems to have taken place independently of a more extensive arrangement by the authorities. Against this background, the Norwegian Petroleum Directorate found it useful and interesting to be allowed to help in the implementation of a conference arranged by the Norwegian Association of Engineers where these very same conditions were discussed by planners, designers, users and authorities. The conference was held in May 1984.

As one has achieved greater insight into which conditions lead to well-being and the safeguarding of ergonomic and cleanliness requirements in accommodation milieux, it appears that regulations with detail requirements do not necessarily contribute to the desired result.

The Norwegian Petroleum Directorate is trying to leave detail requirements behind and is working towards more functional requirements which can ensure more timely regulations. In 1984, the Norwegian Petroleum Directorate has been involved in obtaining views which can clarify the requirement for an audit of the regulations. This work has been summed up in a separate report penned with external consultant assistance.

HELICOPTER TRANSPORT

Also in 1984, the Norwegian Petroleum Directorate participated in the interdisciplinary work initiated by the Transport and Communications Group of the Norwegian Association of Operating Companies which has been geared towards possible problem areas in the North Sea. This group, which has contributors from operating companies, employees, research environments, and authorities, has worked together with Agder Research on the implementation of a poll among helicopter passengers in the North Sea. This work has been summerized by Agder Research, and the group has taken this as part of its basis for the final recommendations to the Transport and Communications Group of the Norwegian Association of Operating Companies with respect to possible improvement measures.

HEALTH SERVICE

In 1984, the Norwegian Petroleum Directorate commissioned a survey of the health service arrangements which exist today for employees in the offshore petroleum activity with respect to the health services of both operating and contractor companies.

This charting work will constitute a contribution to the Norwegian Petroleum Directorate's follow-up of § 30 of the Working Environment Act which, apart from anything else, orders the employer to have safety and health personnel when this is necessary to implement special supervision of the working environment. The activity must be seen in connection with the information obtained in 1983 concerning the employers' responsibility towards occupationally handicapped employees pursuant to § 13 of the Working Environment Act.

FIRE DAMAGE IN 1984

Below is a summary of instances of fire damage on fixed production installations in 1984, based upon reports submitted to the Norwegian Petroleum Directorate by the operating companies:

Damage resulting from fire	Constr. phase	Operat. phase A	B	C
Personal injuries and severe material damage				
Personal injuries and minor or no material damage	1			
No personal injuries, but severe material damage		2		
No personal injuries and minimal or no material damage	1	15	16	1
TOTAL FIRES	2	17	16	1

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 registered a total of 36 fires in 1984 as against 30 in 1983.

None of the fires inflicted any 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.

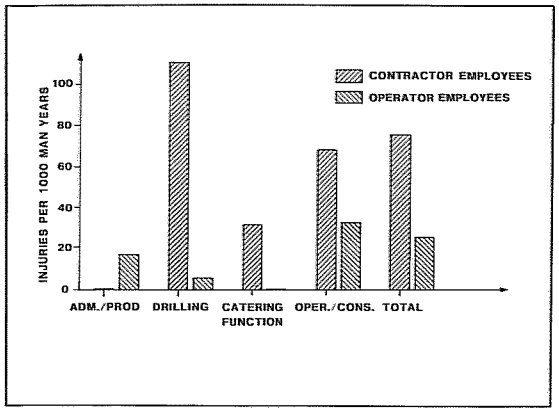
ACCIDENT STATISTICS FOR 1984

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. Medical treatment means that a medical doctor, directly or indirectly, has participated in the treatment of the injury.

These criteria for the reporting of occupational injuries entail that the statistical material cannot be directly 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 injuries and deaths per 1000 man-labour years during the period 1976–84 on production installations, exclusive of diving operations.

FIG. 3.a
Injury frequency 1979–1984 operator-/contractor employees



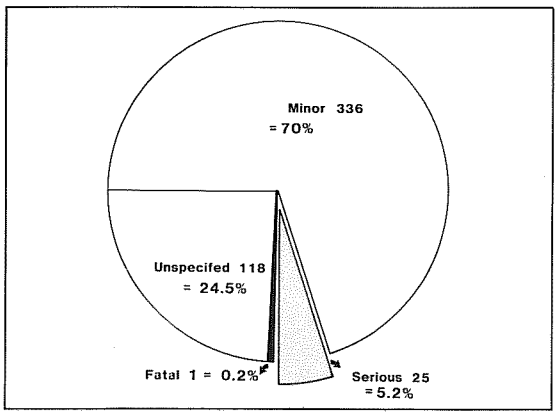
The table reveals an increase in the incidence of injuries in 1984 as compared with 1983. However, the incidence for 1984 is still below the average for the period 1976–1984.

The fatal accident occurred in connection with welding work on the Valhall field where the victim fell from a scaffold. The accident is being investigated by the Stavanger Police.

Injuries which occurred on the installations outside working hours (leisure time injuries) are not included in Tables 3.a to f. For 1984, 18 leisure time injuries were reported.

Table 3.b shows how the injury frequencies are distributed in relation to the different functions of the employees. The positive trend which was recorded in 1983 seems to have stagnated somewhat. This stagnation

FIG. 3.b
Severity of injuries



ıot least, by an increase in the
ırilling, construction and main-
ch can be related to high acti-
k. In practice, there are combi-
work and activities, regardless of

it is necessary to refer to the ex-
ctor personnel, particularly in the
ıase. In 1984, contractor personnel
ent of the total work force on pro-
; and 86 per cent of the total num-
ırred within this personnel category.
ne incidence of injuries for operator
nployees distributed by the various
eriod 1979–84. The incidence of inju-
tor personnel is about three times
ncidence for operator employees. This
not show any substantial change in
ıe main reasons for this difference may
st fields contractor personnel perform
latively high risk level, for example dril-
n types of construction and maintenance

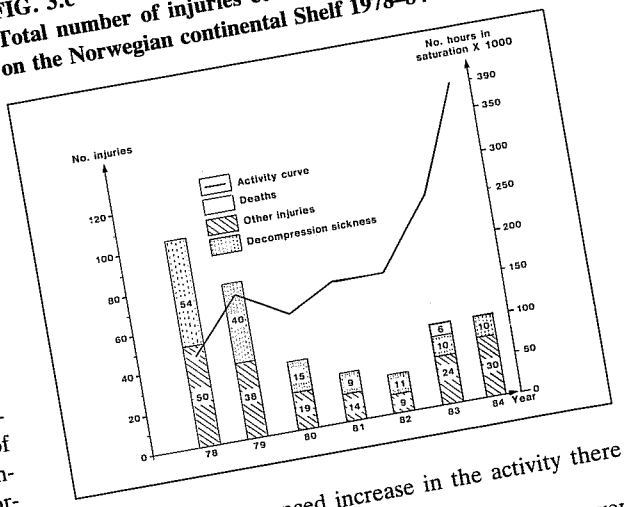
ıivities sustain the highest incidence of in-
ite the 1984 increase, however, it may
he trend recorded earlier towards a slight
ntinuing.
positive trends in the area of injuries during
rs, it still seems as if increased and intensi-
s in safety management are necessary. This
ırticularly to preventive measures against in-
l follow-up efforts in the daily work.
, context, the Norwegian Petroleum Directo-
l more actively place priority on the use of
e data on injuries, among other things in con-
with its auditing and control work. The Nor-
Petroleum Directorate especially wants to eval-
ne injury situation in relation to manning peaks
ious contexts.
oles 3.c through f, as well as Figure 3.b, give a
; detailed view of the accident picture.
gure 3.b provides a summary of the distribution of
ries for 1984 within the categories designated "un-
cified", "minor", "serious" and "fatal". This cate-
rization is based upon a consideration of the nature
the injury, not upon the length of the absence from
ork.

The Norwegian Petroleum Directorate will revert to these and other reviews of personal injuries in a separate report.

Diving

Figure 3.d provides a summary of the number of personal injuries reported to the Norwegian Petroleum Directorate for the years 1978–84 in connection with diving activities on the Norwegian Continental Shelf. The summary embraces the number of cases of decompression sickness, other injuries, and number of fatalities. Figure 3.c also shows the steep increase in diving activities in recent years. "Man-hours in saturation" has been selected as the basis for the expression "activity". This will not necessarily give a completely correct picture of the activities, and this year we have therefore started a more extensive registration.

FIG. 3.c
Total number of injuries connected to diving activities on the Norwegian continental Shelf 1978–84



Despite a pronounced increase in the activity there were no serious accidents this year.

Of the ten cases of decompression sickness, seven occurred in connection with surface-oriented diving with air as breathing gas.

The 30 injuries categorized as "other injuries" are the more normal pinch, cut and fall injuries. In these cases, diving was not the direct cause of injury.

The use of water jets and burner equipment caused six injuries.

TAB 3.a
Occupational accidents/fatalities/1,000 man years (1976–84). Production installations

Year	Hours worked	Hours per man year	Man years	Number of injuries (incl. deaths)	Number of injuries per 1,000 man years	Number of deaths	Number of deaths per 1,000 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	334	51,0	0	0,00
1984	14 419 552	1 752	8 230	480	58,3	1	0,12
Total	111 177 054		63 179	3 904	61,8	11	0,17

TAB 3.b
Occupational accidents per 1,000 man years, distributed on functions (1979–84). Production installations.

FUNKTION		1979	1980	1981	1982	1983	1984	1979–84
Administration/ production	Man years	1 098	1 174	1 144	1 306	1 182	1 455	7 359
	Injuries	24	23	22	21	30	23	143
	Injuries per 1,000 man years	21,9	19,6	19,2	16,1	25,4	15,8	19,4
Drilling	Man years	1 467	1 095	1 098	1 289	1 300	1 324	7 573
	Injuries	178	148	115	138	100	128	807
	Injuries per 1,000 man years	127,5	135,1	104,8	107,0	76,9	96,7	106,6
Catering	Man years	507	383	411	548	525	663	3 037
	Injuries	18	10	7	22	18	22	97
	Injuries per 1,000 man years	35,5	26,1	17,0	40,2	34,3	33,2	31,9
Building/ maintenance	Man years	5 482	4 333	6 258	5 229	3 542	4 788	29 632
	Injuries	345	270	270	348	186	306	1 725
	Injuries per 1,000 man years	62,9	62,3	43,1	66,5	52,5	63,9	58,2
Unspecified	Man years	0	0	0	0	0	0	0
	Injuries	1	1	1	0	0	1	4
	Injuries per 1,000 man years	0	0	0	0	0	0	0
Total	Man years	8 550	6 985	8 938	8 372	6 549	8 230	47 624
	Injuries	575	452	415	529	334	480	2 679
	Injuries per 1,000 man years	67,3	64,7	46,4	63,2	51,0	58,3	56,3

TAB 3. c
Occupational accidents 1983–84. 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	Derrickman	Unspecified	Total	%	Year
Other contact with objects/ machinery in motion	1 2	14 23	4 2	2 7	3 1*	15 29	1 1	0 1	2 3	6 10	1 2	2 7	1 8	3 9	5 9	1 2	4 7	0 0	65 123	19,5 25,6	-83 -84
Fire Explosion etc	0 0	0 0	0 0	0 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	0 0	0 0	0 0	1 1	0,3 0,2	-83 -84
Fall to lower level	1 1	1 2	0 1	0 3	0 0	8 3	2 2	1 1	2 1	4 2	1 1	3 2	3 2	0 1	1 3	1 2	0 3	0 0	28 30	8,4 6,2	-83 -84
Fall to same level	1 1	0 1	0 0	2 1	4 3	4 8	3 2	0 0	2 3	2 2	2 3	4 2	2 2	2 2	2 2	0 1	0 0	0 2	30 35	9,0 7,3	-83 -84
Stepping on uneven surface, mis-stepp	1 1	1 0	0 0	1 3	1 3	3 4	1 1	2 1	4 4	3 0	1 2	0 0	0 4	3 3	2 3	3 5	3 1	0 0	29 35	8,7 7,3	-83 -84
Falling objects	0 0	3 2	2 1	0 0	0 1	6 2	0 1	0 0	0 2	2 3	0 0	6 4	0 3	2 5	1 5	0 0	1 3	0 0	25 32	7,5 6,7	-83 -84
Other contact with objects at rest	2 3	2 2	0 1	3 3	4 3	6 2	1 4	0 0	1 4	2 3	0 2	7 8	1 2	1 2	1 4	1 2	0 1	1 1	31 47	9,2 9,8	-83 -84
Handling accident	0 0	5 1	0 0	1 5	6 5	6 9	1 1	0 1	3 1	5 5	5 0	3 4	2 4	8 2	5 3	2 6	2 0	0 0	50 47	15,0 9,8	-83 -84
Contact with chemical/ physio-compound	0 0	1 0	0 0	0 1	0 3	2 1	1 1	0 0	8 5	3 2	1 1	1 2	0 5	3 3	0 2	0 2	1 1	0 0	21 29	6,3 6,1	-83 -84
Overloading of part of body	0 1	0 7	0 3	1 4	1 2	8 14	1 0	1 0	0 3	2 4	3 1	1 4	5 3	0 0	3 4	0 3	3 0	0 0	29 53	8,6 11,0	-83 -84
Splinters/ splashes	0 1	1 1	1 0	0 0	0 0	1 2	0 1	0 0	0 2	4 2	0 1	1 7	3 4	3 0	0 0	6 14	0 0	0 0	20 35	6,0 7,3	-83 -84
Electric current	0 0	0 0	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 2	0,0 0,4	-83 -84
Extreme temperature	0 0	0 0	0 0	0 1	0 1	1 0	0 1	0 0	0 0	0 1	0 0	0 3	0 0	0 0	0 0	0 3	0 0	0 0	1 10	0,3 2,1	-83 -84
Fall into sea	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0,0 0,0	-83 -84
Other	0 0	0 0	0 0	0 1	0 0	1 0	1 0	1 0	1 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	4 1	1,2 0,2	-83 -84
Total	6 10	28 39	7 8	10 32	19 22	61 74	12 15	5 4	23 28	33 34	14 13	29 43	17 37	21 27	20 35	14 40	14 16	1 3	334 480		-83 84
%	1,8 2,1	8,4 8,1	2,1 1,7	3,0 6,7	5,7 4,6	18,2 15,5	3,6 3,1	1,5 0,8	6,9 5,8	9,9 7,1	4,2 2,7	8,7 9,0	5,1 7,7	6,3 5,6	5,9 7,3	4,2 8,3	4,2 3,3	0,3 0,6		100 100	-83 -84

TAB 3. d
Occupation accidents 1983–84. Production installations. Accidental events/injured part of the body

Injury incident \ Injured part of the body	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	0 1	1 2	7 11	4 14	2 3	3 3	9 13	4 5	39 71	0 0	65 123	19,5 25,6	-83 -84
Fire Explosion etc	0 0	0 0	0 0	0 0	0 0	1 0	0 1	0 0	0 0	0 0	1 1	0,3 0,2	-83 -84
Fall to lower level	0 0	8 6	6 7	5 3	1 6	2 3	2 1	0 0	4 2	0 2	28 30	8,4 6,2	-83 -84
Fall to same level	0 0	8 8	2 7	4 6	4 1	1 3	4 1	2 0	7 9	0 0	30 35	9,0 7,3	-83 -84
Stepping on uneven surface, mis-stepp	0 0	5 1	17 30	6 2	0 0	0 1	1 0	1 1	0 0	0 0	29 35	8,7 7,3	-83 -84
Falling objects	0 0	1 1	11 12	0 3	1 0	1 0	4 2	1 2	7 12	0 0	25 32	7,5 6,7	-83 -84
Other contact with objects at rest	0 1	0 2	2 2	6 9	3 6	1 3	5 7	1 2	14 15	0 0	31 47	9,2 9,8	-83 -84
Handling accidents	1 0	5 2	7 0	0 0	2 1	2 1	6 1	6 5	27 37	0 0	50 47	15,0 9,8	-83 -84
Contact with chemical/physio compound	19 22	0 0	0 0	0 1	0 1	0 0	0 3	0 0	1 1	1 1	21 29	6,3 6,1	-83 -84
Overloading of part of body	0 0	20 38	0 2	3 0	1 0	5 8	0 2	0 0	0 3	0 0	29 53	8,6 11,0	-83 -84
Splinters, splashes	17 29	0 0	0 0	0 2	0 1	0 0	1 3	0 0	1 0	1 0	20 35	6,0 7,3	-83 -84
Electric current	0 0	0 0	0 0	0 0	0 0	0 0	0 1	0 0	1 1	0 0	1 2	0,3 0,4	-83 -84
Extreme temperature	0 3	0 0	0 0	0 2	0 0	0 0	0 2	0 0	0 3	0 0	0 10	0,0 2,1	-83 -84
Fall into sea	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0,0 0,0	-83 -84
Other	1 0	0 0	0 0	0 1	0 0	1 0	0 0	0 0	1 0	1 0	4 1	1,2 0,2	-83 -84
Total	38 56	48 60	52 71	28 43	14 19	17 22	17 37	15 15	102 54	3 3	334 480		-83 -84
%	11,4 11,7	14,4 12,5	15,5 14,8	8,4 8,9	4,2 4,0	5,1 4,6	5,1 7,7	4,5 3,1	30,5 32,1	0,9 0,6			-83 -84

3.e
upational accidents 1983–84. Production installations. Accidental events/Contributing factor

Injury / Incident \ Contributing factor	Chemical/ physio/ biological factors	Cold/pressure/ heat/ ventilation	Materials/ packaging	Electrical equipment	Odther 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 0	5 5	9 10	0 1	8 9	8 12	4 4	17 52	14 30	0 0	65 123	19,5 25,6	-83 -84
Fire Explosion etc	0 0	0 1	0 0	0 0	0 0	0 0	1 0	0 0	0 0	0 0	1 1	0,3 0,2	-83 -84
Fall to lower level	0 0	0 0	1 2	0 0	1 0	0 0	0 0	25 27	0 1	1 0	28 30	8,4 6,2	-83 -84
Fall to same level	1 0	0 0	1 1	0 0	0 1	0 0	0 1	27 29	1 2	0 1	30 35	9,0 7,3	-83 -84
Stepping on uneven surface, mis-stepp	0 1	0 0	2 1	0 0	0 0	0 0	0 0	27 33	0 0	0 0	29 35	8,7 7,3	-83 -84
Falling objects	0 0	1 0	5 6	1 0	3 1	0 0	3 6	9 11	3 8	0 0	25 32	7,5 6,7	-83 -84
Other contact with objects at rest	0 0	0 1	5 6	0 2	2 3	2 1	0 1	19 31	1 2	2 0	31 47	9,2 9,8	-83 -84
Handling accidents	0 0	0 1	9 6	0 0	3 1	0 0	27 32	9 6	1 1	1 0	50 47	15,0 9,8	-83 -84
Contact with chemical/physio-compound	15 22	6 3	0 4	0 0	0 0	0 0	0 0	0 0	0 0	0 0	21 29	6,3 6,1	-83 -84
Overloading of part of body	1 0	0 0	9 10	0 0	5 7	0 2	1 3	9 25	0 2	4 4	29 53	8,6 11,0	-83 -84
Splinters, splashes	0 0	2 2	4 8	0 0	1 6	0 0	7 16	0 0	1 0	5 3	20 35	6,0 7,3	-83 -84
Electric current	0 0	0 0	0 0	0 2	0 0	0 0	0 0	0 0	0 0	0 0	0 2	0,0 0,4	-83 -84
Extreme temperature	0 1	1 0	0 4	0 0	0 0	0 0	0 3	0 2	0 0	0 0	1 10	0,3 2,1	-83 -84
Fall into sea	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0,0 0,0	-83 -84
Other	1 0	0 0	1 0	0 0	1 0	0 0	0 0	0 1	0 0	1 0	4 1	1,2 0,2	-83 -84
Total	18 24	15 13	46 58	1 5	24 28	10 15	43 66	142 217	21 46	14 8	334 480		-83 -84
%	5,4 5,0	4,5 2,7	13,7 12,1	0,3 1,1	7,2 5,8	3,0 3,1	12,9 13,7	42,5 45,2	6,3 9,6	4,2 1,7			-83 -84

TAB 3. f
Occupation accidents 1979–84. 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	Derrickman	Unspecified	Total	%
Other contacts with objects/ machinery in motion	14	137	13	20	15	169	9	8	9	42	8	18	32	20	34	15	57	1	621	22,3
Fire Explosion etc	0	0	0	2	0	5	0	0	0	2	0	1	2	0	0	1	0	0	13	0,5
Fall to lower level	9	14	8	21	3	44	8	3	15	18	5	11	25	7	17	118	12	0	238	8,5
Fall to same level	11	14	1	24	14	45	11	5	12	16	16	16	27	12	23	20	6	4	277	9,9
Stepping on uneven surface, mis-stepp	12	8	0	31	8	36	7	4	11	10	8	9	24	10	15	26	9	0	228	8,2
Falling objects	5	10	4	4	1	25	3		3	8	1	13	13	9	4	5	4	0	122	4,4
Other contact with objects at rest	5	11	2	13	13	30	12	0	11	17	3	27	14	5	19	15	5	2	204	7,3
Handling accidents	2	35	5	29	30	74	11	5	14	49	14	29	52	9	19	36	17	0	420	15,1
Contact with chemical/ physio-compound	0	8	0	6	6	26	3	1	37	10	9	7	12	10	4	7	4	0	150	5,4
Overloading of part of body	4	21	3	17	8	50	1	3	12	18	7	9	30	2	21	11	12	0	229	8,2
Splinters, splashes	4	6	2	2	0	18	2	1	7	12	4	21	38	3	2	59	1	0	182	6,5
Electrical current	0	0	0	16	0	1	1	0	0	1	0	1	0	0	0	0	0	0	20	0,7
Extreme temperature	0	0	0	2	8	1	1	0	0	4	3	5	4	1	0	5	0	0	34	1,2
Fall into sea	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	<0,1
Other	4	3	0	5	2	7	1	2	3	3	2	4	6	0	1	3	0	0	46	1,7
Total	70	267	38	192	98	531	70	32	136	210	80	171	280	88	169	221	127	7	2785	
%	2,5	9,6	1,4	6,9	3,5	19,1	2,5	1,1	4,8	7,5	2,9	6,1	10,0	3,2	6,1	7,9	4,6	0,3		

4. Petroleum economy

4.1 Exploration drilling, deliveries of goods and services

The exploration drilling market since the beginning in 1966 has increased substantially both in volume and value.

The average costs per well during the period 1971–78 were NOK 59 million. From 1979 to 1980 the annual average costs increased from NOK 67 to 83 million, increasing further to NOK 113 million in 1981. Subsequently, the average costs per well have stayed at this level.

Figure 2.2.2.a shows the number of spuddings per year during 1966–1984.

In Figure 4.1.a the value development of the market is illustrated in current kroner and fixed 1984 kroner. In 1966, goods and services amounting to NOK 65 million were consumed. Ten years later, the value of goods and services was approximately NOK 860 million. In 1984 the total costs for exploration ran to some NOK 6714 million. Of this amount, some NOK 5026 were directly related to exploration drilling. General exploration, including geological and geophysical surveys and seismics, accounted for approximately NOK 435 million. Some NOK 680 million were used for field assessment, and some NOK 573 million for administrative and similar purposes.

FIG. 4.1.a
Yearly exploration costs, fixed 1984 kroner

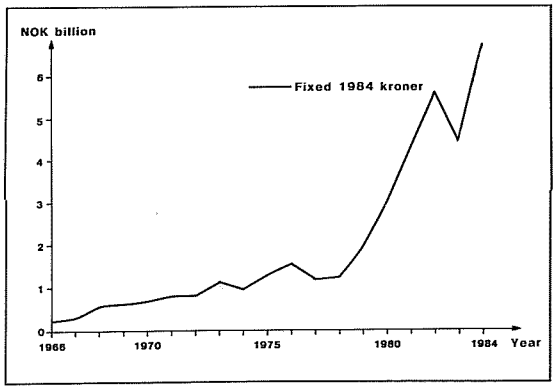
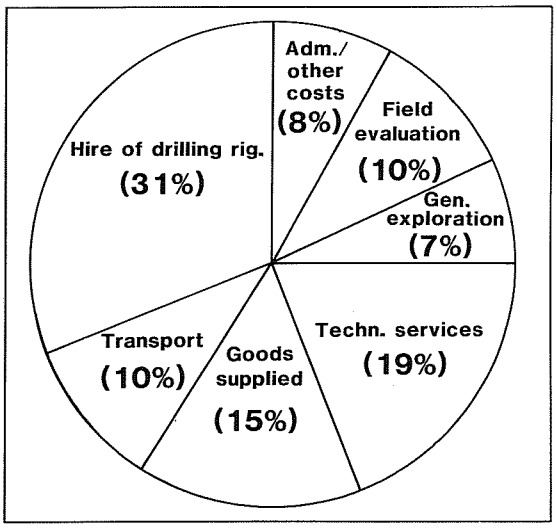


Figure 4.1.b shows roughly how the NOK 6714 million were distributed by main categories of goods and services consumed in exploration activities, including the above.

FIG. 4.1.b
Exploration expenditures in 1984



The statistics are based on reported data submitted by the operating companies, and include all exploration and appraisal wells spudded in 1984. For wells spudded towards the end of the year, the total costs and costs distribution estimates are the Norwegian Petroleum Directorate's.

It should be pointed out that, unlike previous years, this year's figures reflect the total licence costs for licences in the exploration phase.

4.2 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 1970–84. Costs apply to developed fields, fields under development and fields with approved development plans as of 31 December 1984. 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)

FIG. 4.2.a
Historical and expected investments in field development and production drilling, 1972-2008, fixed 1984 kroner

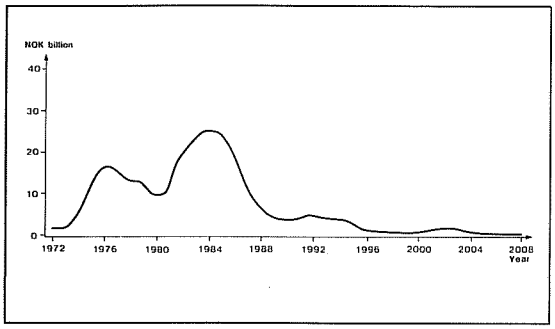
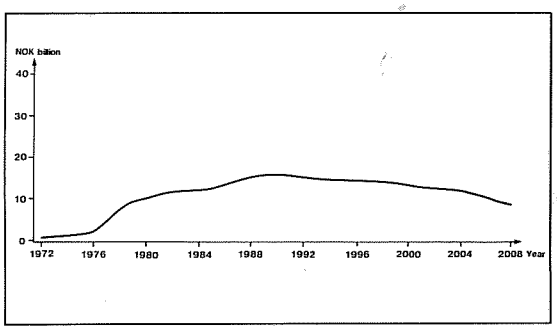


FIG. 4.2.b
Historical and expected operating costs, fixed 1984 kroner



- Valhall
- Ula
- Frigg (including pipeline) (60.82 %)
- North East Frigg
- Odin
- Statfjord (84.09 %)
- Murchison (25.06 %)
- Heimdal
- Gullfaks Phase I
- Statpipe

All figures in the summary are in fixed 1984 kroner.

Historical investments for field development, production drilling and transport facilities for petroleum are depicted in Figure 4.2.a. The investment level increased gradually to 1976 when NOK 16.7 billion were invested. From 1976 until the present, the average annual investments have been NOK 16 billion. However, this figure hides the fact that large variations have occurred. First there was a five-year period from 1976–80 in which the investment level gradually fell off to NOK 9.8 billion. Subsequently we experienced four years with increasing activity until 1984, which presumably will show an investment peak of no less than NOK 25 billion.

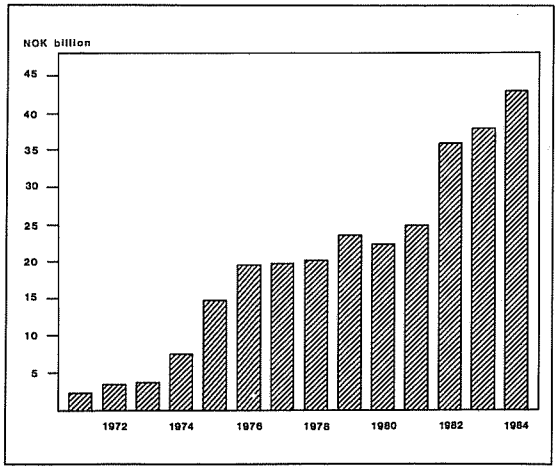
The investment level is expected to remain at about NOK 20 billion in 1985 and 1986. From then on, it will fall off rapidly. New decisions to develop will probably affect the investment level early on in the four-year period and will arrive with full force in 1987–88.

Annual operating costs, including the operation of pipelines, are presented in Figure 4.2.g. The demand level for this type of goods and services has been stable since 1982, the last year during which major fields were put in operation.

The goods and services inputs for the operation and maintenance of these fields will show a long-term increase as a result of new fields being brought on stream. At present, the level is about NOK 12 billion. This level is expected to increase to just under NOK 20 billion in 1988. At this time, the effect of the closing down of the first fields will begin to show, and the operating costs levels for the declared fields are expected gradually to decrease. Nevertheless, any new fields which are declared will be able to create an increase in demand, which will counterbalance this decrease.

Figure 4.2.c shows the total goods and services input. So far the total market has increased by an average of NOK 3 billion annually, and in 1984 the prognosis quotes a total demand of some NOK 43 billion. In Figure 4.2.d the relative share of the three components: exploration costs, investments and operating costs is calculated. After the exploration costs for a period accounted for a relatively small part of the total market, the figure has now settled at approximately 14 per cent. A levelling off of the operating costs at the same time as investment levels increase has caused the operating costs' share of the total market to sink, being approximately 12 per cent in 1984. The investments are expected to make up about 59 per cent of the total market in 1984. In 1976 the investments represented a share of 86 per cent.

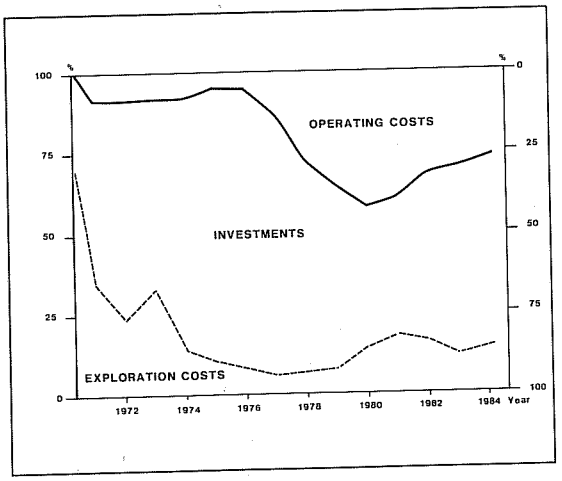
FIG. 4.2.c
Total exploration costs, investments and operating costs, fixed 1984-kroner



4.3 Royalties

Royalties are calculated on the basis of the value of petroleum quantities produced. In 1984, royalties amoun-

FIG. 4.2.d
Exploration costs, investments and operating costs in per cent of the total market for goods and services



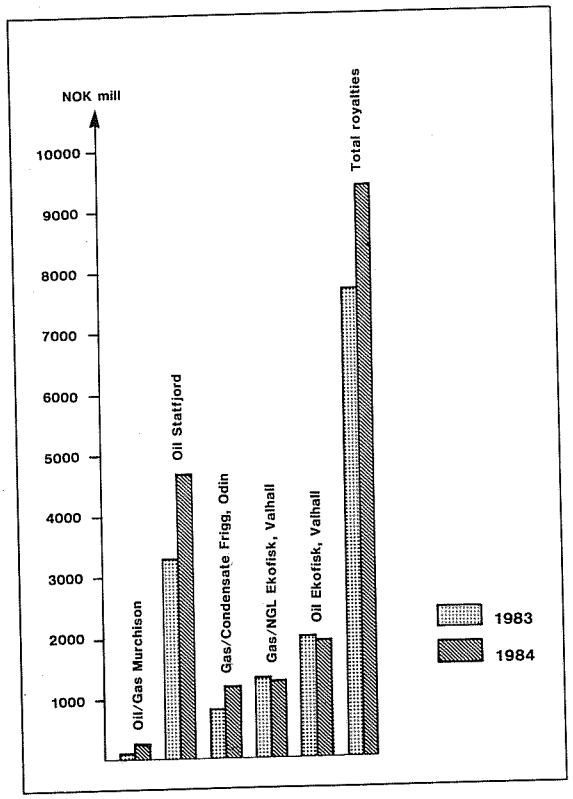
ted to some 25 per cent of total taxes and duties procured from the petroleum activities on the Norwegian Continental Shelf.

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, Odin and Valhall were awarded in pursuance of these regulations. The King's Resolution of 9 April 1965 was superceded by King's Resolution of 8 December 1972. Of the fields in production, production licences for Statfjord and Murchison were awarded in accordance with the 1972 resolution.

FIG. 4.3.1.a
Royalties 1983–84



4.3.1 Total royalties

In 1984, a total of NOK 9,639,415,366 were paid in royalties.

FIG. 4.3.1.b
Royalties 1973–84

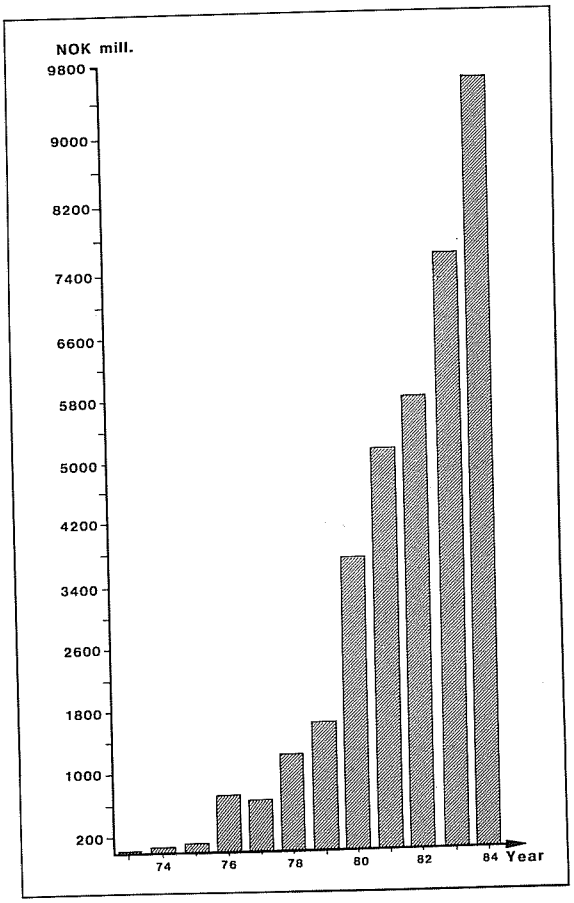


Table 4.3.1 shows the distribution of royalties by petroleum product as paid up in 1983 and 1984.

Figure 4.3.1.a presents the total royalties in 1983 and 1984 as a bar chart, while Figure 4.3.1.b shows the paid-up royalties from 1973–84.

4.3.2 Royalties on oil

In 1984 the Norwegian Petroleum Directorate received NOK 6,932,400,787 in royalties on oil from Ekofisk, Statfjord and Murchison.

TAB 4.3.1
Royalties 1983 and 1984

	1983	1984
Oil Ekofisk/Valhall	2 008 357 221	1 924 617 933
Oil Statfjord	3 311 772 676	4 751 366 160
Production bonus (Statfjord)	50 000 000	
Oil Murchison	114 066 651	256 416 694
Gas Murchison	603 722	3 096 997
Gas Ekofisk	1 182 530 048	1 203 476 267
Gas Frigg	861 972 454	853 727 113
Gas Odin		53 518 568
Gas Valhall	2 542 466	34 092 699
NGL Ekofisk/Valhall	118 394 171	104 609 892
Condensate Frigg	6 929 175	7 844 370
LPG og NGL Murchison	6 329 969	12 347 157
Recalculated Frigg (gas and and condensate)		147 127 463[1]
	7 663 498 553	9 639 415 366

1 The amount was paid 1 December 1984 and covered recalculated for the Frigg area in the period of 1977 to 1984.

Settlements with regard to crude oil were based in 1984 on the standard price. Royalties were paid quarterly as shown in Table 4.3.2.

4.3.3 Royalties on gas

In 1984 the Norwegian Petroleum Directorate collected NOK 2,582,213,160 in royalties on gas. Table 4.3.3 shows the payments of royalties by company (or group of companies) each quarter.

Gas royalties have been settled on the basis of the contract price. This is different from group to group.

The payment made by Dyno/Methanor is settlement for that part of the royalty which was taken out in the form of produced oil. The supply of gas to Dyno/Methanor ceased from 1 July 1984.

The refund amount of approximately NOK 4.4 million is payment to the operator as compensation for the costs on Ekofisk which have accrued on that part of

TAB 4.3.2
Royalties on oilproduction

	Ekofisk/Valhall	Statfjord	Murchison
Provisional settlement, 4. qu. 1983	467 741 242	1 064 197 242	23 914 939
Price adjustment, 3.–4. qu. 1983	40 450 373	96 335 574	2 209 838
Provisional settlement, 1. qu. 1984	437 921 303	1 126 819 755	70 469 324
Price adjustment 1. qu. 1984	16 533 392	7 108 586	2 097 152
Provisional settlement, 2. qu. 1984	548 074 655	1 182 992 183	92 897 098
Price adjustment, 2. qu. 1984	3 102 437	8 182 727	674 016
Provisional settlement, 3. qu. 1984	410 794 531	1 265 730 093	64 154 327
	1 924 617 933	4 751 366 160	256 416 694

TAB 4.3.3
Royalties on gas production

	4. qu. 83	1. qu. 84	2. qu. 84	3. qu. 84	Total
EKOFISK AREA					
Phillips group	257 471 836	224 205 404	247 808 360	281 108 799*	1 010 594 399*
Less refunded by NPD	304 843	2 239 590	1 031 700		3 576 133
Net Phillips Petroleum Co.	257 166 993	221 965 814	246 776 660	281 108 799	1 007 018 266
Dyno/Methanor	11 247 622	98 112 229	37 893 994	– 1 031 079	146 222 766
Shell	14 349 427	11 909 768	10 763 389	10 288 498	47 311 082
Amoco/Noco		184 189	1 112 400	2 433 442	3 730 031
Less refunded by NPD	239 417	337 970	228 491		805 878
Net Amoco/Noco	– 239 417	– 153 781	883 909	2 443 442	2 924 153
TOTAL Ekofisk	282 524 625	331 834 030	296 317 952	292 799 660	1 203 476 267
FRIGG AREA					
Petronord group (NØF)	12 033 882	12 534 352	9 033 877	2 602 453	36 204 564
Petronord group					
(Frigg)	249 009 648	282 015 997	217 567 696	105 133 772	853 727 113
(Odin)	81 609 347	80 314 565	53 499 955	71 750 186	287 174 053
Recalculated (Frigg)				147 127 463	147 127 463
TOTAL Petronord group	342 652 877	374 864 914	280 101 528	326 613 874	1 324 233 193
Esso Expl. (NØF)	5 312 349	6 108 718	4 420 439	1 472 498	17 314 004
TOTAL Frigg area	347 965 226	380 973 632	284 521 967	328 086 372	1 341 547 197
VALHALL					
Amoco/Noco	3 070 677	10 381 931	9 851 011	10 789 080	34 092 699
MURCHISON			x	x	
Stat/Mobil x	869 985	– 78 456	1 440 563	864 905	3 096 997
TOTAL all fields	634 430 513	723 111 137	592 131 493	632 540 017	2 582 213 160

x +condensate
* Inclusive payments in advance per 31 Desember 1983 in NOK 53,150,000,–.

state royalties which have been collected in the form of produced petroleum.

The settlement for calculation of the royalties from the Frigg area for the Petronord group during the period 1977–84 has been calculated according to provisional guidelines. However, agreement has been reached concerning a distribution between deductible and non-deductible equipment components in the royalty accounts for the Frigg field in tune with the "Ekofisk model", which has formed the basis for the 1965 licences. The recalculation for the time period 1977–84 is underway. In this connection, the amount of NOK 147,127,463 was paid up on 31 December 1984. The final settlement for this time period is expected to be made in 1985.

Gas transport from Murchison started on 15 July 1983. The dry gas was taken out at St Fergus and sold to the British Gas Corporation.

Pursuant to the King's Resolution of 1972, the royalty on propane and butane from Murchison which is landed together with oil shall be calculated according to the same duty rate as for Murchison oil, which is 8 per cent.

NGL which is landed together with the gas shall be calculated according to a duty rate of 12.5 per cent. NGL which is transported together with the gas to St Fergus is now being delivered to Mossmorran for treatment and storage. This delivery started on 1 November 1984. The shipment of NGL will be accomplished from Brayfoot Bay.

4.3.4 Royalty on NGL

In 1984 the amount of NOK 124,801,419 was paid up as royalty on NGL. Table 4.3.4 shows the payments by company/group each quarter.

4.4 Acreage fees on licence areas

During 1984 the Norwegian Petroleum Directorate has collected NOK 105,289,895 in acreage fees. The amount is distributed by licence as follows:

Licences announced in 1965:	NOK	52,693,800
Licences announced in 1969:	NOK	26,737,500
Licences announced in 1971:	NOK	1,938,800
Licences announced in 1973:	NOK	5,372,800
Licences announced in 1975:	NOK	3,760,498
Licences announced in 1976:	NOK	6,363,144
Licences announced in 1977:	NOK	1,303,395
Licences announced in 1982:	NOK	2,354,700
Licences announced in 1983:	NOK	4,759,500
	NOK	105,284,137

The Norwegian Petroleum Directorate had refunded NOK 21,417,470 in acreage fees as of 1 November 1984. This represents a deductible part of the acreage fees for production licences 006, 018 and 037 for the period 1 October 1983 to 1 November 1984.

Figure 4.4 shows the paid up acreage fees for 1973–1983.

4.5 Sales of petroleum from the Norwegian Continental Shelf

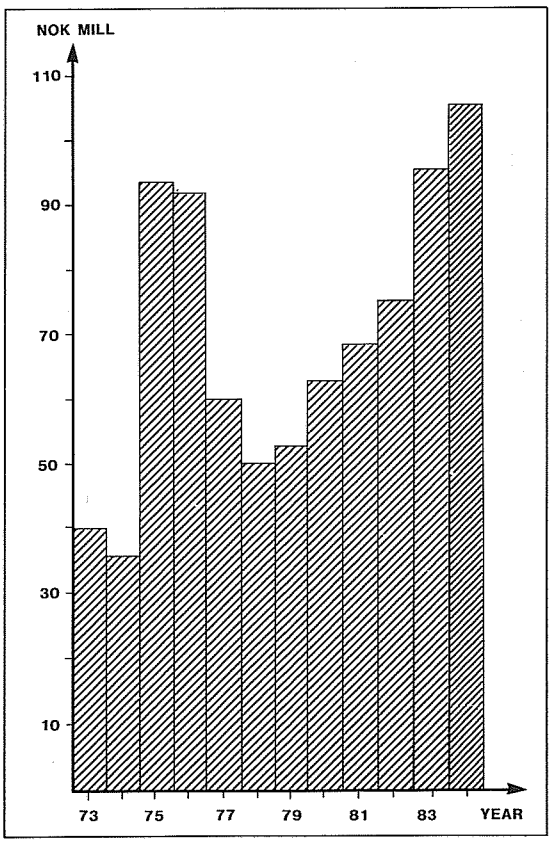
4.5.1 Crude oil

The total shipments of crude oil from Ekofisk (via Teesside), Statfjord and Murchison (via Sullom Voe) were 33.7 milion tons in 1984, compare Figure 4.5.1.a. This represents an increase of 15.4 per cent compared with the previous year. Of these shipments, some 19 per cent went to refineries in Norway. From 1980 up to and including 1982, the US was the largest receiver of Norwegian oil. In 1983, Great Britain took over this

TAB 4.3.2
Royalties on oilproduction

	Ekofisk/Valhall	Statfjord	Murchison
Provisional settlement, 4. qu. 1983	467 741 242	1 064 197 242	23 914 939
Price adjustment, 3.–4. qu. 1983	40 450 373	96 335 574	2 209 838
Provisional settlement, 1. qu. 1984	437 921 303	1 126 819 755	70 469 324
Price adjustment, 1. qu. 1984	16 533 392	7 108 586	2 097 152
Provisional settlement, 2. qu. 1984	548 074 655	1 182 992 183	92 897 098
Price adjustment, 2. qu. 1984	3 102 437	8 182 727	674 016
Provisional settlement, 3. qu. 1984	410 794 531	1 265 730 093	64 154 327
	1 924 617 933	4 751 366 160	256 416 694

FIG. 4.4
Area fees 1973–1984



place, and in 1984 no less than 27.1 per cent of crude oil shipments were directed to Britain.

Figure 4.5.1.b shows the crude oil sales in 1984 for the major oil companies. Statoil accounts for approximately 40 per cent of crude oil sales and had available more than 100 million barrels in 1984, including royalty oil to the Norwegian state. Phillips Petroleum Company Norway, Norske Fina A/S and Mobil Development Norway A/S all had more than 20 million barrels of crude available in 1984. These same companies, beside Statoil, were also the most important producers of crude oil from the Norwegian Continental Shelf.

4.5.2 Natural gas

The market for Norwegian dry gas is presently limited to Great Britain and the continent, represented by buyer countries West Germany, the Netherlands, Belgium and France. The total gas exports, as shown in Figure 4.5.1.a, were 26.24 billion Sm^3 in 1984. This represents an increase of approximately 7.5 per cent in relation to the previous year. Some 13.65 billion Sm^3 were exported to Great Britain and 12.56 billion Sm^3 to the continent.

Figure 4.5.2 shows the distribution of the gas sales among the most important companies in 1984. Elf Aquitaine Norge is the company having most gas available on the Norwegian Continental Shelf, with 5.3 billion Sm^3, or approximately 20 per cent. The most important change since 1983 is that Esso Exploration and Production Norway has now achieved a sizeable gas sale since the Odin field came on stream.

FIG. 4.5.1.a
Sales quantities of oil and gas as per country

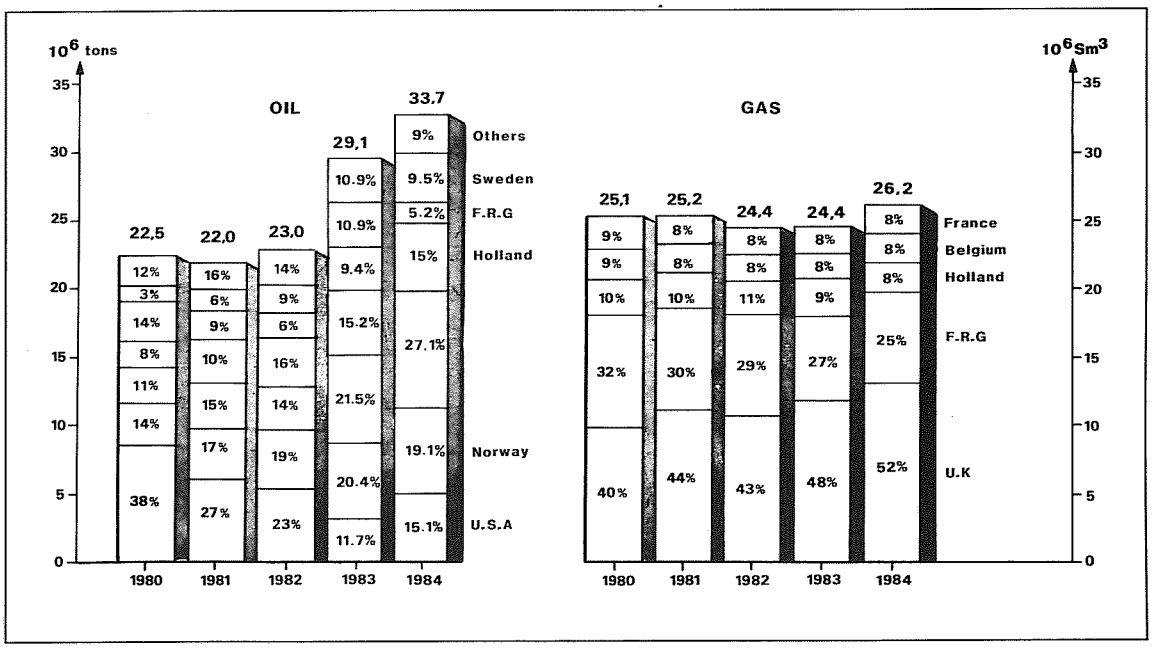


FIG. 4.5.1.b
Sales quantities of oil as per licensee

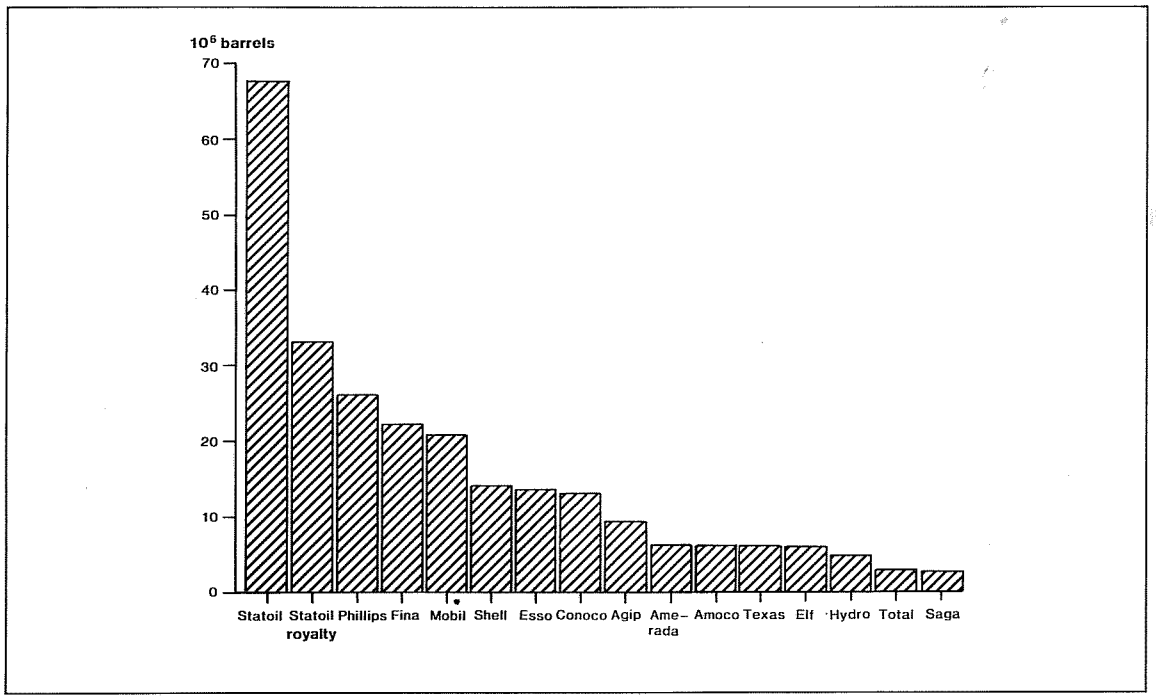
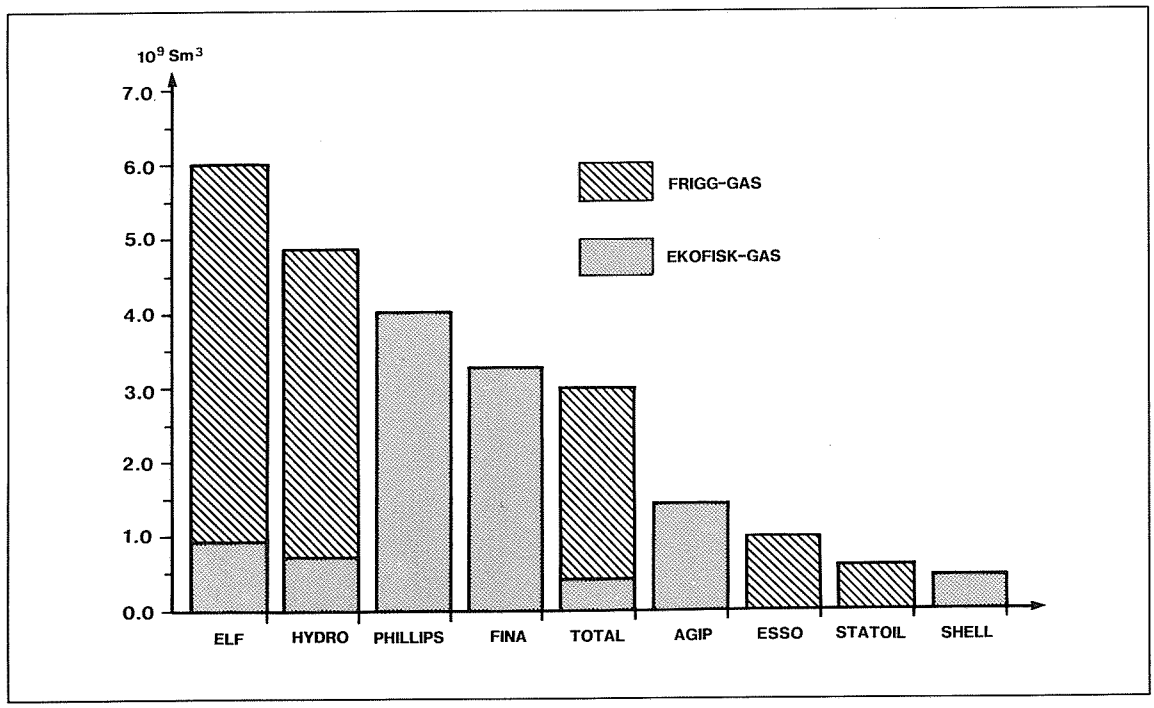


FIG. 4.5.2
Sales quantities of gas as per license



5. Perspectives for petroleum activities

Background for the Petroleum Outlook 1984

The Petroleum Outlook is prepared by the Norwegian Petroleum Directorate as a basis for discussion for the authorities in their planning of Norwegian petroleum activities in the long and medium-to-long term. They are also prepared to assist the Directorate in its internal planning.

An attempt has been made to present a form of analysis which can provide a high level of information for other parties who wish to keep informed regarding Norwegian petroleum activities and its future prospects.

The Petroleum Outlook 1984 has generally the same structure as the 1983 issue. Some technological subjects have been taken up to show what challenges one is facing in this area. Furthermore, a relatively comprehensive discussion of development activities north of Stad is presented. A four-year prognosis for the activities ahead is also presented.

When preparing the development scenarios particular emphasis has been placed on stressing the uncertainty of prices and our dependence on market opportunities for gas.

As compared with the Petroleum Outlook 1983, some substantial changes have been included in this year's edition as a result of new information received and decisions made since last year:

- The resources base off Troms and on Haltenbanken has been upgraded. In particular, the proving of a pure oil field on Haltenbanken has increased the chances of a rapid development of this area.
- The development plan for Sleipner has suffered a further set-back.
- Gullfaks Phase II has been submitted as a candidate for early development, with possible project start in 1985.
- The Oseberg field has been declared for development and the estimated resources base in the area has been upgraded.
- Confirmation has been received that Saga's oil discovery on Block 34/4 extends into Block 34/7.

Summary and conclusions

The most important conclusions of the Petroleum Outlook 1984 may be summarized under the following headings:

Historical developments

In recent times a substantial increase in the rate of opening new areas has been pursued, both as regards areas opened for surveying and areas opened for exploration drilling. A continual assessment should be made of whether capacity limitations seem to be in evidence, either as regards the authorities or the companies, concerning the interpretation and utilization of collected data, and whether these limitations are preventing other activity from being performed in a directed and resource optimal fashion. A continual assessment should also be run of whether this increase in activity is necessary to achieve the desired framework conditions for future activity.

Both as regards the distribution of blocks and drilling activities, a marked displacement of activity has taken place northwards. Of areas available for exploration drilling, 31 per cent are to be found north of Stad and 25 per cent of the collected exploration and appraisal drilling in 1984 was done in this area.

Total proven potential reserves amount to about 4.2 billion t.o.e. This represents an increase from 1983 of about 0.5 billion t.o.e. Development in the past also shows that there has been a displacement in the distribution of potential reserves from oil to gas. In 1979, oil comprised well over 50 per cent of the proven reserves. Today, gas comprises 65 per cent of the proven potential reserves.

Production composition is not suited to our distribution of reserves as about 57 per cent of production today is oil and NGL.

Four-year prognosis

The four-year prognosis for exploration drilling, exploration costs, operation, production and income shows that it is generally possible to maintain activity at the level decided upon for implementation. As regards the four-year prognosis for investments, the level for 1985–86 will probably be the same as the 1982 level – in other words, lower than the peak value attained in 1984, even if new development projects are decided upon in 1985.

Price and market development for oil and gas

Petroleum prices and market conditions represent the greatest factors of uncertainty for the future development of the activity on the Continental Shelf. Historically, oil prices have varied greatly and, at the mo-

ment, there are factors which are depressing oil prices, as the producing countries' desired level for oil production exceeds expected demand for oil in the short term. The same factors apply to the gas market and influence the price levels on new gas contracts.

The market opportunities for Norwegian gas seem today to be difficult until the mid-1990s. Competition may arise for future market shares, both between alternative energy bearers, alternative gas exporting countries, and between Norwegian gas fields.

Technological challenges

Over half our proven petroleum reserves are found in areas with water depths of 200–350 meters. This means great challenges regarding the development of new production installations and recovery methods.

The prices uncertainty means that it is likely that there will arise a need to reduce the costs connected with recovering petroleum. This has to be done to ensure the development of marginal fields and to increase the recovery factor on each individual field, in other words, to take care of the marginal resources in each field.

These and other factors will result in a great need to develop better and more economical recovery methods. The technological innovations accomplished will also be of importance for Norwegian industry's opportunity to compete with foreign vendors.

Resource potential

The resource potential used in the Petroleum Outlook lies between 4.7 and 4.9 billion tons oil equivalent (t.o.e), depending on which development alternatives are chosen for the North Norwegian projects. The resources potential incorporates some undrilled prospects in addition to the proven reserves of 4.2 billion t.o.e. This reserves potential is dependent on a reasonable prices, market and technological development if it is to be realized.

On the basis of today's resources mix and market conditions, it seems correct to try to increase our oil resources and prove gas reserves which will be able to utilize existing installations, or other gas reserves which can be developed with very low development costs per produced unit.

This relationship must be balanced against the need to have long-term planning of resources management, making it desirable to have a total overview of the resources.

It must nevertheless be emphasized that it is not clear in advance which blocks contain oil, and which gas. In some mature areas, it is possible to state how probable it is to find gas (or oil) in a given area, though the uncertainty is large. In particular, uncertainty is large off North Norway, where exploration is in a very early phase.

Likely development projects south of Stad

Our freedom of action regarding the development of gas fields is to a large extent dependent on market factors. Particularly with regard to satellite fields and fields with associated gas, it will be important to achieve new gas agreements which incorporate a certain flexibility regarding which fields can supply the gas to be sold.

The Troll field represents the largest single development on the Norwegian continental shelf and the demand must be made that any development plans provide the necessary flexibility and total resources utilization from the field as a whole.

For some projects like Gullfaks Phase II, one will be faced with having to choose between early, separate development, or a postponement of the development until idle capacity on other fields can be redirected, thus reducing development costs.

The development of satellite fields will be crucial in the time to come when idle capacity arises in existing transportation and process equipment. This will open new questions and make large demands of cooperation between the various groups of licensees.

Development projects north of Stad

At present one oil field has been proven on Haltenbanken. If further mapping of the field confirms the reserves estimates already assumed, this field will most probably be the first development task north of Stad. Additionally, the discovery opens prospects of being able to prove further oil in the area.

Midgard and Tyrihans may well be subject to development under optimistic economic presuppositions. A coordination of the development will probably be able to provide substantial advantages. A resource related clarification regarding gas development seems to be possible in the course of few years. Statoil's discovery in Block 6506/12 may prove to be a central one in this context.

At present on Haltenbanken there seems to be a small difference in transportation costs between LNG and pipeline transportation in favour of LNG. On Troms, this difference is greater, and also in favour of LNG. The selection of transport concept, if any, should not be made before the resources potential has been better surveyed. Any change in transportation system later will prove highly costly. For this reason, the first choice made should be very thoroughly considered.

Source rocks have been proven in the Troms area which indicate that the possibility of an oil strike in the area is good.

The gas discoveries made so far constitute together a sizeable resource. A coordinated development provides clear-cut advantages by comparison with separate development of the structures. Only with the optimistic economic presuppositions do the projects provide a return approaching the ordinary criteria for returns and taxes.

Market factors will be quite decisive for the development of the gas fields in the Troms area and on Haltenbanken. The projects on Haltenbanken seem to possess both economic and transport related advantages in relation to the Troms projects.

The individual development scenarios

It seems it will be possible to maintain a long-term investment level of about NOK 20 million annually for all scenarios presented. This also applies to the scenario with low gas, where one precondition is that no new gas fields enter production before 1995, though here it is assumed that there will occur a rapid increase in gas production after that date.

Low price expectations will reduce the portfolio of fields. The lowest long-term price path which the Norwegian Petroleum Directorate has utilized, with a constant real price until the year 2010, nevertheless provides a sufficient number of fields with acceptable economy to maintain the desirable activity level for the duration of the plan period ending 2010.

It will be difficult to achieve a uniform regional distribution of the investment level as long as the number of projects north of Stad is small. This applies particularly at lower price expectations, which would cause the Troms projects to lapse.

If the total investment level is to be held uniform, the activity in the south will have to be reduced strongly during periods with high activity in the north. It is possible to phase the fields in the south in this way as long as sufficient non-time-dependent projects of diverse magnitude are available. However, it is probable that the increase in idle transportation and process capacity in the south will lead to the number of non-time-dependent projects decreasing.

Operating costs will escalate strongly as the new fields are gradually brought on stream. By about 1995 the operating costs will probably have reached some NOK 20 billion annually, which is equal to investments. Until the year 2000, the level is expected to flatten off at approximately NOK 25 billion a year. Operating costs seem to be little affected by which scenario is chosen, and the spread in annual estimates is small.

If we largely base our intentions on sustaining activity by developing new oil fields, our position will become gradually more precarious regarding the possibility of keeping the activity levels at par. This must only be viewed as a middle term strategy until the market can accept Norwegian gas. To be able to deliver gas from the year 2000, such gas ought to be sold before 1995.

Gas constitutes approximately 65 per cent of our proven reserves and it is further probable that gas will constitute a sizeable part also of the predicted, non-proven reserves. Of the proven gas reserves, approximately 25 per cent have been sold. The future activity is therefore greatly dependent of being able to sell gas which will have to make up an important component of our long-term petroleum production. It will be easy to maintain a production level of 70 billion Sm^3 gas per year for almost 30 years solely on the basis of the proven, unsold gas reserves.

Apart from market uncertainties, price uncertainty represents the greatest challenge for our long-term planning. The State's revenues will to a large extent be affected by the price suppositions which are assumed. For the scenario with high gas production, the estimated revenues vary from NOK 50–250 billion in year 2010, depending on the price assumptions made. These revenues' contribution to Norway's onshore economy vary accordingly between 10–35 per cent in 2010.

Nevertheless, none of these price alternatives provide in any of the scenarios a long-term level of income below the present level. The potential for income growth will, however, vary greatly and highlights the desire to effectively distinguish the application of revenues from the earning of them.

6. Regulatory work

6.1 Norwegian Petroleum Directorate's work with regulatory reforms

In 1984 the Norwegian Petroleum Directorate has been working on a total of 15 revisions in regulations. Certain formal requirements are applicable when making regulatory reforms. In addition to the rules of the Administration Act regarding the duties to report, notify in advance and gather comments from interested parties, the Government laid down by King's Resolution of 17 December 1982 a separate set of instructions, the "Instructions relating to Regulations", which deal with the administration's work involving public reports, acts, regulations, etc.

This has had direct consequences for the Directorate's regulatory work insofar as the Directorate in 1984 found it necessary to lay down a separate, internal job instruction for the work of reforming regulations. The instructions were laid down on 20 November 1984 and replaced the previous instructions dated 15 June 1983. The new instructions emphasize in particular the Directorate's administrative system for the decision-making base when initiating and implementing regulatory works.

The point of departure for the Government's Instructions relating to Regulations is that regulatory reforms cannot be initiated without receiving consent from the relevant ministry, making submission to the Ministry of Finance or receiving the Government's consent. The Instructions relating to Regulations of 17 December 1982 focus particularly on the work of analysing the economic and administrative consequences of the proposed regulations. The Directorate is therefore bound to submit to the relevant ministry plans for the initiation of regulatory work, plus the associated reports on the economic and administrative consequences.

Before initiating regulatory work, the Norwegian Petroleum Directorate in 1984 has stressed the necessary evaluations of matters and questions within the petroleum activity for which regulation is important and necessary. The formulation of objectives for each individual regulatory reform has found a central place. The Directorate places particular weight on finding the best solution in terms of the means and instruments which can be of interest in solving the tasks and problems which the regulatory reform is aimed at.

In connection with the evaluation by the Directorate, a description and clarification of whether a different safety standard should be facilitated, or whether the regulations should be tightened or relaxed, is also included.

The Directorate's regulatory work has uncovered weaknesses in the regulatory system now prevalent, partly by limiting delegations between directorates, the lack of cohesion in the regulations, and the relationship to maritime legislation, cf. Section 6.2 below.

The Directorate in particular degree has emphasized the tuning of the detail regulations to the framework which the Petroleum Act will lay down, both as regards material requirements and requirements for documentation during various phases of the petroleum activity. The regulatory work has therefore also encompassed special assessments regarding any needs for initiatives for coordination with other regulations, either which the Directorate itself has supervisory responsibility for, or which belong under another supervisory agency.

In the opinion of the Norwegian Petroleum Directorate, the Instructions relating to Regulations have triggered a clear-cut systemization and provided a better decision base for the relevant ministry regarding initiation and implementation of regulatory work. On the other hand, the Instructions relating to Regulations have caused regulatory revisions to take longer than hitherto, and be more sluggish to accomplish. However, the Directorate sees one advantage in these Instructions in that they provide an instrument by which one can achieve better control of the body of regulations and a methodical development of them, cf. Section 6.4 below.

6.2 Characteristics of the regulation situation, preparations for entry into force of the Act relating to Petroleum Activity in 1985

Within the supervision of safety, the working environment and preparedness in the petroleum activity, there exist a total of five ministries and eleven directorates who have supervisory authority according to continental shelf legislation, the Working Environment Act and maritime legislation. The legislative instruments referred to have different natures, are aimed at different target groups and make requirements which are mutually inconsistent. For the Directorate and our supervisory efforts, this situation causes regular difficulties, apart from for the industry itself, for employees and other implicated parties. The Norwegian Petroleum Directorate is therefore looking ahead to the entry into

force of the Petroleum Act with its new Safety Regulations, which will provide the central hub of legislation for public control and monitoring of the petroleum activities.

With the Petroleum Act, a superordinate requirement for sound activity will have been put on paper. The requirement is directed at the licensee and any other participant in the petroleum activity, but with a special duty for the licensee to see that the requirements are met (internal control). By this act, the Ministry of Local Government and Labour as special ministry for safety and preparedness will be assigned the particular responsibility for seeing that the collected safety related total assessment is performed before the activity is initiated or in association with operations. The Norwegian Petroleum Directorate is of the opinion that this can best be done by concentrating the control responsibility in one organ. In the Directorate's opinion, one will therefore avoid a continuation of the splitting up of supervisory responsibility which has contributed to the present unclear control arrangement based on detail-oriented rules which reflect different control methods and different control traditions in the various government agencies. The Directorate will look with concern to see whether the main trends in the present splitting up of control authority at directorate level will be continued pursuant to the Petroleum Act.

On the background that unfortunately, no clarification of the main contours of implementation of supervision of petroleum activities pursuant to the Petroleum Act was undertaken, the Norwegian Petroleum Directorate in its work with regulatory reform has had to take special consideration of this uncertainty.

Further, it is characteristic for the regulatory situation that the safety requirements in the continental shelf legislation and the Working Environment Act do not have the same area of application. This has generated particular problems in connection with coordination and implementation of control responsibility as it relates to supervision of safety related conditions and working environment conditions for production installations where the licensee has chosen untraditional development concepts, or selected to use a mobile installation during an early phase of the field development. The problem came particularly to a head through the Ministry of Local Government and Labour's instructions to the Norwegian Petroleum Directorate relating to the termination of control pursuant to the Working Environment Act on the Ekofisk waterflood project when using the jack-up rig "Dyvi Beta". Confer Section 6.3 below.

6.3 Relationship between continental shelf legislation, working environment legislation and maritime legislation on mobile installations used for production purposes

Licensees on the Norwegian Continental Shelf have in recent years in ever increasing degree presented development concepts for approval in which mobile installations are utilized as production facilities, or as an integrated part of such facilities. The utilization of such mobile installations generates many legal problems for which the implicated authorities will have to find solutions.

The background for the formal problems exists in the fact that the current safety and working environment legislation is insufficiently adapted to the situation which has arisen, where mobile installations are utilized for production purposes. Norwegian and foreign registered mobile installations are basically regulated by the country of registration's maritime legislation (flag state jurisdiction). The use of mobile installations belongs at the same time under the Norwegian Continental Shalf and working environment legislation. There are conflicts between several legal bases, and it will be the task and responsibility of the authorities to harmonize the applicable legislation. This harmonization must be based on several fundamental motives, such as the consideration of proper operation, the consideration of clarity in legislation for both the authorities and the parties involved, and the need for constitutional clarity in the assigning of authoritative responsibility. The need for consistency, harmony and cohesion in the legislation has been frequently voiced as a political target. Among other citations, reference can be made to the report concerning the "Alexander L Kielland" disaster and the committee's comments following dealing with the matter by the Storting. In Odelsting Proposition no. 72 (1982–83) for the Act relating to Petroleum Activity, the Halden Committee's reports, NOU 1976:40 and NOU 1977:36, it is also emphasized that there is a need for consistency in the regulations on the Norwegian Continental Shelf.

The above-mentioned problems were described for the first time in the Norwegian Petroleum Directorate's Annual Report for 1983. In Section 2.3.5.3 on Odin, the Directorate explained the application of the shelf, maritime and working environment legislations to the semi-submersible rig "Treasure Hunter", which was acting as integrated production facility on the Odin field. In 1984 too, the Directorate has dealt with several development concepts in which mobile installations are utilized as production facilities.

By King's Resolution of 30 September 1983, it was decided to initiate the water injection project on the Ekofisk field. In Storting Report no. 18 (1983–84) the field development plan is described. The development will require construction and installation of a new Platform 2/4-K, which is planned to be installed in the second quarter of 1986. Drilling of production wells through already installed seabottom templates started in the second quarter of 1984 and will continue until 2/4-K is placed in fixed position over the template. Drilling of the production wells will take place in the interim from a mobile Norwegian registered rig, "Dyvi Beta". The Dyvi Beta will, according to the Storting Report mentioned, constitute a part of the field development plan, which, in principle, will mean that safety

and working environment related matters will have to be evaluated in concert.

Based on development plans presented by Phillips Petroleum Company A/S, the Ministry of Local Government and Labour stated by letter of 17 April 1984 that one would apply the same regulatory basis as for the Odin concept. This means the application of King's Resolution of 9 July 1976 relating to Safety during Production, plus the application of the Working Environment Act as for other fixed installations. The Ministry of Trade has since disputed that the Ministry of Local Government and Labour has the authority to assume that the Working Environment Act is applicable on Dyvi Beta. The disagreement between the ministries was brought to the Ministry of Justice Legal Department in August 1984. The Legal Department concluded that the arguments which point to Dyvi Beta being a fixed installation do not carry such weight that the clear wording of King's Resolution of 1 June 1979, § 2, first paragraph, should be set aside. The Legal Department therefore assumes that Dyvi Beta must be assumed to be a mobile installation in pursuance of § 2, first paragraph. Consequently, the Working Environment Act does not find application for the activities of the Dyvi Beta.

In a letter to the Norwegian Petroleum Directorate from the Ministry of Local Government and Labour of 19 September 1984, the Ministry takes recognizance of the Legal Department's statement. The Ministry of Justice further states that it finds there can be little dispute that the King's Resolution of 9 July 1976 relating to Safety Regulations for Production applies for the activity on Dyvi Beta. The inspection and control activities which the Norwegian Petroleum Directorate performs with authority in this regulation will thus not be affected by the fact that the Working Environment Act is not applicable. Following from the Ministry of Local Government and Labour's letter, the Norwegian Petroleum Directorate has therefore terminated its control of Dyvi Beta pursuant to the Working Environment Act as regards matters covered by maritime legislation.

On the background of the above arguments, the Norwegian Petroleum Directorate puts forth the following summary of the formal situation on mobile installations which are used for production purposes:

A. Authorities' responsibility – management and coordination

The Directorate considers it desirable to clarify the total authorities' responsibility for use of mobile installations for production purposes. In the operation of the Odin field, the Norwegian Petroleum Directorate has held the total responsibility based on application of the Working Environment Act and shelf legislation (King's Resolution of 1976). The Ministry of Local Government and Labour's main view was stated in the Ministry's letter to the Norwegian Petroleum Directorate of 25 March 1983: "The Ministry in its assessment has also emphasized the idea that the project, in the development as well as the production phase, shall be subject to a safety and working environment related evaluation and control". An equivalent precondition was included by the Ministry of Local Government and Labour in the letter of 17 April 1984 to the Norwegian Petroleum Directorate concerning the rig Dyvi Beta.

The situation which has arisen following the Ministry of Local Government and Labour's resolution of 19 September 1984 is complicated and disquieting for the Directorate. Apart from anything else, there is no longer just *one* official control agency possessing the coordination responsibility for the legislation to be applied. The Norwegian Petroleum Directorate will continue to have the responsibility for pursuing the shelf legislation as represented by the 1976 resolution, and regulations issued pursuant to it. Furthermore, the Norwegian Petroleum Directorate will have the responsibility for certain groups who will continue to be covered by the working regulations of the Working Environment Act and 1979 resolution. The Labour Inspectorate will have responsibility for the Working Environment Act, Chapters 11 and 12, for these groups. The Maritime Directorate will, through the Act relating to Working Hours on Ships, cf King's Resolution of 19 August 1977 relating to Regulations for Working Hours on Norwegian Drilling Rigs etc, cf the Crewing Regulations of 28 February 1975, be charged with the responsibility for working hours matters for the installation's maritime crew, drill crew, catering staff, etc. As a third control agency, the Directorate for Seamen will, through the Seamen's Act, cf King's Resolution of 19 December 1980, have the responsibility for safety conditions onboard for all groups, excepting external inspectors who visit onboard for short periods.

Regarding work related conditions therefore, there will be no less than four public agencies who are charged with control duties. None of the agencies has at present the right or duty to coordinate the public sector responsibility for protecting life and health.

The Norwegian Petroleum Directorate wishes to raise the question of where the authorities' total responsibility will be placed if an accident should occur. A "minor accident", in which only personal injury occurs, seems to come under the Directorate for Seamen (Ministry of Trade) by virtue of the application of the Seamen's Act. For "major accidents", the 1976 resolution's provisions are assumed to be applicable, charging responsibility to the Norwegian Petroleum Directorate/Ministry of Local Government and Labour/licensee. The Norwegian Petroleum Directorate/Ministry of Local Government and Labour/licensee will have responsibility, irrespective of whether the accident is major or minor, pursuant to the 1976 resolution, § 5, first paragraph. This provision overlaps the safety and supervisory authority of the maritime authorities.

The Ministry of Local Government and Labour's resolution that the Working Environment Act shall not apply to Dyvi Beta means that, in reality, there will be effectively two "labour inspectorates", the Norwegian Petroleum Directorate (for "technical" detail regula-

tions) and the Maritime Directorate/Directorate for Seamen. In the same way as the licensee has problems looking after his total responsibility, the involved authorities will be directed to have a supervisory responsibility without having control of all conditions which touch on this responsibility. For example a situation can be imagined whereby the Norwegian Petroleum Directorate issues an injunction for changes to equipment in the drilling module which will have consequences for the responsibility of the Maritime Directorate/ Directorate of Seamen regarding occupational hygiene matters for the employees.

Additionally, in this special situation, the Norwegian Petroleum Directorate, as supervisory agency, is unable to draw upon the organized safety cooperation between the employees, safety services and employer, as prescribed by the Working Environment Act and as applies for other production activities on the Norwegian Continental Shelf.

The task and duty of the Norwegian Petroleum Directorate to record (and prevent) work accidents etc includes the production activities on the Norwegian Shelf. It will clearly be difficult for the Norwegian Petroleum Directorate to include in its statistics work accidents which occur on this installation, seeing as the Directorate has neither contract nor influence on the organized safety cooperation, nor influence otherwise on a number of conditions which affect the accident picture.

Through the licensee's system of internal control for following up legislation which charges the *licensee* with duties, the Norwegian Petroleum Directorate has established a system for following up the rules which the Directorate is responsible for. Users of this set of rules have adjusted their control function on the basis of this internal control system. Shipowner activities have not to the same extent established a corresponding control arrangement. As a consequence of this, for one and the same activity, for example Dyvi Beta, one will have introduced two different systems for following up control of safety and working environment factors.

B. Mandatory subject

The mandatory subject according to the 1976 resolution and largely according to the Working Environment Act is the operator. Through established internal control, the operator will coordinate the follow up of the set of rules mentioned as regards safety and the working environment on each individual installation. The mandatory subject according to the Seamen's Act, Act relating to Working Hours on Ships, etc, will be the individual shipowner/platform manager. The Norwegian Petroleum Directorate assumes that the above relationships will create uncertainty regarding responsibility and coordination, both on the authorities' side and, not least, towards the users. On one and the same installation, the operator, pursuant to the rules of the 1976 resolution, will have the responsibility for the technically related matters, as opposed to the safety and environmental standard, which is the responsibility of the shipowner/platform manager. The above mentioned matters will create coordination problems as regards the operator/shipowner, as well as in the relationship between the user and the authorities.

A major point in the Ministry of Local Government and Labour's original resolution to make the Working Environment Act applicable to Dyvi Beta's activities, was to ensure that the licensee was awarded the opportunity to take care of the total responsibility for safety, preparedness and working environmental aspects which lie within the accomplishment of the development plan. This is a fundamental principle in the control arrangement which has been set up for production installations. Such a total responsibility will be a presupposition if the licensee is to be able to perform his duties in pursuance of § 5 of King's Resolution of 9 July 1976, which stipulates that the licensee is responsible for seeing that the activity is run such that all persons staying on or by Dyvi Beta are protected, as far as possible, from injury.

The licensee is ordered to establish an internal control system. The basis of the licensee's control activities will be determined by the demands the legislation makes of the licensee (mandatory subject).

The licensee cannot be ordered to bear a responsibility to ensure that the requirements made of safety and the working environment which are laid down pursuant to other legislation, and where someone apart from the licensee is the mandatory subject (shipowner), shall be maintained with the aid of the licensee's internal control.

By and large, the licensee seems in this situation to be faced with an uncomfortably difficult task, namely to hold total responsibility for the activity, including a general responsibility to secure the life and health of all persons staying onboard, at the same time as the licensee is not the mandatory subject for parts of the total legislation. The licensee's problems regarding maintaining a total responsibility are aggravated by the fact that the shipowner/maritime authorities on their own initiative – in pursuance of their own rules – can make changes in the facilities on the installation etc which affect the total level of safety.

It follows from this that any reintroduction of the Working Environment Act on Dyvi Beta would of course only partially resolve the fundamental questions here facing us.

C. Right of the safety delegate to stop work

One special problem seems to be linked to the fact that there now no longer exists a regulation of the safety delegate's stopping rights which accords with the regulation applying on production facilities otherwise. This applies to the duty to notify the Norwegian Petroleum Directorate, and for the safety delegate to present a demand for shutdown to the person responsible for the operation it is desired to stop.

According to the maritime legislation's provisions, the safety delegate can himself stop the activity tempo-

rarily until the platform manager, or his appointee, has decided whether the work operation may continue.

Phillips Petroleum Company Norway, as operator of Dyvi Beta, have clearly explained that the company cannot accept stoppage of work according to the maritime legislation's provisions, and that they intend to enter into an *agreement* with the platform manager/shipowner that the provisions laid down pursuant to the Regulations relating to Worker Protection and the Working Environment of 1 June 1979 shall apply in the absence of legislation which maintains harmony in the rules.

D. Legislation and regulations

In general therefore it can be said that, for example, Dyvi Beta's activities, technical and physical facilities and plant, operating procedures, approvals and certificates, working environment factors, security against damage, etc., are subject to two different sets of rules and two different mandatory subjects, each of them controlled by different public agencies.

Moreover, the two agencies are often responsible for control of one and the same detail circumstance on the basis of more or less identical sets of rules (control related to the Norwegian Petroleum Directorate's consent and control related to the Maritime Directorate's certificates), but vis-a-vis two mandatory subjects (licensee contra captain/owner). Such double control activity is considered to be unfortunate.

For safety related matters, the situation is that the great majority of provisions regarding the physical and chemical working environment are regulated by both sets of legislation. We can mention for example: the general requirements made of the workplace, security devices for technical installations and equipment, dimensioning of workrooms, cabins, recreation rooms, stairs, ladders, lighting conditions, climatic conditions, pollution, noise, hygienic conditions, etc.

On the basis of the above, the Directorate considers that we are confronted with an unclear legislative situation and unclear inter-relationships between the control agencies.

E. The consideration of clarity for the authorities

The Norwegian Petroleum Directorate is presently evaluating some future development plans and concepts in which Norwegian registered, mobile installations will be utilized for production purposes. Soon to be accomplished activities of this type will be the predrilling on Gullfaks A (Dyvi Stena) and Oseberg (Vildkat). At a rather later date, the field areas of Troll, East Frigg, Hod, Haltenbanken, the Statfjord area and Tom Thumb will be interesting for similar evaluations, depending on technological progress, etc. The Norwegian Petroleum Directorate is further aware that diverse operators have corresponding plans for future activities in which, for one thing, mobile installations will be utilized as processing plant (production and testing installations, alternatively combined with drilling rigs).

It will therefore be necessary to clarify the legislation to be applied, both as regards the employees' and the licensees' duties, as well as the authorities' responsibility.

F. The consideration of clarity for the involved parties

An unclear formal situation creates problems for the offshore industry in total. Effective planning of future activities is difficult. This can have major administrative and economic consequences for the parties.

6.4 The need for methodic regulatory evolution

As is apparent from the presentation above, the existing regulations are complicated and non-consistent, at the same time as they do not adequately look after the need of the authorities for collective safety and working environmental assessments.

When the Petroleum Act enters into force in 1985, this will provide a basis for a more methodic approach to the architecture of the regulations. The legislation will at this point in time in petroleum legislation consist of three structural levels:

- Petroleum Act with frameworks and main requirements for the activity as regards the most important decisions and licensing system during different phases
- The Ministry of Petroleum and Energy's regulations pursuant to the Act and the Ministry of Local Government and Labour's regulations pursuant to the Act (as outlined in the appendix to Odelsting Proposition 72, 1982–83)
- King's Resolution relating to the Requirement for the Licensee's Internal Control System, incorporating the requirements for the licensee's management instruments and administration to ensure observance of the legislation
- Detail regulations pursuant to the Act.

The Petroleum Act will furthermore, by clarifying the main principles for the relationship between the supervisory responsibility pursuant to the Petroleum Act and maritime legislation (cf Odelsting Proposition, Pages 12–13), provide a basis for methodic implementation of how requirements for documentation shall be satisfied by using maritime certificates in the individual areas of activity.

The Norwegian Petroleum Directorate notes moreover with satisfaction that the Ministry of Local Government and Labour has used the Instructions relating to Regulations, cf King's Resolution of 17 December 1982, for active management of its regulatory evolution insofar as the regulatory work which is intended to cover the entire activity is concerned. For 1984, this is the case with the Directorate's regulatory work for Requirements relating to Load-bearing Structures for Production Installations, Rules for Preparedness and Regulations for Fire Prevention Measures.

On the basis of the Petroleum Act, a collaboration has been inaugurated between the Ministry of Local Government and Labour and the Norwegian Petro-

leum Directorate in the form of a preliminary project aimed at assessing the possibilities for and the implementation of a methodical structuring of the regulations on the basis of the Petroleum Act. The objective is to evaluate more closely the possibility of guiding regulatory amendments according to a coherent plan for regulatory revision within petroleum activities, on the basis of activities and phases, plus documentation principles and licensing systems pursuant to the new Petroleum Act and Safety Regulations.

The Directorate considers that the work with the regulatory structure should, additionally, particularly be aimed at ensuring a uniform and non-ambiguous safety level for petroleum activities and a more systematic and coherent structuring of the rules. The Directorate further views this matter such that it will provide a clearer definition of areas of responsibility within supervisory authorities and better potential for a controlled development of the use of terminology in the rules.

The Directorate also believes that planning of the regulatory development will improve the opportunity to select either functional, result-oriented rules which do not lock developments, or specification rules. This also accords with the Petroleum Act and the new Safety Regulations, which in fact open the way for better regulation techniques at the detail regulation level than is the case pursuant to the present Safety Regulations of 3 October 1975 (exploration drilling) and 9 July 1976 (production).

7. Special reports and projects

In 1984 the Norwegian Petroleum Directorate granted a total sum of NOK 12,942,370 for special projects. This amount is distributed on the basis of NOK 2,703,522 for the Safety Control Department; NOK 9,957,205 to projects under the auspices of the Resource Management Department; NOK 281,643 to projects of the Legal and Economic Department. In addition, the sum of NOK 4,270,883 has been granted for the project North Sea Ocean Bed Clean-up, which has been administered by the Administration Department. The project titles with executing agencies are listed below. In addition, some of the projects are described in particular.

Safety Control Department

PROJECT TITLE	PROJECT EXECUTION AGENCY
Nodal Point Influence on the Design of Steel Jackets	UEG, W S Atkins Group
Area Classification, Regulations/Guidelines	NPD
Further Development of Drilling Data Bank	Rogaland Research/NPD
Evaluation of New Technology/New Equipment within Drilling/ Completion and Well Maintenance	NPD
Guidelines	NVE/SSI/NPD
Support to NEC for Participation in International Standardization Work regarding Regulations for Electrical Installations and Area Classification	Norwegian Electronics Committee
Registration and Location of Lightning Discharges	Electrical Association's Research Institute (Norway)
Safeguards for Electrical Motors in Explosion Hazard Areas	Electrical Association's Research Institute (Norway)
Flexible Hoses, Pipes and Pipelines in Hydrocarbon Systems	Veritec
Draft Guidelines for Minimum Performance Requirements and Standard Unmanned Test Procedures for Underwater Breathing Apparatus	Department of Energy/NPD
Time Margins for Hyperbaric Evacuation	NUTEC
Neurological Long-Term Effects of Deep Diving	European Undersea Biomedical Society/ NPD
Guidelines for Emergency Preparedness	Quasar Consultants A/S
Chemicals in the Offshore Industry	NPD/Product Registry/Toxicological Information Center
Reporting from the Organized Safety and Environmental Work	NPD/Rogaland Research
Work Conference	NPD/Rogaland Research
Pre-project: "Living Quarters on Production Installations"	NPD/Firma Karl Rogne
Pre-project: "Lighting on Production Installations"	Electrical Association's Research Institute (Norway)
Accumulation of Natural Radio Activity	Institute of Energy Technology
Mutagen Activity in Drilling Mud	Central Institute of Industrial Research
Updating of E&P Data Regulations	NPD, with external assistance
Updating of 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

PROJECT TITLE	PROJECT EXECUTION AGENCY
Participation in Fatique Program	DnV/SINTEF
Pipeline Regulations	NPD, with external assistance
Testing and Evaluation of Repair Equipment and Methods for Pipelines and Rises	Veritec
Data Bank for Marine Calculation	DnV
Corrosion Control in Seawater at Depths Down to 500 m	Veritec/NSFI
Calculation Procedure for Cathodic Protection, Platforms	DnV
Drying of Offshore Pipelines Before Start-up with respect to Corrosion	NSFI
Acceptance Criteria for H Divisions	Norwegian Laboratory of Fire Technology/ NPD
Computer Based Safety and Control Systems	DnV/NPD

Emergency shutdown valves in gas pipelines

In the 1983 Annual Report, the need for emergency shutdown (ESD) valves in underwater gas pipelines was mentioned.

One Norwegian and two foreign oil companies are now working on the development of different concepts for valves with the diameters and operating pressures which are required.

The most difficult part of the task is to develop structures which are almost maintenance free over many years. Furthermore, considerable development work will be required to arrive at reliable systems for efficient remote control of such valves. Electrical, pneumatic, hydraulic and accoustic signal transmission will be studied.

The above mentioned work is of great general interest as experiences and technical solutions may be transferred to other underwater equipment.

The Norwegian Petroleum Directorate is following up the development work which is performed.

Flexible hoses

Particularly for underwater production installations, flexible hoses offer many advantages in relation to conventional, rigid steel pipes.

The hoses can be prefabricated, and installed directly on the sea floor from cable drums placed on relatively small vessels at a fraction of the cost incurred by conventional pipelaying vessels.

Remotely controlled hook-up under water is easier to perform with flexible hoses and also seems to represent a useful solution to the problem of marine risers for floating production units.

The hoses are built up of several layers of plastic or rubber, reinforced with many layers of flat steel tape or steel wire.

Some operational experiences from various parts of the world are available.

These hoses with their composite sandwich structure raise several problems. For example, plastic and rubber are not 100 per cent diffusion tight to gas at high pressures, and small quantities of gas will leak out through the hose walls. Seawater will penetrate into the walls and cause corrosion of the reinforcement. Furthermore, conventional "intelligent pigs" cannot be used for corrosion monitoring in the same way as with steel pipes.

The Norwegian Petroleum Directorate has engaged Veritec to perform a study of the design of the various makes of flexible hoses, collect data from operation experiences and propose acceptable methods and procedures for status control.

Guidelines for preparedness

In 1984, the Norwegian Petroleum Directorate started a broadly based work with a view to strengthening the preparedness on the Norwegian Continental Shelf. A preliminary project was initiated for preparedness guidelines, and was expected to be concluded by the turn of the year 1984–85.

One objective of the preliminary project is to analyze the preparedness problems in sufficient breadth and depth to initiate a main project in 1985. The objective of the main project is "to develop a preparedness model which, among other things, includes management, rescue, combating shipwrecks, and supplies and communications for the offshore petroleum industry". Furthermore, "to develop methods and control tools for the evaluation of the quality of preparedness systems which are used or planned to be used on offshore installations and production fields. This tool shall be able to show the systems' ability to act to minimize the loss in the event of accidents (loss of or injury to human lives, the environment and material values)".

The main project is expected to last about two years. Its organization and contents will, among other things, be clarified in the preliminary project. The knowledge which is obtained through studies of the preparedness problems in the main project shall be applied in the preparation of future regulations and/or guidelines for preparedness.

Also subject to the preliminary project's regulations and guidelines for preparedness is the Maritime Directorate's ongoing audit of the applicable regulations relating to rescue means on production installations in the petroleum industry.

Safety and environmental work

In collaboration with Rogaland Research, the Norwegian Petroleum Directorate held a conference in the period 3–6 December 1984 in Farsund, entitled: "Safety and Environmental Work. Action Program for Practical Implementation". In the course of the conference the Norwegian Petroleum Directorate hoped to start a dialogue between personnel in the safety service, safety delegates and health personnel in the industry. The objective was to illuminate these personnel groups' characteristics, collaboration pattern, and areas of joint engagement. The conference has been summarized in a report prepared by Rogaland Research.

Accumulation of natural radioactivity

In the summer of 1984, the Norwegian Petroleum Directorate, together with the Institute of Energy Technology, performed a systematic survey of the accumulation of the radioactivity in production systems, oil, gas and formation water. This was done in connection with the production of hydrocarbons on the following fields:

- Statfjord
- Odin
- Frigg
- Ekofisk
- Valhall

The purpose of the survey was to uncover possible working environment problems in the petroleum industry on the basis of the accumulation of natural radioactivity.

Resource Management Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
Diagenetical Examination of the Statfjord Formation	Intitute for Geology, Univ. of Oslo
Further Development of Economic Analysis Tools	CMI
Analysis of Project Portfolios on the Continental Shelf	SINTEF
TARIFF, Model for the Calculation of Transportation Costs and Capacities of Transportation Facilities on the Norwegian Continental Shelf	Kvam Data A/S
Geological Analyses of Jurassic Sediments in the North Sea	University of Liverpool, Dep. of Geology
Reserve Calculation Program, Statfjord Field	IFE
Primo Simulation Model for the World Oil Market	CMI
Area Plan, Haltenbanken	NPC
Updating the Petroleum Outlook Model	Compas Consultants
When should oil/gas discoveries in North Norway be initiated, and in what form?	CMI
Reservoir Computer Simulation of the Brent Reservoir – "Black Oil"	IFE
Reservoir Simulation of Troll, Part I	Rogaland Research
Reservoir Simulation of Troll, Part II	Franlab
Computer Based Data Bank for Use in Connection with Uncontrolled Blowouts	O.P. Berget
Further development/Prognosis Uncertainty (PROPRO)	CMI
LOPAP – Systematic Storage of Pres. Production Prognosis	CMI
Internal Development of Competence, Increased Recovery	IFP

In-house competence build-up for increased recovery

The estimate of in-situ quantities of petroleum seen in relation to the quantities which are expected to be recovered by traditional recovery methods show that there is a substantial potential for increased exploitation of reservoirs on the Norwegian Continental Shelf. One has resolved to initiate a national research program on increased exploitation of reservoir technology, with grants totalling NOK 9.8 million in 1985. This shall be administered in close collaboration with the Norwegian Petroleum Directorate.

Against this background, the Norwegian Petroleum Directorate wants to increase its in-house competence in enhanced recovery. Projects which were implemented in 1984 partly encompassed internal studies, partly tuition and assistance by international experts in gas injection and chemical flooding.

Legal and Economic Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
NEL-Automatic Sampling of Crude Oil	National Engineering Laboratory, Scotland
Density Determination of Natural Gas Under Operation Conditions	Rogaland Research
Modification of HP programs	G. Kolnes

Administration Department

TITLE OF PROJECT	PROJECT EXECUTION AGENCY
Clearing up the Sea Bed of the North Sea	NPD

Clearing up North Sea seabed

Also for 1984, the Norwegian Petroleum Directorate was given the responsibility for the implementation of the clearing-up project.

The clearing up of junk took place in the period 2 July to 27 August. This year too, the fishermen's organizations placed priority on clearance efforts on Egersundbanken, primarily on parts of Blocks 10/1, 18/12 and 19/10.

Two stern trawlers were engaged to be in charge of the clearance work, for which a specially made trawl and sweep line with six grapnel irons were used.

During the last part of the project a visual inspection of the 31 recorded obstructions was made with a remotely operated subsea vehicle.

In all, about 150–200 tons of junk were cleared up the bulk of which consisted of old wire rope.

The clearing-up project was headed by an executive committee on which the Norwegian Petroleum Directorate, Directorate of Fisheries, Hydrographic Survey of Norway, Norwegian Fishermen's Association, and Norwegian Industry Association for Operating Companies were represented. The executive committee has prepared a final report from the project where the various aspects of the clearing work are described in greater detail.

8. International Cooperation

8.1 North-West European cooperation

The fourth North-West European conference on "Safety and pollution safeguards in the development of North-West European mineral resources" was held in London in the period 16–18 October 1984. The participating countries in the international harmonization work are Belgium, Denmark, Eire, France, the Netherlands, Norway, Great Britain, Sweden and the Federal Republic of Germany.

In addition, the following countries and organizations were represented as observers at the London conference:

- Canada
- Internation Maritime Organization
- European Community, Oil Industry
- International Exploration and Production Forum
- International Association of Classification Societies
- International Association of Drilling Contractors
- British Rig Owners' Association
- Norwegian Ship Owners' Association

The conference was a continuation of the Oslo conference in 1982, with main emphasis on the voluntary certification system for mobile drilling platforms.

In the two year period 1984–86, Denmark will take care of the secretariate functions and is the host country for the fifth North-West European conference which is planned to be held in 1986.

8.2 The European Economic Community EEC

The Norwegian Petroleum Directorate 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 with the designation "Safety and Health in the Oil and Gas Extractive Industries".

8.3 The European Diving Technology Committee EDTC

The EDTC includes members from 13 countries in Europe and each member country is, among other things, represented with a member from its national authorities. The objective of the organization is to give recommendations to member countries in matters relating to the safety of divers. The Norwegian Petroleum Directorate's representative is the chairperson of the organization for the present two-year period.

8.4 The Association of Diving Contractors AODC

The Norwegian Petroleum Directorate has participated in the work performed by the AODC to set up a "Code of practice for safe use of electricity under water". The draft is ready and will be published in the beginning of 1985.

8.5 The European Undersea Biomedical Society EUBS

Under the auspices of the EUBS, a major meeting was held in Stavanger concerning the long-term effects of deep diving on the divers' central nervous system. The Norwegian Petroleum Directorate has seen to it that the speeches and an extract of the discussions have been collected in a book which has now been published.

8.6 The international organizations CIRIA/UEG

In 1980, the Norwegian Petroleum Directorate became a member of CIRIA/UEG, UK. CIRIA is a research and information institution which performs a great number of significant research projects in connection with the petroleum industry. The research assignments have been very relevant for the areas of responsibility and work tasks which are allocated to the Department of Safety Control. The professional cooperation which has been established and the source of information which CIRIA represents have been of great help, among other things in safety reports and regulation work for the Norwegian Continental Shelf.

8.7 Aid to foreign countries

The Norwegian Petroleum Directorate has continued its aid to foreign countries, through NORAD, as in previous years. 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. Among other things, a program for the interpretation of seismic data has been worked out.

The assignments in Mocambique have been tied to the further work in connection with the allocation of production licences. In addition, guidance has been given in connection with the collection and processing of seismics in shallow waters.

For Burma, an evaluation has been concluded of a suggested program for increased petroleum extraction

from an existing oil field. It was recommended that NORAD should not become further involved in this program.

For Bangladesh, a geological evaluation has been performed and assistance has been given to the Bangladesh Petroleum Institute with respect to training. Further, detailed surveying work has been planned.

The Norwegian Petroleum Directorate shall function as a data bank for seismic data for the Seychelles. In addition, assistance has been given in the evaluation of consultant reports.

For Jamaica, a seismic data collection program has been evaluated, and has now been approved for financing by NORAD.

8.8 Welding Institute

The Norwegian Petroleum Directorate has been a member of the Welding Institute since 1981. This Welding Institute is a leader in the offshore area and is very active within research, education and consultancy services. Membership opens the door for consultancy assistance, project participation, and current information on the most recent knowledge within materials and welding technology.

One of the members of staff of the Norwegian Petroleum Directorate is also a member of an advisory group for research in offshore safety in the British Department of Energy in England.

8.9 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, a Norwegian Measurement Technology Forum has been formed in which the Norwegian Petroleum Directorate participates. In the report period, the Norwegian Petroleum Directorate participated in a total of four meetings in this field.

9. Statistics and Summaries

9.1 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:

Sm^3 = 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 Sm^3 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 Sm^3 =	Standard cubic meter
Nm^3 =	Normal cubic meter
Scf (Scuft) =	Standard cubic feet

Temperature and pressure references must be given for the unit to be unambigious.

Conversion

1 Sm^3 corresponds to approximately 0.95 Nm^3

1 Sm^3 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 Sm^3 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 Sm^3 gas

9.2 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.

9.3 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 447 exploration and appraisal wells had been spudded as of 31 December 1984.

Information from these wells is presented statistically to illustrate some features of the activities.

A total of 328 of these were exploration wells and 119 were appraisal wells. Of these, 420 were concluded as per the same date. Fifteen wells were suspended for various reasons (*), and twelve are currently being drilled. The wells have been drilled by 17 different operating companies. In 1984, 47 wells were spudded, of which 35 exploration wells and twelve appraisal wells. They were drilled by ten operating companies, of which three were Norwegian. The Norwegian companies drilled 33 wells (63.8 per cent). Furthermore, in 1984, six suspended wells were re-entered for further operations (testing, further drilling, plugging). Five of these were concluded and one was suspended. Fourteen of the wells spudded in 1984 were drilled in the northern region, seven on Tromsøflaket, one on Trænabanken and five on Haltenbanken. A total of 34 blocks were drilled in, of which 21 in the southern and 13 in the northern region.

A total of 1,416,053 meters have been drilled in the wells included above, of which 149,034 meters were drilled in 1984. The average penetration of the 47 wells which were spudded in 1984 was 3116 meters, and the average water depth was 213 meters.

For the drilling on the Continental Shelf a total of 57 different drilling rigs were employed, five of them under two different names. Of these, 40 were of the semi-submersible type, eleven were jack-ups, four were drill ships and two were fixed installations.

In 1984, a total of 16 drilling rigs operated on the Norwegian Continental Shelf. In the course of 1984, four new drilling rigs started drilling on the Norwegian

(*) 101.325 kPa = 1.01325 bar = 1013.25 mbar = 1 atmosphere
(*) Some reasons for suspending wells are later testing, possible completion as production wells and further drilling or later plugging.

Continental Shelf. Two are of the semi-submersible type: "Vildkat" and "Zapata Ugland"; one of the jack-up type: "Glomar Moray Firth I", and one a drill ship: "Pelerin". The deepest bore 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 for Well 34/2–3, drilled in 1981 with Amoco as operator.

Tab 9.3.a
Monthly activity on the Norwegian Shelf 1984

		Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Des		
Drilled at year-end	1983/84													10 wells	
Spudded	1984	2	1	5	5	5	5	2	4	7	3	6	2	47 wells	
Re-entries	1984			3			1	1		1				6 wells	
In progress	1984														63 wells
Completed	1984	1	3	6	6	3	3	4	7	6	7	4	1	51 wells	
Suspended	1984													0 wells	
Abondoned	1984														51 wells
Drilled at year-end	1984/85														12 wells
Rig days: Foreign		31	24			4	35	55	25	48	88	60	62	432	10,2%
Rig days: Norwegian		301	276	311	323	342	340	400	351	316	301	259	3803		89,8%
Rig days: Total		332	300	311	323	346	375	455	376	364	389	319	345	4235	100%

TAB 9.3.b
Rig days per rig on the Norwegian Shelf 1984

Drilling rig	1. quarter	2. quarter	3. quarter	4. quarter	Total
Borgny Dolphin	84	88	90	90	352
Byford Dolphin	91	46	87		224
Cod Plattform				8	8
Deepsea Bergen	90	91	87	91	359
Dyvi Alpha	15	91	43		149
Dyvi Delta	83	91	91	48	313
Glomar Moray Firth I .		34	49	92	175
Neddrill Trigon	55			92	147
Nortrym	91	88	89	83	351
Le Pelerin		13	32		45
Ross Isle	91	88	92	92	363
Treasure Saga	91	87	91	90	359
Treasure Scout	82	90	92	73	337
Treasure Seeker	83	90	90	90	353
Vildkat		53	89	92	234
West Vanguard	87	90	92	86	355
Zapata Ugland		4	79	26	109
	943	1044	1193	1053	4233

TAB 9.3.c
Rig days per quarter 1966–1984

Year	1. quarter	2. quarter	3. quarter	4. quarter	Total per year
1966			74	85	159
1967	90	91	168	191	540
1968	144	334	286	244	1 008
1969	211	224	268	114	817
1970	64	167	424	286	941
1971	179	180	286	198	843
1972	172	363	560	372	1 467
1973	142	205	309	461	1 117
1974	490	462	339	367	1 658
1975	267	468	523	411	1 669
1976	646	451	536	323	1 956
1977	225	296	532	564	1 617
1978	371	436	474	342	1 623
1979	464	548	653	757	2 422
1980	936	892	1 022	1 027	3 877
1981	1 030	933	1 000	1 068	4 131
1982	1 081	1 192	1 075	1 028	4 376
1983	1 084	920	944	952	3 900
1984	943	1 044	1 193	1 053	4 233
	8 539	9 206	10 666	9 843	38 354

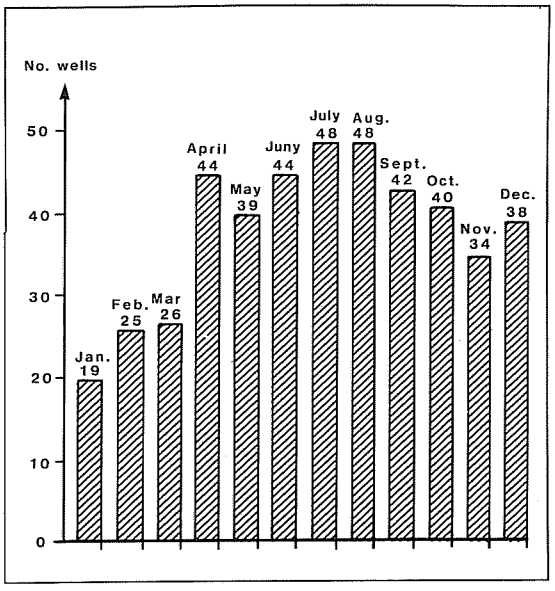
TAB 9.3.d
Exploration wells per operator

Statoil	91	wells
Norsk Hydro	58	«
Phillips	52	«
Esso	46	«
Elf	40	«
Amoco	32	«
Shell	35	«
Saga	30	«
Mobil	18	«
BP	16	«
Conoco	15	«
Gulf	6	«
Murphy	4	«
Texaco	1	«
Agip	1	«
Syracuse	1	«
Union	1	«
	447	wells

TAB 9.3.e
Exploration wells spudded in 1984

Statoil	15	wells
Norsk Hydro	10	«
Shell	7	«
Saga	6	«
Elf	2	«
Esso	2	«
BP	2	«
Conoco	1	«
Mobil	1	«
Gulf	1	«
	47	wells

FIG. 9.3.a
Seasonal variations in drilling activity 1966–84



TAB 9.3.f
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
1984	213	3 116

TAB 9.3.g
Drilling rigs that have been operating on the Norwegian Continental Shelf

Name of drilling rig	No of wells	Type of rig
Aladdin	1	Semisubmersible
Chris Chenery	2	«
Borgny Dolphin (formerly Fernstar)	21	«
Borgsten Dolphin (form. Haakon Magnus)	6	«
Byford Dolphin (form. Deepsea Driller)	10	«
Cod Plattform	1	Fixed installation
Deepsea Bergen	8	Semisubmersible
Deepsea Driller (now Byford Dolphin)	8	«
Deepsea Saga	17	«
Drillmaster	6	«
Drillship	1	Drillship
Dyvi Alpha	17	Semisubmersible
Dyvi Beta	7	Jack-up
Dyvi Gamma	1	«
Dyvi Delta	9	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
Glomar Biscay II (former Norskald)	12	Semisubmersible
Glomar Grand Isle	11	Drillship
Glomar Moray Firth I	2	Jack-up
Maersk Explorer	7	«
Neddrill Trigon	2	«
Neptune 7 (former Pentagone 81)	12	Semisubmersible
Nordraug	10	«
Norjarl	3	«
Norskald (now Glomar Biscay II)	26	«
Nortrym	21	«
Ocean Tide	5	Jack-up
Ocean Traveler	9	Semisubmersible

Continue

Name of drilling rig	No of wells	Type of rig
Ocean Victory	1	«
Ocean Viking	29	«
Ocean Voyager	2	«
Odin Drill	3	«
Orion	7	Semisubmersible
Pelerin	1	Drillship
Pentagone 81 (now Neptune 7)	1	Semisubmersible
Pentagone 84	3	«
Polyglomar Driller	11	«
Ross Isle	6	«
Ross Rig	28	«
Saipem II	1	Drillship
Sedco H	2	Semisubmersible
Sedco 135 F	2	«
Sedco 135 G	1	«
Sedco 703	3	«
Sedco 704	3	«
Sedco 707	6	«
Sednth I	3	«
Transworld Rig 61	2	Semisubmersible
Treasure Saga	10	«
Treasure Scout	11	«
Treasure Seeker	24	«
Vildkat	3	«
Waage Drill	2	«
West Vanguard	10	«
West Venture	5	«
Zapata Explorer	13	Jack-up
Zapata Nordic	5	«
Zapata Ugland	3	Semisubmersible
	447	

4 new drilling rigs operated in 1984:

Glomar Moray Firth I	Jack-up
Pelerin	Drillship
Vildkat	Semisubmersible
Zapata Ugland	Semisubmersible

TAB 9.4.a
Production in million ton oil equivalents

1984	Oil	Gas	Total
Ekofisk area	11 643	12 047	23 690
Statfjord	18 598	0	18 598
Frigg area	0	13 652	13 652
Valhall	2 362	513	2 875
Murchison	2 351	81	2 432
Total 1984	34 954	26 292	61 246
Total 1983	30 565	24 455	55 019

The figures show Norwegian shares of Statfjord, Frigg and Murchison: 84.09322%, 60.82% and 45.06%.
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.

9.4 Production of oil and gas in 1984

The production of oil and gas on the Norwegian Continental Shelf in 1984 was 61.2 million tons oil equivalents, compared with 55 million t.o.e. in 1983. In Table 9.4.a and Figures 9.4.a and 9.4.b, the production on the Norwegian Continental Shelf is presented in more detail.

FIG. 9.4.a
Oil and gas production from the Norwegian Shelf in million ton oil equivalents

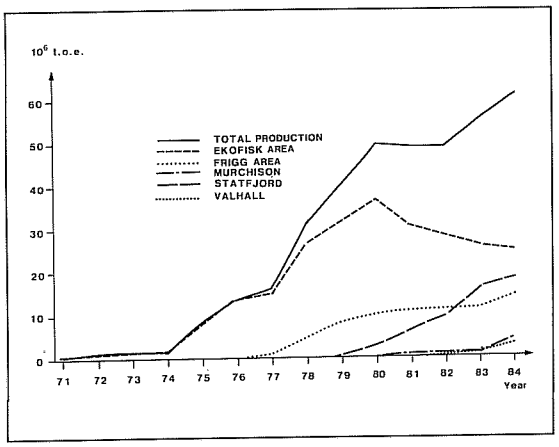
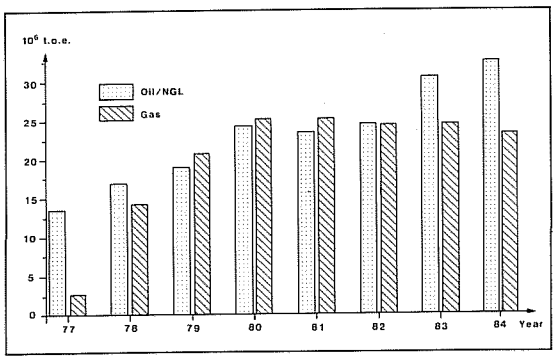


FIG. 9.4.b
Oil and gas production from the Norwegian Shelf



TAB 9.4.b
Monthly oil and gas production from the Ekofisk area

1984	Prod. oil incl. NGL 1000 Sm^3	Produced gas Mill Sm^3	Injected gas Mill Sm^3	Flared gas Mill Sm^3	Gas consumed (fuel) Mill Sm^3	Stable oil Teesside 1000 Sm^3	NGL Teesside Ton	Gas sales Emden Mill Sm^3
Jan	1 340	1 257	91	3	69	1 241	103 776	1 119
Feb	1 262	1 194	14	3	61	1 439	102 989	1 147
Mar	1 344	1 324	16	4	64	1 417	108 989	1 281
Apr	1 264	1 227	75	3	61	1 230	102 303	1 100
May	1 277	1 201	63	4	63	1 349	108 575	1 109
Jun	1 193	1 111	52	3	62	1 272	100 662	1 038
Jul	1 217	1 132	177	8	64	1 331	94 349	935
Aug	933	817	130	5	45	1 022	67 733	632
Sep	1 285	1 163	182	2	63	1 373	97 726	951
Oct	1 325	1 234	127	2	64	1 368	106 028	1 077
Nov	1 290	1 209	102	1	64	1 351	102 444	1 070
Dec	1 304	1 213	93	1	67	1 400	107 180	1 101
Year's total	15 035	14 081	1 120	37	747	15 794	1 202 663	12 560

Stabilized oil and NGL, Teesside contains oil from Valhall. This concerns also gas sold in Emden.

TAB 9.4.c
Monthly gas and condensate production from the Frigg area

1984	Produced gas Mill Sm^3	Produced condensate Sm^3	Injected gas Mill Sm^3	Flared gas Mill Sm^3	Consumed gas Mill Sm^3	Gas sold St. Fergus Mill Sm^3	Condensate St. Fergus Sm^3	Condensate ton/Sm^3
Jan	1 362	1 008	0	0	3	1 475	4 823	8 357
Feb	1 287	1 085	0	0	3	1 381	4 608	8 353
Mar	1 373	1 352	0	0	3	1 456	5 536	8 350
Apr	1 216	1 335	0	0	2	1 243	4 520	8 357
May	1 087	1 489	0	0	2	1 102	5 153	8 334
Jun	861	1 187	0	0	2	934	4 853	8 338
Jul	619	833	0	0	3	669	1 002	8 331
Aug	693	1 431	0	0	1	710	2 193	8 296
Sep	790	1 655	0	0	1	771	9 768	8 266
Oct	1 196	2 853	0	0	2	1 119	7 242	8 259
Nov	1 389	2 646	0	0	2	1 317	6 446	8 277
Dec	1 495	2 703	0	0	2	1 421	7 095	8 272
Year's total	13 369	19 575	0	0	26	13 599	63 240	

Figures show Norwegian share of Frigg 60.82%, NØ-Frigg and Odin 100%.

TAB 9.4.d
Monthly oil and gas production from Murchison

1984	Oil prod Stable oil 1 000 Sm^3	Gas prod Mill Sm^3	Gas inj Mill Sm^3	Flared gas Mill Sm^3	Gas consumed (fuel) Mill Sm^3	Stable oil Sullom Voe 1 000 Sm^3	Gas sales St Fergus Mill Sm^3
Jan	261	21	1	3	2	258	8
Feb	247	20	0	2	2	245	9
Mar	217	18	0	2	2	212	10
Apr	246	19	1	3	2	243	8
May	251	15	0	2	2	248	8
Jun	192	10	0	1	1	190	5
Jul	243	13	1	1	1	241	5
Aug	256	14	0	1	1	256	7
Sep	184	10	0	2	1	184	4
Oct	250	13	0	1	1	249	6
Nov	235	13	1	2	1	234	5
Dec	253	14	0	2	1	255	6
Year's total	2 836	179	4	22	18	2 813	81

Figures show Norwegian share of Murchison:

Oil:	45,06%	
Gas:	Jan–april	35,06%
	May	27,06%
	Jun–dec	25,06%

TAB 9.4.e
Månedlig olje- og gassproduksjon fra Statfjord

1984	Olje prod stabil olje 1 000 Sm³	Gass prod Mill Sm³	Gass inj Mill Sm³	Gass brent Mill Sm³	Gass brensel Mill Sm³
Jan	1 888	331	298	13	19
Feb	1 498	264	237	11	16
Mar	1 575	296	264	16	16
Apr	1 728	320	278	24	18
Mai	1 862	332	291	19	21
Jun	1 794	321	287	14	20
Jul	1 670	301	271	13	17
Aug	2 133	383	351	9	23
Sep	1 927	356	312	22	22
Okt	2 142	409	370	14	25
Nov	2 046	398	360	15	23
Des	2 173	421	385	11	25
Årssum	22 437	4 131	3 705	181	246

Tallene er norsk andel av Statfjord: 84,09322%

TAB 9.4.f
Monthly oil and gas production allocated to the Valhall field

1984	Prod. oil incl. NGL 1000 Sm³	Produced gas Mill Sm³	Injected gas Mill Sm³	Flared gas Mill Sm³	Consumed gas Mill Sm³	Stable oil Teesside 1000 Sm³	NGL Teesside 1000 ton	Gas sold Emden Mill Sm³
Jan	219	46	0	2	7	205	8	36
Feb	240	51	0	2	6	225	9	41
Mar	279	59	0	3	7	261	10	48
Apr	163	35	0	2	4	148	6	27
May	280	59	0	2	7	259	12	48
Jun	273	57	0	2	7	254	11	47
Jul	291	61	0	1	7	274	10	51
Aug	220	39	0	9	5	204	8	29
Sep	279	58	0	4	7	259	11	45
Oct	243	50	0	1	7	225	10	41
Nov	261	54	0	2	7	245	10	43
Dec	295	61	0	1	8	277	11	50
Year's total	3 049	635	0	37	85	2 843	122	512

9.5 Publications by the Norwegian Petroleum Directorate in 1984

Regulations

- Regulations compendium: "Kontinentalsokkelen" ("The Continental Shelf"): An up-to-date compendium of the regulations and guidelines stipulated by the Norwegian Petroleum Directorate and other regulatory agencies. Up-dated to 1 January 1984.
- Forskrift for fiskal kvantumsmåling av olje som produseres fra indre norske farvann, norsk sjøterritorium og den del av kontinentalsokkelen som er undergitt norsk statshøyhet (Regulation for fiscal measurement of oil produced in internal waters, in Norwegian territorial waters and in the part of the Norwegian Continental Shelf which is subject to Norwegian sovereignty). Stipulated by the Norwegian Petroleum Directorate on 2 April 1984.
- Forskrift for fiskal kvantumsmåling av gass som produseres fra indre norske farvann, norsk sjøterritorium og den del av kontinentalsokkelen som er undergitt norsk statshøyhet (Regulation for fiscal measurement of gas produced in internal waters, in Norwegian territorial waters and in the part of the Norwegian Continental Shelf which is subject to Norwegian sovereignty). Stipulated by the Norwegian Petroleum Directorate on 2 April 1984.

Research reports

- Kjemikalier i petroleumsvirksomheten – produktrapport (Chemicals in the petroleum activity – product report).
- Kjemikalier i petroleumsvirksomheten – stoffrapport (Chemicals in the petroleum activity – substance report).
- Mutagen aktivitet i boreslam – innledende studier (Mutagen activity in drill mud – introductory studies).
- Petroleumsforskning 1984. Forskningsprosjekter fra den britisk-norske databasen INFOIL 2 (Petroleum research 1984. Research projects from the joint UK-Norwegian database INFOIL 2). Norwegian text.
- Offshore R&D projects 1984. Forskningsprosjekter fra den britisk-norske databasen INFOIL 2 (Research projects from the joint UK-Norwegian database INFOIL 2). English text.

Geological publications

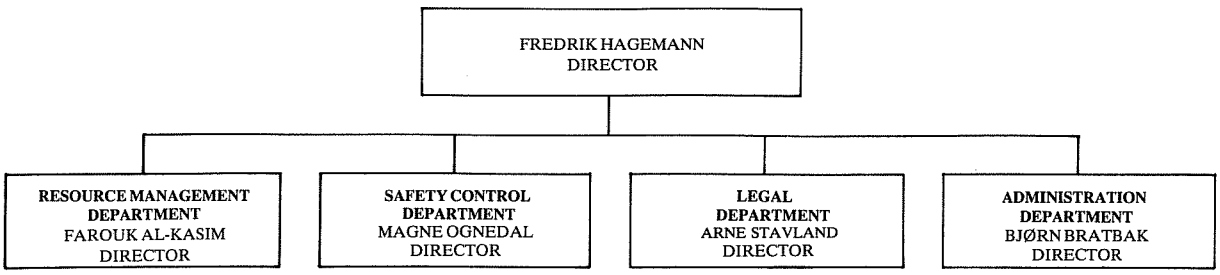
- Well Data Summary Sheets, Vol 8. Borehull fullført 1977 (Well Data Summary Sheets, Vol 8. Wells completed 1977).

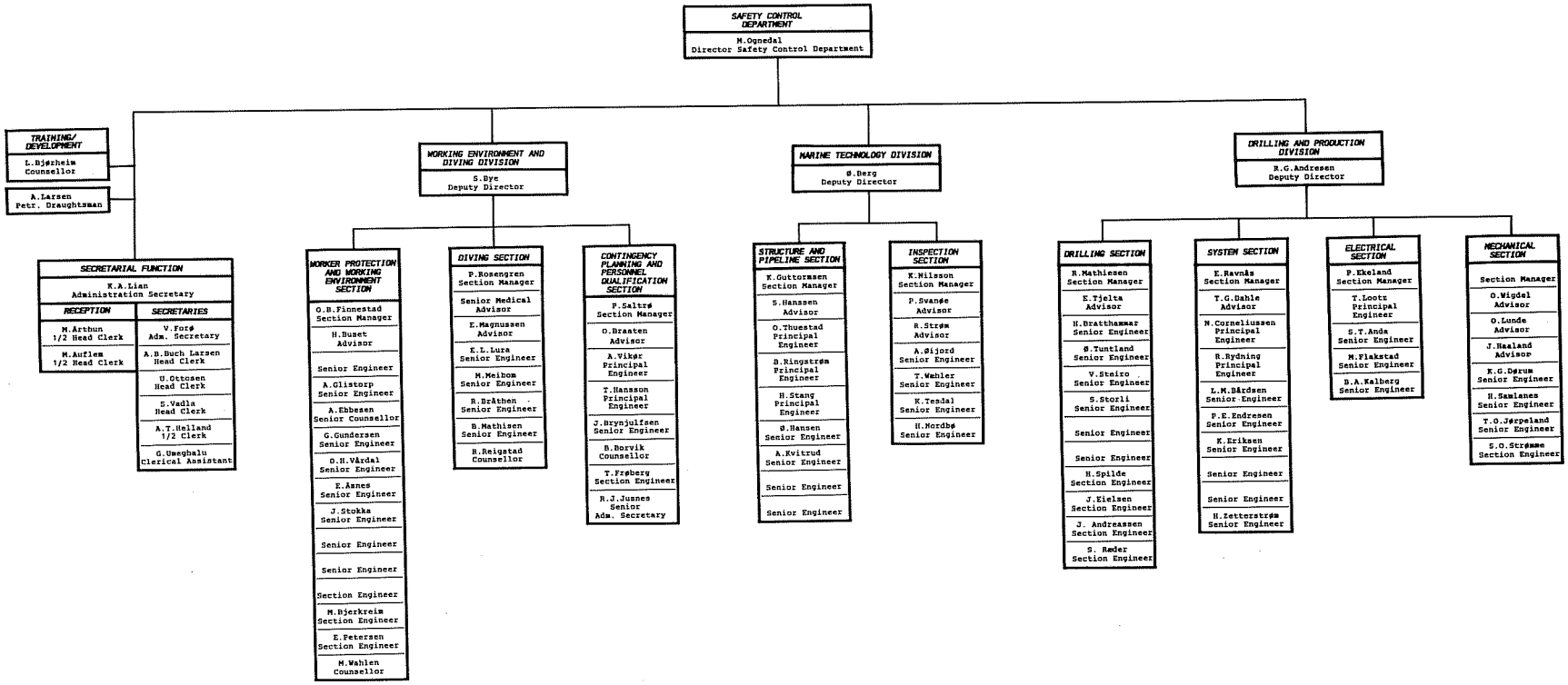
Other publications

- Oljedirektoratets årsberetning 1983 (the Norwegian Petroleum Directorate Annual Report 1983)
- NPD Annual Report 1983 (English translation of the above Annual Report)
- Perspektivanalysen 1983
- Petroleum Outlook 1983
- Map of the Norwegian Continental Shelf
- List of publications published by the Norwegian Petroleum Directorate
- List of 16 mm movies and video cassettes which can be borrowed from the Norwegian Petroleum Directorate
- Safety reports published by the Norwegian Petroleum Directorate (Norwegian and English editions)
- NPD Bulletin 3. A Revised Triassic and Jurassic Lithostratigraphic Nomenclature for the Norwegian North Sea.
- NPD Contribution No 14. Structural Highs and Basins in the Western Barents Sea.
- NPD Contribution No 15, Arctic Experiences.
- NPD Contribution No 16, Interpretation and Modelling of Seismic Data from the Barents Sea.
- NPD Contribution No 17, Accoustic Modelling of the Seafloor.
- NPD Contribution No 18, Ressursgrunnlaget (Resource basis).
- NPD Contribution No 19, The Role of Northern Areas – Petroleum Developments – as Seen from the West. Resource Aspects.
- NPD Contribution No 20, Jan Mayen-ryggens geologi (NPD Contribution No 20, Geology of the Jan Mayen Ridge).
- NPD Contribution No 21, The Norwegian Continental Shelf – Discoveries and Related Research Challenges.

9.6.

NPD's CENTRAL MANAGEMENT

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M.Ognedal
Director Safety Control Department
TRAINING/ DEVELOPMENT
L.Bjørheim
Counsellor
A.Larsen
Petr. Draughtsman
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M.Auflem 1/2 Head Clerk
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S.Vadla Head Clerk
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G.Uwaghalu Clerical Assistant
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O.H.Vårdal Senior Engineer
E.Åsnes Senior Engineer
J.Stokka Senior Engineer
Senior Engineer
Senior Engineer
Section Engineer
M.Bjerkreim Section Engineer
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Senior Engineer
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H.Samlanes Senior Engineer
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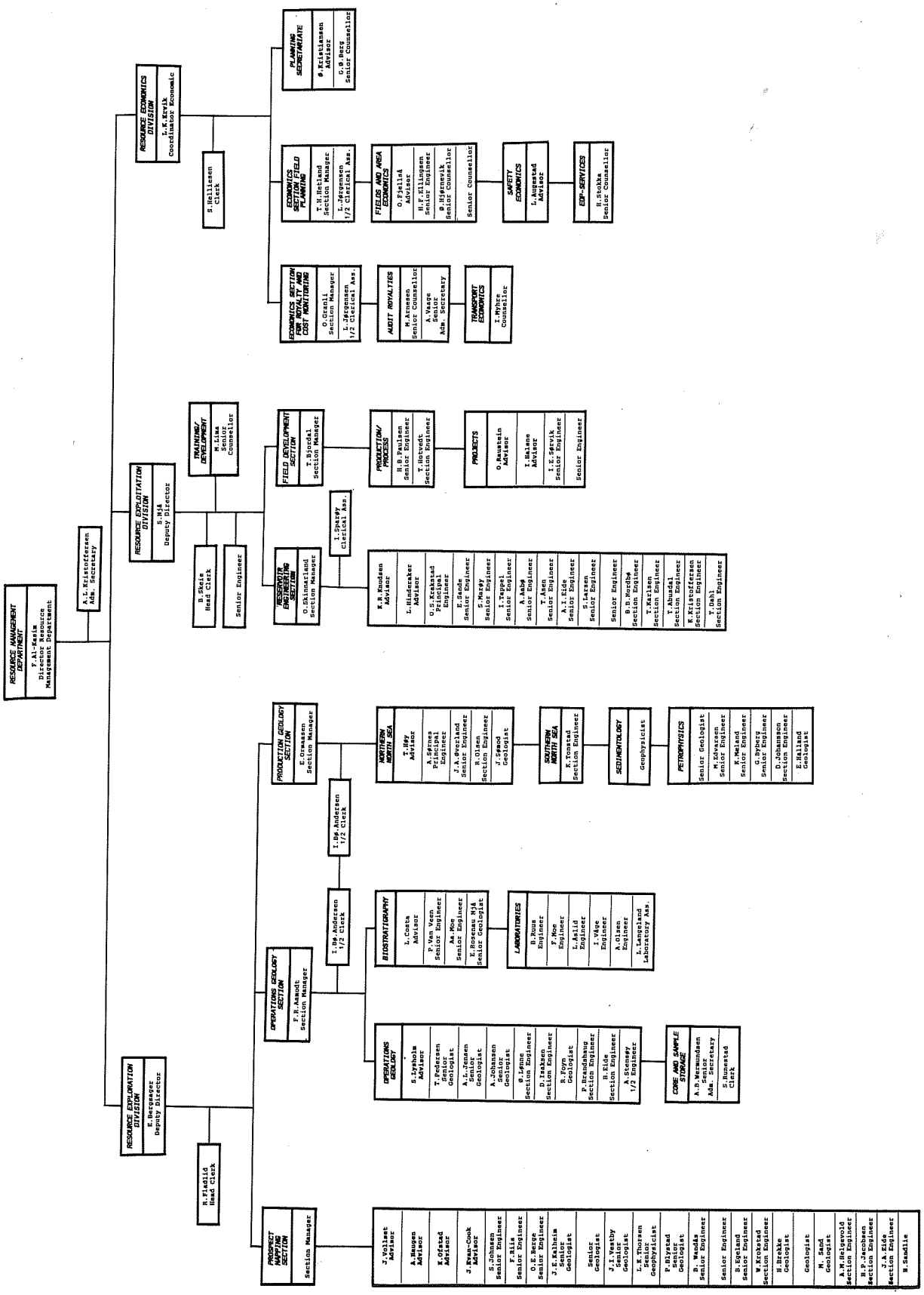
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Section Engineer
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PETROPHYSICS
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I.K.Thorsen
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Senior Engineer
B.Egeland
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W.Krobstad
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Geologist
Geologist
M. Sand
Geologist
A.M.Helgerud
Section Engineer
H.P.Jacobsen
Section Engineer
J.A.Eide
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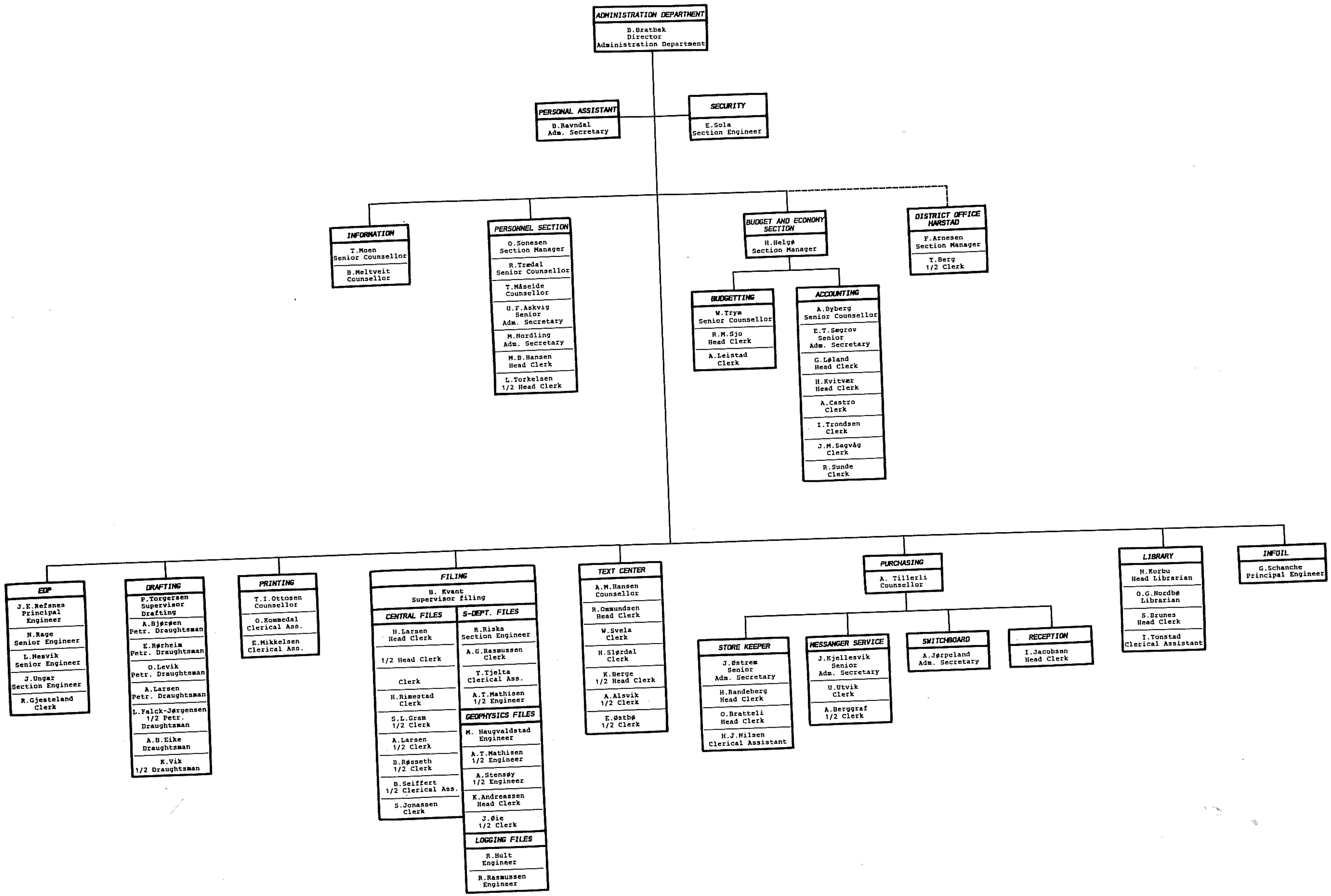
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T.Moen Senior Counsellor
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A.T.Mathisen 1/2 Engineer
A.Stensøy 1/2 Engineer
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J.Øie 1/2 Clerk
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R.Hult Engineer
R.Rasmussen Engineer
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K.Berge 1/2 Head Clerk
A.Alsvik 1/2 Clerk
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J.Østrem Senior Adm. Secretary
H.Randeberg Head Clerk
O.Bratteli Head Clerk
H.J.Nilsen Clerical Assistant
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J.Kjellesvik Senior Adm. Secretary
U.Utvik Clerk
A.Berggraf 1/2 Clerk
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A.Jørpeland Adm. Secretary
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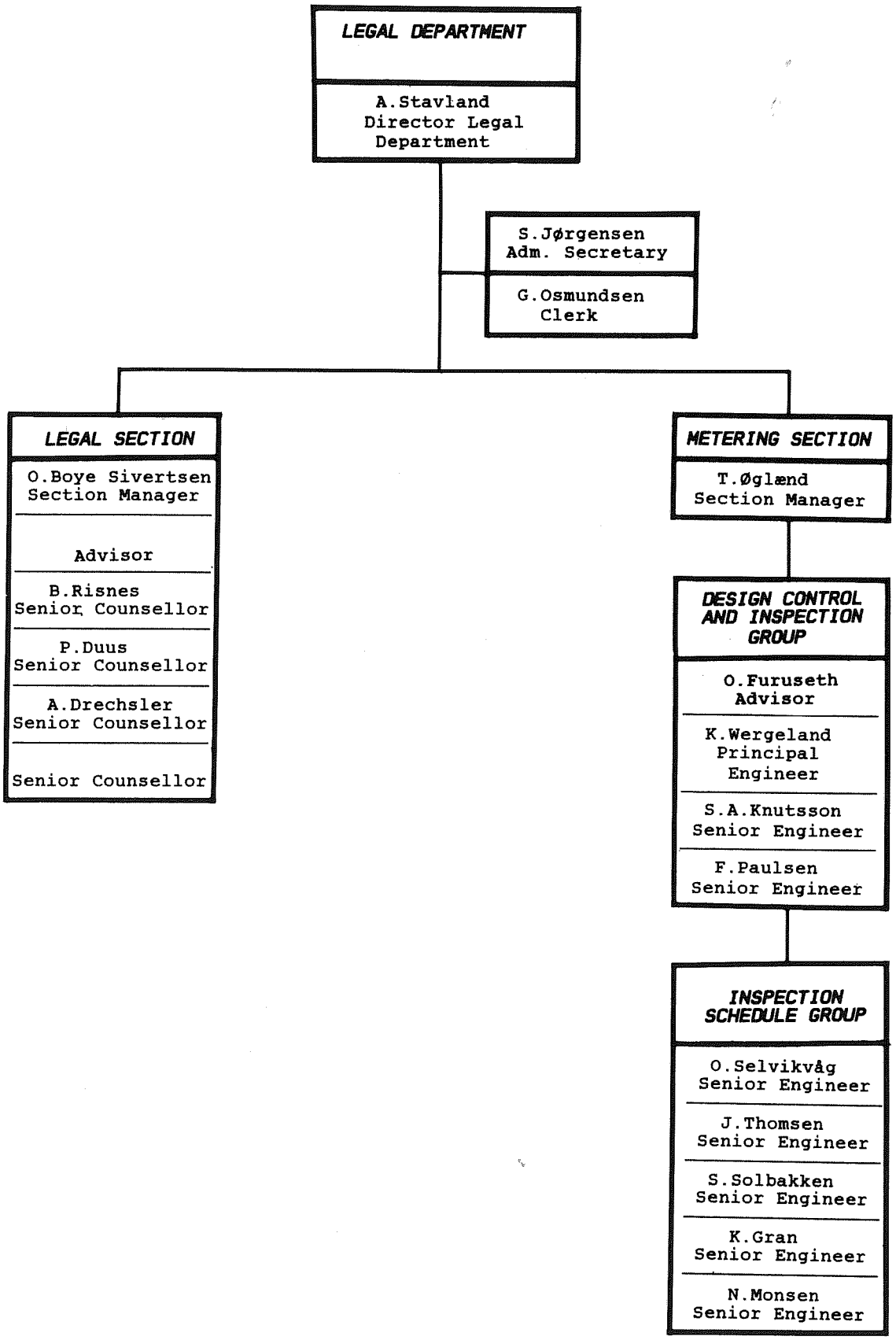
N.Korbu Head Librarian
O.G.Nordbø Librarian
S.Brunes Head Clerk
I.Tonstad Clerical Assistant
INFOIL
G.Schanche Principal Engineer


LEGAL DEPARTMENT
A.Stavland
Director Legal
Department
S.Jørgensen
Adm. Secretary
G.Osmundsen
Clerk
LEGAL SECTION
O.Boye Sivertsen
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Advisor
B.Risnes
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P.Duus
Senior Counsellor
A.Drechsler
Senior Counsellor
Senior Counsellor
METERING SECTION
T.Øglænd
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DESIGN CONTROL AND INSPECTION GROUP
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Advisor
K.Wergeland
Principal
Engineer
S.A.Knutsson
Senior Engineer
F.Paulsen
Senior Engineer
INSPECTION SCHEDULE GROUP
O.Selvikvåg
Senior Engineer
J.Thomsen
Senior Engineer
S.Solbakken
Senior Engineer
K.Gran
Senior Engineer
N.Monsen
Senior Engineer