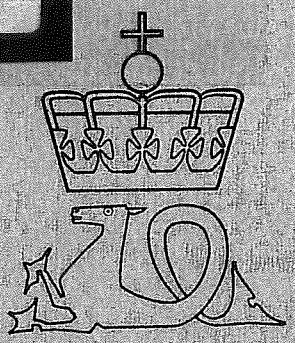


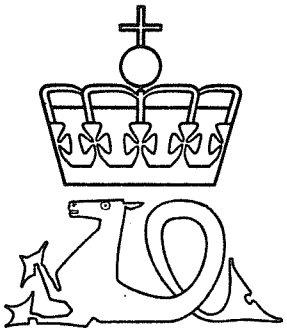
Annual Report

1980

Unofficial translation

Oljedirektoratet

ISBN 82-7257-063-7



Annual Report 1980

Unofficial translation
prepared by Translatørservice A/S

Oljedirektoratet

March 1981

TABLE OF CONTENTS

F O R E W O R D

In accordance with § 4 (f) of the instructions to the Norwegian Petroleum Directorate, the Board of Directors shall prepare a report on the Directorate's activities. The Board of Directors hereby present the Annual Report for 1980.

Stavanger January 29th, 1981
On the Board of Directors for the Norwegian Petroleum Directorate

Martin Buvik

Andreas Lønning Bjørg Simonsen Liv Hatland

Kåre D. Nielsen Ole Knapp

Kåre A. Tjønneland Inge Døskeland

Fredrik Hagemann Bjørn Bratbak

THE BOARD OF DIRECTORS' REPORT

In 1980 the activity on the Norwegian Continental Shelf increased and with it the amount of work for the Norwegian Petroleum Directorate.

The encouraging results from exploration drilling in 1979 continued in 1980. This has led to a significant increase in the exploration drilling activity on the Shelf which reached a top level of 13 drilling platforms in simultaneous operation in November/December. In total, 36 wells were started in 1980 compared to 28 the year before.

The new discoveries made after the 4th licensing round have so far provided a basis for an upwards adjustment of proven reserves in the order of magnitude of 1/2 billion tons of oil equivalents (t.o.e.) corresponding to an increase of approx. 30%. Along with this increase in the reserve basis, several fields that were previously considered to be marginal are now under consideration for development in the near future. This positive development has created a new situation for further development on the Shelf. For this reason we are now, for the first time, faced with the real choice of deciding what type of fields should be developed, how these should be managed in the long term and what arrangements for development (infra-structure) are required for securing the best possible utilization of the fields in isolation and as a whole. There is therefore an urgent need for an overall development strategy based on national objectives in relation to inter alia the rate of depletion, an even level of activity, safety, the best possible utilization of resources and effective development and operation.

In the view of the Board it is an important task of the Norwegian Petroleum Directorate to continue contributing objective evaluations/analysis for the framing of such a strategy.

Furthermore, the Board considers it very important that the Directorate should be involved in evaluation of basic concepts for the different development plans at the earliest time possible. This evaluation phase must be followed by an evaluation of the concrete development concepts. The Board emphasizes the importance of securing for public authorities sufficient time for careful consideration in all phases of such development projects.

1980 stands out as an important milestone in the development on the Shelf, since exploration drilling was started in the Troms I area and on Haltenbanken. As the government surveys become supplemented by drilling data, it can be determined with greater accuracy whether petroleum resources are present. It is too early to say anything about possible reserves in these areas. However, the results obtained so far give reason to count on continued drilling activity north of 62°N which in time may lead to economically interesting petroleum discoveries. This spreading of the activity in several operating areas will result in new requirements as regards planning, coordination and control, and this again will lay claim to increased resources and efforts on the part of inter alia the Norwegian Petroleum Directorate.

The pace of further activities in relation to development should take into account the development in technical capacity and competence shown by both the companies and the authorities. A large part of the activity on the Continental Shelf covers work areas representing relatively new technology.

A common factor in part of these work areas is that a great deal of work needs to be done while at the same time the highest quality is required both in relation to the design of the facilities and installations and in relation to the personnel organizing and operating the facilities. In order to take care of central safety obectives it is thus important to integrate the necessary quality into all phases of the activity.

In view of the large growth of activity envisaged for the first years to come, the Board is concerned with the possibility of obtaining sufficiently qualified personnel to carry out the tasks ahead. This applies to both operating personnel on the installations and onshore engineering personnel. If the need for drilling personnel for the years to come is compared with the present training program for such personnel, it may be that there will be a significant shortage of leading drilling personnel in the time to come. This may therefore result in the supply of qualified personnel becoming decisive for the level of drilling activity on the Shelf.

The tragic accident with the hotel platform "Alexander L. Kielland" on March 27th, 1980, killing 123 people, led the Directorate to examine, within the scope of its responsibility, all routines and problems which have become relevant in connection with the accident. A number of measures were enacted, partly in cooperation with the Norwegian Petroleum Directorate, for finding solutions to problems in areas common to the two Directorates. The Inquest Committee´s report had not been presented at the end of the reporting period.

In last year´s Annual Report the Board emphasized the importance of further efforts to increase the degree of recovery from the resources on the Continental Shelf. It is now expected that the pilot project for water injection in the Ekofisk field will be started early in 1981. The Norwegian Petroleum Directorate follows with great interest the licencees´ studies and plans for possible large scale water injection both on the Ekofisk and the Tor fields. A successful result of this water injection may represent an increase in recoverable oil reserves in the order of magnitude of 80 - 100 million Sm^3 corresponding to NOK 100 - 125 billion. The Norwegian Petroleum Directorate notes with satisfaction that fields currently under study/planning are based on plans for early increased recovery through injection of water or gas to the extent that this is possible and relevant.

Increased recovery from the resources will require efforts in several professional areas. Correct interpretation of geological circumstances and reservoir properties is of basic importance. This presupposes increased competence and efforts, not only on the part of the licencees and the authorities , but also on the part of institutions for research and scientific work. The Board wants to emphasize the importance of the enormous values which are inherent in increased recovery from the resources on the Shelf. Even a modest increase of 1% in the recovery factor will correspond to an increase in value of the proven reserves to date in the order of magnitude of approximately NOK 30 billion. The Board holds the view that it is possible from a technical point of view to achieve considerable improvements as concerns the average recovery factor from the resources on the Shelf.

The Board is concerned that unnecessary use and waste of oil and gas in connection with production, processing and bringing ashore should

be reduced.

In view of the new discoveries and the significant increase in proven reserves it is natural to evaluate the existng facilities in the Ekofisk and Frigg areas in connection with a coordinated solution for transporting the gas.

In the report from the Steering Group for "Cost Analysis - the Norwegian Continental Shelf", appointed by Royal Decree of March 16th, 1979 ("the Moe Report") the need is emphasized in several places for better coordination and control of development projects on the Norwegian Continental Shelf. The Moe Committee recommends that the authorities should develop a system and find routines for better control of the planning process and cost development for new projects on the Continental Shelf. In the period covered by the report, the Directorate has continued the work of establishing models and tools to analyse costs and to look after other economic administrative tasks.

At today's level of activity and on the basis of the large development tasks which we are faced with on the Shelf, it will become still more important to evaluate the economic effects of the petroleum activity on the basis of national objectives.

The Board considers it natural for the Directorate to be developed so that the economic consequences of governmental levies and decisions may be clarified. In this connection, computer based routines and models for analysis which may be used in the Directorate's work in an economic area must be developed. There is furthermore a need for economic research and study in several areas. Amongst others, it is important to arrive at the knowledge and instruments which may be used in connection with economic planning. It is also important for the Directorate to further develop its supervisory experience in relation to royalties and taxes to be claimed from oil companies operating on the Continental Shelf.

In the summer of 1980, all activity on the Continental Shelf came to a halt in the most widespread labour conflict on the Continental Shelf so far. All production facilities were stopped because of a strike among some of the Labour Unions in the period July 3rd to July 18th. The activity was further paralysed when the Labour Unions for personnel on moveable drilling platforms registered in Norway decided to go on strike. All exploration activity on the Norwegian Continental Shelf was thus stopped in the period July 9th to August 9th.

The labour conflict on the production facilities led to a reduction in petroleum production corresponding to 2 million tons of oil equivalents representing a gross production value of more than NOK 2 billion.

In relation to the exploration activity, the strike led to a delay in execution of the drilling. In relation to the drilling activity offshore northern Norway the strike led to a reduction in the planned drilling activity for 1980.

In the period covered by the report, the Directorate started to issue divers' certificates for the personnel approved for diving on the Norwegian Continental Shelf. So far, 1,460 such certificates have been issued.

In the period covered by the report, the Directorate also arranged a labour meeting on working environment conditions. As was the case in the two earlier conferences, this also uncovered a need and a wish on the part of the relevant workers to take part, through such meetings, in the planning and implementation of the bases as a better and safer working environment.

Analysis of reported personal injuries and present research projects in relation to injuries and accidents provide a good basis for the continued work by the Directorate in reducing the frequency of injuries.

Through the continuing Research and Development Program (R & D) for Safety and Preparedness, the Norwegian Petroleum Directorate has been provided with valuable kmow-how in addition to the level of knowledge which has been developed over the years in the executive institutions. The Board considers it important that the Directorate should be given resources within its area of responsibility to continue part of the activities in the field of safety and preparedness, also after the completion of the two on-going 4 year programs under the direction of the Norwegian Petroleum Directorate.

In the period in which the tasks increase in importance and scope, the Board continues to be concerned for the staffing of the Directorate.

In the course of the year, 49 employees have left the Directorate to start other work. It is of particular concern that the Directorate has lost several of its experienced geologists/geophysicists and reservoir engineers in 1980. As the competition for personnel with know-how and experience within the oil industry is strong, the Board assumes that, inter alia, the salary level is important for the recruitment and for keeping the personnel from leaving. After this question was raised with the presiding Ministries, the State and the main unions entered into an agreement in August leading to a certain degree of improvement and greater flexibility over the salary question. The Board assumes that this may represent a certain strengthening in the competitive position vis-a-vis inter alia the oil companies. It should also be emphasized that the Directorate still has a staff of competent employees. The Board considers that they work conscientiously on the often complicated and time consuming tasks which the Norwegian Petroleum Directorate is faced with. Even if the number of resignations has been large this year, there are more tha 110 employees with more than 3 years employment with the Directorate and at the end of the report period and 160 employees with more than 2 years employment with the Directorate.

However, it is not only the question of salary which decides whether an institution is able to attract employees and provide them with satisfaction. For this reason, the Board will give attention to inter alia the budget situation. A strongly increasing share of fixed expenses in the Norwegian Petroleum Directorate's budget has over the years had the effect that the resources for EDP, external assistance, training , assistance and other services have fallen behind compared to the increase in activity that has taken place.

The Board is of the opinion that improvement in working environment and working conditions would also be effected by obtaining one building for the whole Directorate. The work of planning the room program and building schedules has gone according to plan. The question of the site has been further studied in 1980, and the first

allocation for the pilot project has been included in the budget for 1981.

In the period covered by the report, the Norwegian Petroleum Directorate has collected a total of NOK 3,641 million in royalties. This is a marked increase compared to 1979, in spite of the production stoppage caused by the strike in the summer of 1980. In addition , the Norwegian Petroleum Directorate has collected a total of NOK 63 milion in net acreage fees.

The Directorate's department for northern Norway was opened in Harstad on June 20th, 1980. Giving information is one of the main tasks of the office, which will serve as a liaison between the Directorate and the authorities in northern Norway, its industry and commerce and mass media. The short period in which the office has been functioning has shown that there is a clear and unfulfilled need for information on the oil activity in this part of the country. For the time being, the office staff is relatively small, but the Board wil give close attention to whether the staff should be increased and if other tasks may be asigned to the office.

1. THE DIRECTORATE'S TASKS BOARD OF DIRECTORS AND MANAGEMENT

1.1. Instructions for the Norwegian Petroleum Directorate

The objectives and tasks of the Petroleum Directorate are provided in special instructions. These were most recently changed by the decision of the Ministry of Petroleum and Energy on March 29th, 1979. The instructions in § 1 relating to the objectives and § 2 relating to the tasks are worded as follows:

§ 1 - Objectives

The Petroleum Directorate is located in Stavanger and reports to the Royal Ministry of Petroleum and Energy. In matters relating to working environment, safety and emergency preparedness, it reports to the Royal Ministry of Local Government and Labour. The Petroleum Directorate is authorized to decide on matters relating to exploration and utilization of petroleum resources on the seafloor and its subsoil, to the extent that the matters shall not be decided by the King, relevant Ministry or other public authority. The Petroleum Directorate exercises this authority in inner Norwegian waters, in Norwegian sea territory and on that part of the Continental Shelf which is subject to Norwegian sovereignty, as well as in other areas where Norwegian jurisdiction follows from agreements with foreign countries or from International Law in general. In addition, the Petroleum Directorate shall enforce safety regulations, etc, for exploration and drilling for petroleum resources and alike in the areas defined by Article 1 of the Svalbard Treaty of July 17th, 1925, as well as in the territorial waters of these areas.

§ 2 - Tasks

The Petroleum Directorate has these tasks within its area of authority:

a) To take care of public administration and economic control of complying with applicable legislation, regulations, decisions, concessionary terms, agreements, etc in the exploration and utilization of petroleum, cf § 1.
b) To ensure that the applicable safety regulations are complied with.
c) To ensure that the exploration and utilization of petroleum resources do not lead to unnecessary damage or cause inconvenience to other activities.
d) To ensure that exploration and utilization of petroleum resources are carried on in accordance with the guidelines stipulated by the relevant Ministry.

e) To collect and process geological, geophysical and technical material relating to subsea natural resources, including evaluation of this and possibilities provided by this for assisting in the formulation of the state oil policy and negotiation plans, as well as to plan and look after the execution of surveys concerning petroleum geology and geophysics.
f) To look after current economic control of exploration and utilization of petroleum resources.
g) To issue exploration licences, as well as to assist the relevant Ministry, upon request, in the handling of applications for other licences, the formulation of regulations, etc.
h) To keep in contact with scientific institutions and to ensure that the 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 the licencees and in general pursuant to the decision of the relevant Ministry.
i) To prepare and present for decision by the relevant Ministry matters of importance to vegetation and animal life or matters which may otherwise be of relevance to the important preservation of nature interests in the areas mentioned in § 1, last sentence.
j) To present regulations and individual decisions concerning sound utilization of petroleum resouces (conservation) to the relevant Ministry.
k) To be an advisory body to the Ministry in questions relating to exploration and utilization of subsea natural resources. Even if a matter is subject to the authority of the Directorate pursuant to § 2, a-h, it shall be submitted to the relevant Ministry if it is of special importance or of principal interest.

1.2. The Board of Directors and the management

1.2.1. The Board of Directors

In the period covered by the report the Board has consisted of:

1 Governor Martin Buvik, Tromsø
2 Director Andreas Lønning, Oslo
3 Mayor Bjørg Simonsen, Mo i Rana
4 Municipal Director Liv Hatland, Trondheim
5 Director Kåre D. Nielsen, Oslo
6 Secretary Ole knapp, Oslo
7 Senior Engineer Hallvard Tunheim, Stavanger
8 Section Manager Inge Døskeland, Stavanger

Deputies:

For 1 - 4	Farmer Olav Marås, Sæbøvåg
	Consumer Advisor Ragna B. Jørgensen, Bodø
	Editor Marit Greve, Oslo
For 5	Director Odd Henrik Robberstad
For 6	Attorney-at-law Bjørn Kolby
For 7 - 8	Section Manager Kåre A. Tjønneland
	Department Engineer Åase Moe

Department engineer Åase Moe acceded to the Board on February 1st, 1980 as deputy after the previous deputy to the Board, senior geologist Erik Talleras had resigned from his position in the Directorate. From November 1st, 1980, senior executive officer, Kåre A. Tjønneland , became a member of the Board when senior engineer Hallvar Tunheim resigned from his position in the Directorate.

In the period covered by the report the Board of Directors have had 9 meetings. In the month of May, the Board of Directors went on a study tour to Italy where inter alia it visited the management and several of the installations of the Italian state oil company, Agip.

The Board of Directors was present at the opening of the branch office in Harstad on June 20th, 1980.

On August 6th, 1980 the Ministry of Petroleum and Energy laid down provisional rules for how the employees may exercise codetermination with the Directorate´s Board of Directors.

1.2.2. The Organization

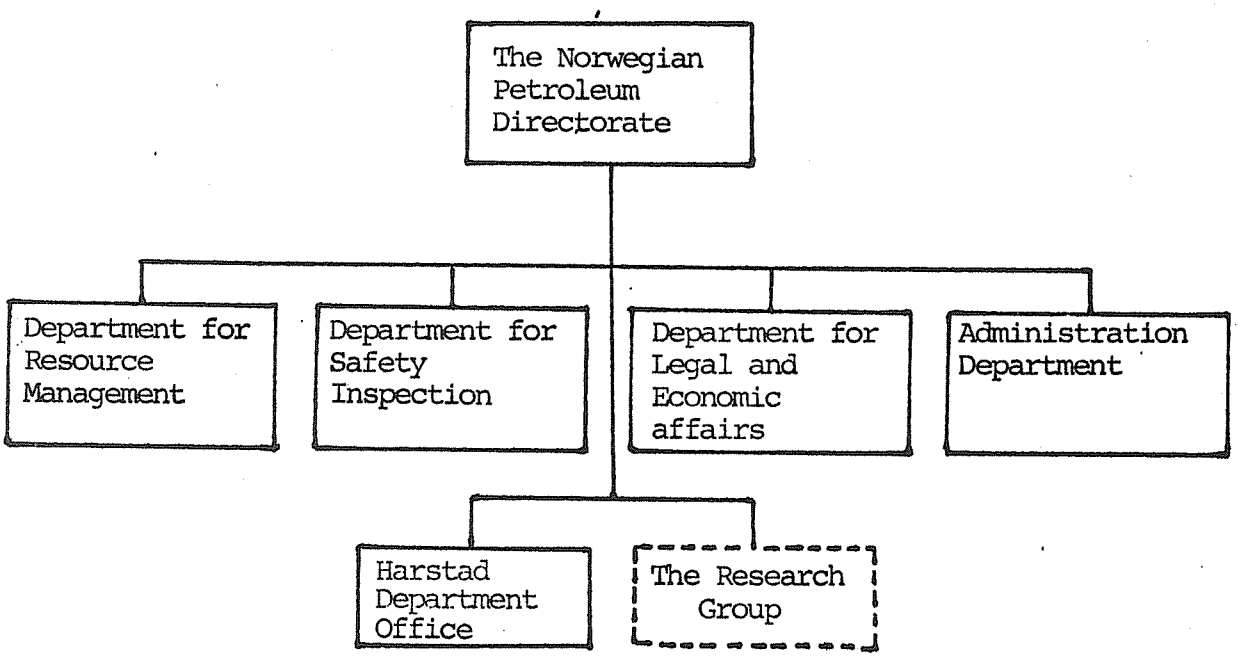
Plans for changes in the organization presented in the Annual Report for 1979 were implemented with certain changes in the first half of 1980 with new department designations as stated in figure 1 A (cf Organization plan). It was decided, however, that it would be right to establish 9 sections in the department for safety control and not 11 as originally planned.

In the Department for Resource Management the place in the organization of the section for production geology has been changed so that the section now reports to the deputy director for surveying of resources.

The newly established department office in Harstad has been placed in the organization under the assistant director general for the Administration Department.

As the research program for safety and emergency preparedness under the Norwegian Petroleum Doirectorate´s direction shall be finalized at the expiry of 1981, a scaling down of the temporarily established research group has been started.

Fig. 1 A Table of Organization



1.2.3. Personnel

In connection with the handling of the budget for 1980 it was decided that 17 new positions should be established. The Directorate therefore has 227 permanent positions. In addition, the Directorate has 51 contract positions, of which one is paid by NORAD. The Directorate has made 8 working positions available for employees who are paid over the budget of other authorities, either for persons restricted in their choice of work because of handicaps or for the unemployed youth. A pensioned civil servant has been employed on pensioner terms. 2 scholarship holders from NORAD have been connected to the Directorate for parts of the year.

At the expiry of the period covered by the report there were 257 employees in service. 6 officers had not started work in their positions and 17 employment matters were being dealt with. 49 officers have resigned and left their positions in 1980 (table 1). The number of resignations amounts to approximately 17% of the total number of authorized positions against 14% for 1979. 11 of the employees resigning in the spring of 1980 had given notice of termination in the autumn of 1979.

In view of the difficult manning situations which have also been mentioned in earlier Annual Reports, the question of changing the salary conditions in the Directorate was raised with the presiding Ministries in the autumn of 1979 and the spring of 1980. The matter was also raised in the Storting by a question to the

Minister of Petroleum and Energy. The civil servant unions through their main federations demanded negotiations on the same matter in the spring of 1980. The matter was widely covered in the press and mass media. Negotiations between the State and the main federations were finalized on August 12th, 1980 by an agreement with the following main points:

Position Changes

- 14 positions as executive officer and senior executive officer are changed so that they are placed at a higher level in the salary schedule.
- 18 positions as clerical assistants and 7 positions as senior clerical assistants are changed to higher placings.
- 19 positions as senior engineer in salary steps 24-25 were changed to senior engineer in salary step 26.
- 1 position as laboratory assistant and 1 position as senior laboratory technician were given a higher salary placing.
- 2 positions as drafting assistants and 1 position as drafting supervisor were changed to a higher placing.

Allowances under table B

- For positions as department engineer and senior engineer, geologist/geophysicist and senior geologist/senior geophysicist, allowance 5 on table B is given after 3 years of actual service and the allowance is changed to step 10 after 5 years of actual service.
- For positions as Section Manager, Assistant Director, Assistant Director General and Director General, an allowance in accordance with step 10 on table B is given.

Special Salaries

Up to 14 positions for geologists, geophysicists and petroleum experts may be paid in accordance with salary steps 28, 30 and 32 and designated as special advisors.

The condition for this salary is that the person holding the position has high professional qualifications within the activity of the Norwegian Petroleum Directorate. The election for this salary takes place in consultation with the unions, and if applicable in a committee with representatives from several parties in the Norwegian Petroleum Directorate, and the recommendations shall be presented to the Ministry of Consumer Affairs and Government Administration for approval.

Allocation of changed positions

The changed positions are allocated to offices/sections and departments in consultation with the civil servant unions and are

filled in the normal manner.

As a consequence of the agreement, the salaries of 157 employees were improved. It is still too early to say to what degree this will contribute to keeping the personnel in the Directorate. The tendency after announcing the agreement may indicate, however, that it has had a positive effect.

In April an agreement was entered into between the State and the civil servant unions for the remuneration of inspectors on assignments on the Continental Shelf. In connection with negotiations on the general improvement of salary conditions in the Directorate, this agreement was also mentioned. In November, negotiations were opened between the Ministry of Consumer Affairs and Government Administration and the main unions, but the parties have been unable to arrive at a new agreement at the expiry of the period covered by the report.

The question of changing the contract positions has in this period covered by the report also been raised with the Ministry, and this was mentioned during the negotiations on salary conditions in the Directorate. The Directorate has been led to understand that this question will now be evaluated at its core in connection with the changing of all contract positions in the State.

Company Doctor

In the course of the period covered by the report, a special arrangement for a company doctor has been established for the Directorate

TABLE I.

Personell resigning from the NPD in 1980 with indication of new work.

Department	Oil industry	Other private activities	Other public activities	Sundry	Education	TOTAL
Resource Management	12	1	1	0	0	14
Safety Inspection	10	1	0	0	0	11
Legal/Economic	2	1	1	0	0	4
Administration	6	2	2	9	1	20
TOTAL	30 (76)	5 (24)	4 (21)	9 (23)	1 (10)	49

The numbers in parenthesis refer to the period 1973 - 80.

1.2.4. Training

The need for further professional development and the need created by the great number of resignations and therefore new appointments has had the effect that the need for training in this period has been extensive. The Norwegian Petroleum Directorate has used 2237 course days in the period, 1654 in Norway and 583 abroad. This gives an average of approximately 9 course days per employee. Of the domestic course days, 1120 days were used in Stavanger. 370 of these were used for courses at Rogaland District University and were attended by 43 persons. 7 employees were granted leave of absence for some few hours a week to follow semester education at the District University/University of Technology. The education was relevant for the work of the employees. 25 persons were given places on courses arranged by the Ministry of Consumer Affairs and Administration. 12 of these took part in a course arranged in Stavanger. In total this amounts to 115 course days. The Norwegian Petroleum Directorate has a good rapport with the oil companies and has access to the courses offered by the companies by concessionary agreements.The Directorate has attended 97 course places amounting to 590 course days. 480 of these were used for participation in courses in Stavanger.

The Directorate has itself arranged 5 professional courses and has promoted courses arranged in Stavanger by oil companies. In addition there have been 3 introductory courses for new employees. These courses and the course days used have not been included in the numbers mentioned above.

1.2.5. The Liaison Committee

The Liaison Committee arranged 5 meetings in 1980 wherein matters such as housing projects, loan arrangements, salary conditions, cost budget, allocation of welfare provisions etc were discussed.

The Liaison Committee in 1980 was made up as follows:

Members appointed by the management:

Director General	Fredrik Hagemann, committee chairman
Assistant Director General	Farouk Al-Kasim
" " "	Magne Ognedal
" " "	Bjørn Bratbak

Deputies:

Assistant Director General	Arne Stavland
Deputy Director	Egil Bergsager
Deputy Director	Svein Bye
Section Manager	Nic B Askvik

Members appointed by the unions:

Senior Executive Officer	Øystein Kristiansen	(AF)
Senior Geologist	Inger Flesland Strass	(AF)
Senior Engineer	Hans Chr. Rønnevik	(NOPEF)
Executive Officer	Thomas Houge-Thiis	(YS)

Deputies:

Senior Engineer	Lars Olaf Eide	(AF)
Junior Executive Officer	Arne B. Wermundsen	(NOPEF)
Administrative Secretary	Torunn Fraser	(NOPEF)
Typing Coordinator	Anne M. Hansen	(YS)

The Liaison Committee was dissolved December 23rd, 1980 when the main agreement relating to codetermination entered into force in the Norwegian Petroleum Directorate.

1.2.6. The Working Environment Committee

The Working Environment Committee has had 3 meetings during 1980 wherein matters such as medical examinations of personnel, offshore travel, physiotherapy service, office location, Electronic Data Processing Council have been dealt with.

In addition to the members in the Liaison Committee, the Working Environment Committee has consisted of the main Safety Representative as well as an additional representative from the management.

Head Safety Representative:

Senior Engineer Njål Corneliussen

Assistant Head Safety Representative:

Junior Executive Office Arne B. Wermundsen

The management's additional representative on the Working Environment Committee:

Assistant Director General Arne Stavland

1.2.7. Budget/Economy

To the Directorate's different tasks, a total of NOK 125,948,500 was allocated in 1980. The amount may be divided in the following way:

- Ordinary budget	NOK 74,348.500,-
- Geological and geophysical surveys	NOK 32,800.000,-
- Safety and emergency preparedness research	NOK 8,800.000,-
- Cleaning up the sea-floor of the North sea	NOK 10,000.000,-
	NOK 125,948,500,-

Of the ordinary budget, NOK 30 million is for inspection costs. These expenses are wholly refunded by the licencees. NOK 27,043,500,- is for salaries and NOK 4,870,000,- for operating buildings. The rest of the budget, NOK 12,435,000,- represents the Directorate's budget for conducting normal activities.

Table II shows the development of the budget in the period 1973 - 80 compared with the increase in the number of permanent employees and the increase in the cost of living index.

Like a number of other institutions in the State, the Norwegian Petroleum Directorate witnesses growing tasks and increased prices at a time when the economic situation does not allow for a corresponding increase in the budget.

The budget situation therefore confronts the Norwegian Petroleum Directorate with great challenges as regards priorities. Great emphasis is put on the development of planning and administration systems as a means of giving the right priority to a number of intensive resource measures or as a means of arriving at the right priority between a number of measures demanding great resources.

TABLE II DEVELOPMENT OF THE DIRECTORATE'S BUDGET FOR CONDUCTING NORMAL ACTIVITIES

	1973	Increase in %	1974	Increase in %	1975	Increase in %	1976	Increase in %	1977	Increase in %	1978	Increase in %	1979	Increase in %	1980	Increase in %	1981
(Mill NKr) Activity budget	3.7	21.6	4.5	33.3	6	18.3	7.1	8.5	7.7	23.4	9.5	20	11.4	8.8	12.4	11.3	13.8
No. of permanent employees	40	57.5	63	30.2	82	46.3	120	25.8	151	25.8	190	10.5	210	8.1	227	3.5	235
Consumer price index	91.3	9.5	100	11.7	111.7	9.1	121.9	9.1	133	8.1	143.8	4.8	150.7	14.8	173	ca 13	-

Income

In addition to production fees and acreage fees paid (cf § 2.3) the Directorate has received NOK 70.016 million in income.

The income for 1980 is made up as follows:
(NOK thousands)

Account	4801 01 00	Exploration fees	NOK 400
"	4801 03 00	Refunding of inspection costs	NOK 33,673
"	4801 05 00	Incoming fees for test material released	NOK 235
"	4801 06 00	Sale of publications	NOK 387
"	4840 01 00	Sale of seismic data	NOK 35,304
"	5309 29 00	Sundry Income	NOK 17
Total			NOK 70,016

The income development in the period 1973 - 80 is divided as shown in Table III.

TABLE III The NPD's income development for the period 1973 - 80

	1973	1974	1975	1976	1977	1978	1979	1980	TOTAL
Sale of publications	-	-	-	30	135	197	291	387	1040
Sale of released test material	-	-	-	2	33	46	282	235	598
Exploration fees	345	340	220	210	280	380	420	400	2595
Inspection costs	5.525	16.539	19.721	26.717	42.037	45.189	47.358	33.673	236759
Sale of data sets	-	-	-	1.300	3.170	14.847	31.275	35.304	85896
Ref. from Statoil	-	288	463	375	76	71	-	-	1273
TOTAL	5.860	17.177	20.404	28.634	45.731	60.730	79.626	69.999	328.161
Direct total income	38.067	45.380	61.101	79.855	101.160	114.730	123.565	125.949	679.807

1.2.8. Information

Also in this period covered by the report there has been a large requirement for information from both Norwegian and foreign public institutions, mass media, companies and persons. The Norwegian Petroleum Directorate has been visited through the year by a number of public delegations from abroad. There has also been an increase in visits from foreign journalists arriving individually or in groups to familiarize themselves with the Directorate and the petroleum activity.

The Norwegian Petroleum Directorate's Annual Report takes a central place in the informative activity of the Directorate. The Annual Report has become a publication in high demand and 6,000 copies have been printed. The Annual Report for 1979 was available in March. In this connection, representatives from the press were invited to the Norwegian Petroleum Directorate to meet the management of the Directorate who made themselves available for supplemental commentary on the Report.

The Norwegian Petroleum Directorate participated with its own stand at the oil exhibition 'Offshore Northsea" in Stavanger in August. Participation in such arrangements represents a new element in the Norwegian Petroleum Directorate's external informative activity. The experience gained from participation was positive, and participation in similar arrangements will be evaluated in the time to come.

A Continental Shelf map, updated to and including the block allocations in the fifth concessionary round was prepared and was ready for the oil exhibition in August.

The number of press releases issued in 1980 shows a continued increase compared to earlier years. The increase reflects the growing activity. In the course of the year, 57 press releases were issued. Among these, it may be mentioned that the monthly activity report is also submitted in English.

1.2.9. The Office in northern Norway

The Norwegian Petroleum Directorate's departmental office in Harstad was officially opened on 20 June 1980. The opening of the office was directly related to the start-up of drilling offshore northern Norway.

The service district of the new office will be the three northernmost counties.

Within the Norwegian Petroleum Directorate's area of work, the departmental office shall be the Directorate's contact with regional and local authorities and the industrial life in northern Norway. In addition, the office shall keep in contact with the

press and the radio, and shall otherwise assist mass media by making information available. The department office shall provide information through talks, participation in meetings, etc., in that part of the country.

The office shall be a service body for the employees of the main office when on duty in northern Norway.

The staff at the office comprise one local representative, and a part-time clerk.

1.2.10. Premises

The office location in this period has had no difficulties of any kind, if the problem of having the Directorate divided between two locations is disregarded. Good and suitable premises for the department office in Harstad were also rented so that they were ready for the opening day (Fig. 1 B).

Through the accommodating courtesy of the owner of Lagårdsveien 80 it has been possible to extend the storage rooms for the geological sample storage considerably. The Directorate has also leased vacant offices in Lagårdsveien 80 so that a need in the nearest future is covered.

The preparation of plans for a new building in the Ullandhaug area is moving ahead satisfactorily. A close and good cooperation with the State's Building and Property Directorate has been established. The room program was approved during this period, and the building program is being prepared.

Fig. 1 B Magnusgate 6, Harstad, where the Norwegian Petroleum Directorate's departmental office for northern Norway is located.

1.2.11. Library

Also in 1980 a considerable increase in the number of applications for borrowing or for copies was registered, and this also applies to the number of applications for references. A third of all the queries come from external users, including Norwegian libraries, individuals and local oil companies and other companies within the petroleum industry. The library staff have also given information on the services of the library and technical library guidance to several companies having their own libraries or planning to establish their own libraries.

Literature applications from international and national data bases show a continued increase. In addition to earlier hook-up to SDC,

contact has now been established with Lockheed (USA), and Scannet (Oslo). The selection of data bases has thereby increased.

Parts of the library's catalogue (ODIN) have been put on-line with the Directorate's computer. When the whole catalogue apparatus has been automized, this will lead to a more effective library service.

In cooperation with Statoil's library and the Norwegian Centre for Informatics, a petroleum thesaurus for assistance in indexing work has been completed. The thesaurus has been publicly available since 1 January 1981.

1.2.12. The INFOIL Secretariat

In 1980, publication started of the English version "Oil-index" of the reference publication "Olje-indeks", which has now started its eight volume. Both indexes are issued as a printed publication and are on-line on the nordic Scannet data net. The translation of subject words from Norwegian to English takes place through a translation vocabulary. This has been prepared by the Norwegian Petroleum Directorate in a project under the direction of the Norwegian Centre for Informatics, with support from the Norwegian Research Council for Technology and Natural Sciences.

Certain parts of the production are still contracted to a consultant. The number of subscribers has increased by about 25 %, and the on-line use on Scannet is growing. The Directorate is presently considering offering the oil index data base OIL in an English version on the international market.

A new cooperation project called INFOIL II between the Continental Shelf Committee of the Norwegian Research Council for Technology and Natural Sciences and the Directorate with the Norwegian Centre for Informatics as executive consultant aims at developing a data bank on initiated research projects and professional competence within shelf-related and petrochemical research and industry in Norway (See Chapter 7.2 Petroleum Documentation). The Department of Energy in Great Britain will take part in the project in 1981.

This year as last year, a seminar on petroleum documentation was arranged with Norwegian and foreign speakers.

1.2.13. Effectivization - rationalization

The work of making effective and rationalizing office services has continued through the procurement of and training on modern office and word processing equipment. The use of electronic data

processing within the office service has increased, and in the period use of the Directorate's Nord 10 computer for word-processing has started.

The continued introduction of computers has been made more difficult by complete change-out of all computer personnel in 1980. To cover the steadily increasing need for computer services and computer capacity, the Directorate has purchased a larger computer system of the type Nord-100 on the recommendation of the Directorate for Industrial Efficiency. This was being installed at the expiry of the period.

A larger computer based system for storing geological information with associated possibilities for computerized print out and calculation etc has been developed under contract from the Norwegian Petroleum Directorate and is ready to be commissioned.

The Norwegian Petroleum Directorate participates in an informal cooperation group with the Ministry of Petroleum and Energy and the Norwegian Waterfalls and Electricity Administration, with the Directorate for industrial efficiency as group management to develop and implement a joint plan for the use of computers for office work and for the handling of cases.

2. THE ACTIVITY ON THE NORWEGIAN CONTINENTAL SHELF

2.1. Resource Management

2.1.1. Exploration and Production Licences

2.1.1.1. Production Licences

3 new production licences were allocated in 1980. Production licences 059-061 are the first blocks allocated north of 62°N.

Production licence 059.
By royal decree of January 18th, 1980, production licence 059 covering block 6507/12 was allocated to the following companies:

Statoil	50%	
Saga	10%	(Operator)
Elf	20%	(Technical Assistant)
Volvo Petroleum	10%	
Hydro	5%	
Deminex	5%	

Production licence 060. By royal decree of January 18th, 1980, production licence 060, covering block 7119/12 was allocated to the following companies:

Statoil	50%	(Operator)
Esso	25%	(Technical Assistant)
Hydro	10%	
Saga	5%	
Deminex	5%	
Hispanoil	5%	

Production licence 061 By royal decree of January 18th, 1980, production licence 061 covering block 7120/12, was allocated to the following companies:

Statoil	50%	
Hydro	15%	(Operator)
Conoco	25%	(Technical Assistant)
Amoco	10%	

The participation interests given above may be changed in accordance with the sliding scale governing each of the blocks and adjusting Statoil's participating interests. Statoil's share may reach 80% depending on the maximum production level for the relevant block.

2.1.1.2. Relinquishment of licenced areas

One relinquishment of a licenced area took place in 1980.

This was licence 042, block 36/1, where Amoco Norway A/S was the operator. The relinquishment was associated with such negative geological results from the first two wells that the group did not see any reason to drill more wells. The Norwegian Petroleum Directorate agreed in this evaluation and the group was therefore given given dispensation from the rest of the work program. One of the conditions however was that the whole block was relinquished.

The total licenced area as of December 31st, 1980 is specified in table IV divided into production licences in table V.

TABLE IV LICENSED AREA AS OF 31.12.80

Production licences granted	Original area	Relinquished area as of 31.12.80	Licensed area in km^2	Licensed area as % of original	Divided into no. of blocks
1965	42,106,041	36,169,546	5,936,495	14.10	26
1969	5,878,647	3,004,037	2,874,610	48.90	13
1971	523,937	130,727	393,211	75.05	1
1973	586,834	295,157	291,677	49.70	2
1975	2,329,206	488,659	1,840,577	79.02	7
1976	2,068,317	-	2,068,317	100.00	7
1977	1,175,665	-	1,175,665	100.00	5
1978	500	-	500,509	100.00	1
1979	4,007,887	-	4,007,887	100.00	3
1980	1,108,078	-	1,108,078	100.00	3
	60,285,121	40,088,125	20,196,996	33.50	73

TABLE V PRODUCTION LICENCES AS OF 31.12.1980

Granted with effect from	Production licence no.	Total area km^2	No. of blocks
1 Sept 1965	001-021	39,842,476	74
7 Dec 1965	022	2,263,565	4
23 May 1969	023-031	4,107,833	9
30 May 1969	032-033	746,255	2
14 Nov 1969	034-035	1,204,529	2
11 Jun 1971	036	523,937	1
1 Sept 1973	037	586,834	2
1 Apr 1975	038-042	2,329,206	8
6 Aug 1976	043	604,559	2
27 Aug 1976	044	193,076	1
3 Dec 1976	045-046	1,270,682	4
7 Jan 1977	047	368,363	2
18 Feb 1977	048	321,500	2
23 Dec 1977	049	485,802	1
16 Jun 1978	050	500,509	1
6 Apr 1979	051-058	4,007,887	8
18 Jan 1980	059-061	1,108,078	3
		60,285,121	126

2.1.1.3. Transfer of shares

In the course of 1980 the following share transfers were approved in accordance with § 48 of the Royal Decree of December 8th, 1972.

Production licence 020 (blocks 7/9, 8/5 and 16/8)

In this block is A/S Pelican & Co. K/S's share of 5% has been taken over by BP Petroleum Development of Norway A/S who thereby has an 87.5% share. The allocation of licence 020 is therefore:

BP Petroleum Development of Norway A/S	87.5%
The Norwegian State Oil Company A/S	12.5%

Production licence 022 (Blocks 2/3, 3/1, 3/5 and 9/10)

On this block, Amax Petroleum Norge A/S has transferred its 12.3% share in the production licence to the other foreign licencees.

The ownership is therefore:

Norske Gulf Production Company A/S	47,045%
Norske Murphy Oil Company	6,028%
Norske Ocean Exploration Company	6,028%
Wintershall Norge A/S	26,554%
K/S A/S Polaris Oil Consortium	3,345%
The Norwegian State Oil Company	11,000%

2.1.1.4. Exploration licences

A total of 89 commercial licences have been allocated. The commercial exploration licences have a duration of 3 years. When these 3 years have expired, application for a new licence must be made. Since January 1st, 1980, the first 64 licences have expired for this reason.

The following licences were allocated in 1980:

License No.	081	Amoco Norway Oil Company
"	082	Elf Aquitaine Norge A/S
"	083	Scandinavian Sun Oil Company A/S
"	084	Unionoil Norge A/S
"	085	Total Marine Norsk A/S
"	086	Phillips Petroleum Company Norway
"	087	Texaco North Sea Norway A/S
"	088	Mobil Exploration Norway Inc.
"	089	Norske Getty Exploration A/S

The last three licences were allocated in 1980, but will not be valid before January 1st, 1981.

2.1.2. Regional Surveys

2.1.2.1. The purpose of geological/geophysical surveys under the direction of the State

As an important part of the surveying of petroleum resources on the Norwegian Continental Shelf, the Norwegian Petroleum Directorate is carrying out geophysical/geological surveys under the direction of the State. The main part of the funds are used for seismics. The service mainly takes place in the area which has not been opened for detailed seismics by the companies.

A general objective for the Norwegian Petroleum Directorate's geophysical surveys is to map the petroleum is to map out the petroleum potential on the different parts of the Shelf. It is furthermore desirable that a picture is obtained by the Government of the geological main features within the relevant areas before they are opened to the oil companies.

When detailed surveys are made and drilling locations selected, it is very important that the companies are given the opportunity to take charge of this themselves. Experience shows that there are often great variations in the view of what constitutes the best prospects even if the views are largely the same as far as the geological main features are concerned.

Within the general aim of surveying the emphasis on resources follows a number of objectives.

Some of the most important are:

Preparing new areas

In view of the political signs priority is given to areas which it is desirable to open to the companies. Such priorities are important instruments for retaining full political control. It is therefore very important that such surveys are not left to companies with commercial interests.

Delineation of deep waters

Geological criteria have been implied in connection with the law of the sea as the basis for jurisdiction amounts, particularly beyond 200 nautical miles towards deep waters. It is therefore important to also obtain a picture of the geological development in these areas, even if they should be less interesting in relation to oil exploration.

Knowledge of parts of the Shelf where jurisdictional requirements are unclear

In connection with questions of delineation, it is useful to acquire knowledge as early as possible on the geological conditions in the area. It is evident that such a service must be performed by an Institution with no commercial interests.

2.1.2.2. The Norwegian Petroleum Directorate's geophysical surveys

This year's regional geophysical surveys were performed in the north eastern parts of the Barents Sea and on Spitsbergenbanken, fig. 2.1.A. The total line length is about 6,200 km. Along these lines, deep seismic data was assembled with gravimetric measurements and ground seismics (sparker).

Deep seismics and gravimetrics were performed by GECO A/S, while A/S GEOTEAM were responsible for the sparker registrations. Since the ice condiitons were very favourable on the north east side of Svalbard, a couple of lines were drawn quite far towards the north, about 80° 23' N, where the ice border was reached. Fig 2.B gives the statistical representation of surveys in the north (number of km of seismic line) performed by the Norwegian Research Council for Technology and Natural Sciences and the Norwegian Petroleum Directorate. A total of 84,000 km of deep seismics have been shot under the direction of the State since 1969.

FIGURE 2.1.A

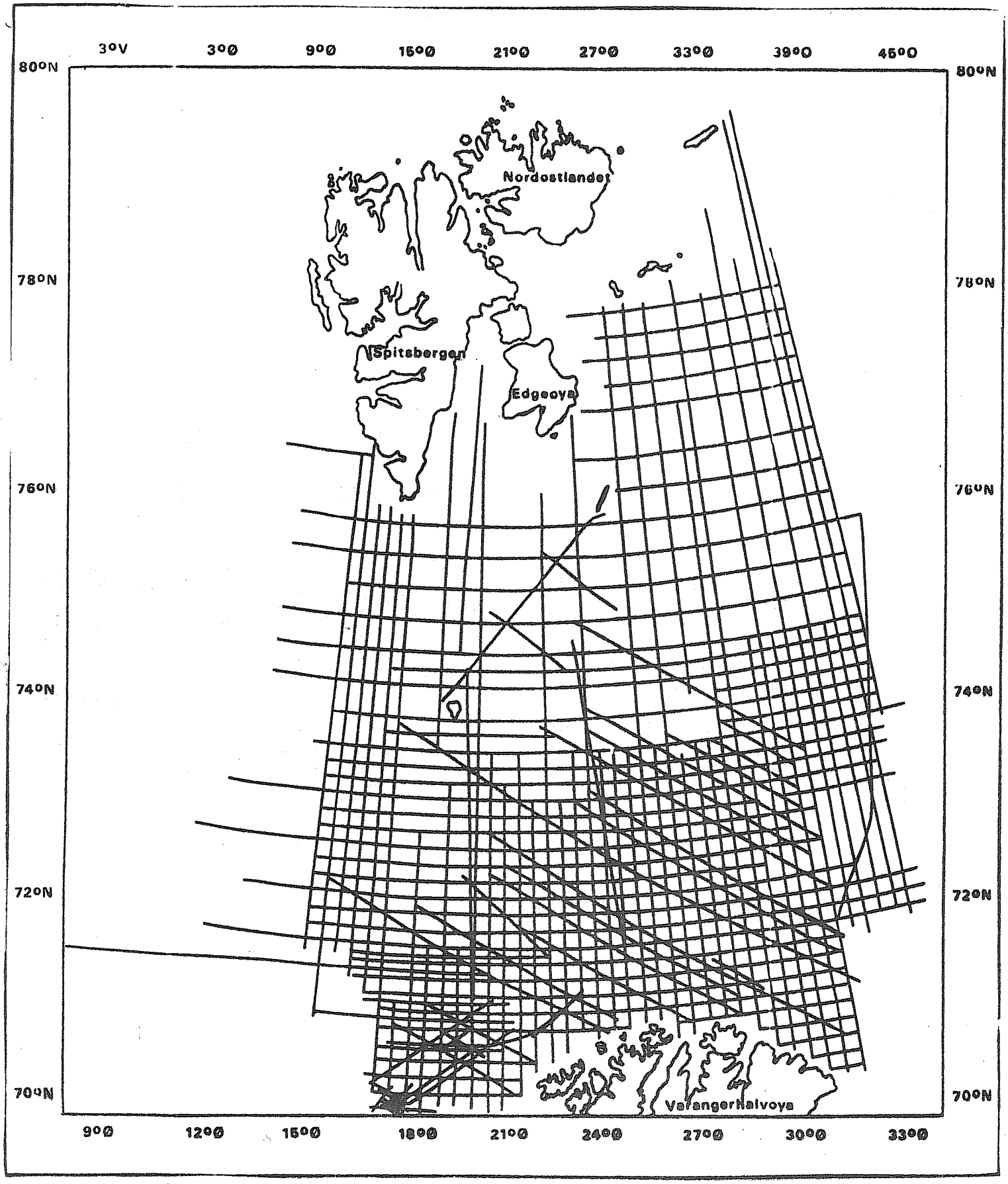
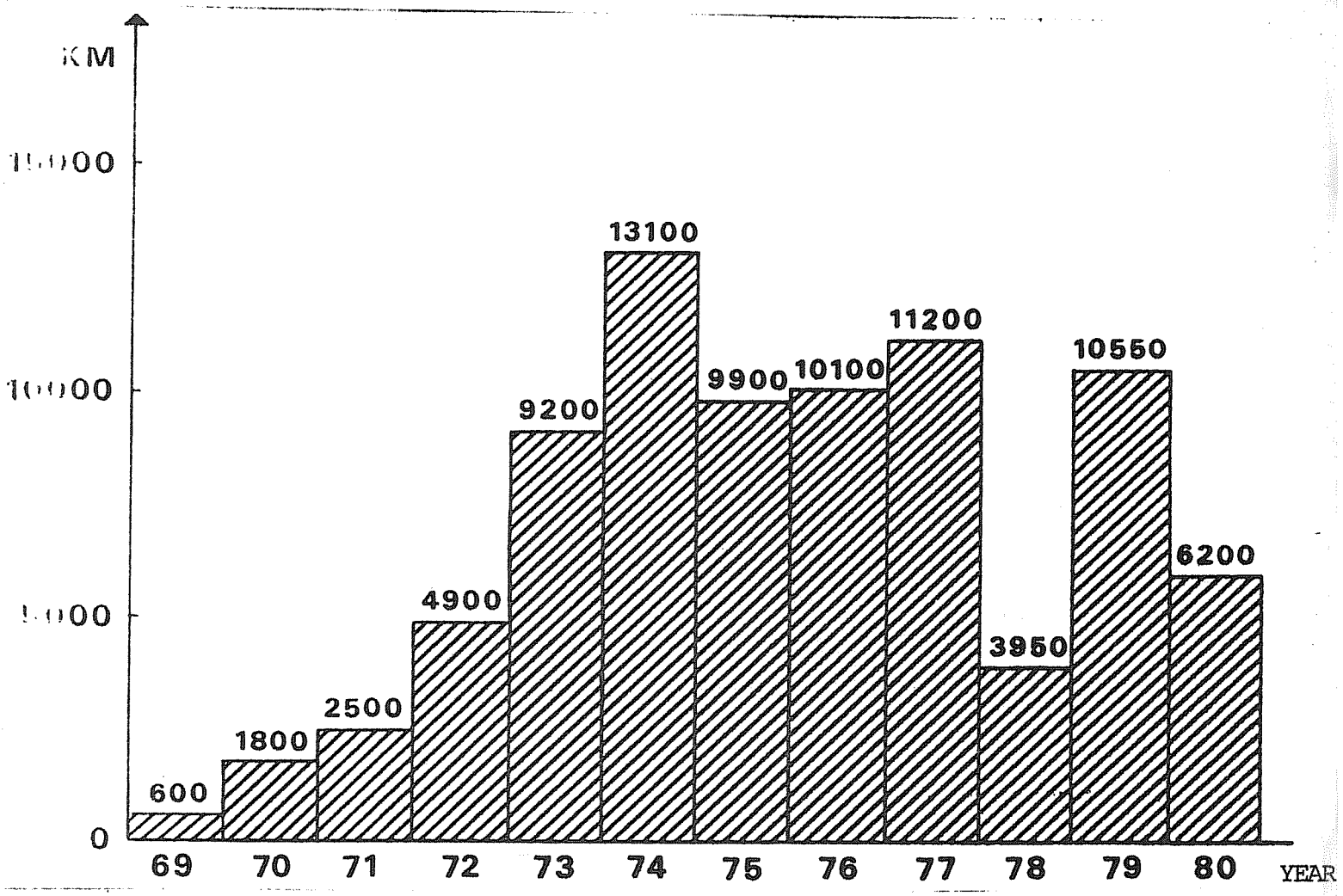

30°V
30°Ø
90°Ø
150°Ø
210°Ø
270°Ø
330°Ø
390°Ø
450°Ø
80°N
78°N
76°N
74°N
72°N
70°N
Nordostlandet
Spitsbergen
Edgeøya
Varangerhalvøya
90°Ø
120°Ø
150°Ø
180°Ø
210°Ø
240°Ø
270°Ø
300°Ø
330°Ø

FIGURE 2.1.B



TOTAL : 84000 km

GEOPHISICAL SURVEYS NORTH OF 62°N
UNDER THE NORWEGIAN PETROLEUM DIRECTORATE'S DIRECTION

2.1.2.3. Gathering and processing

In general it may be said that it has proven difficult to obtain good quality seismic data from the Barents Sea and the Shelf offshore northern Norway by conventional methods. One of the reasons for this is that the seafloor in these areas is very hard (high seismic velocities) and this makes it difficult for the energy to reach the rocks under the seafloor. Emphasis has therefore been placed on improving collection techniques and on arriving at methods for improving data quality.

In the deep seismic survey a very long energy source was also used in 1980. This energy source (SLAG) has to a large degree been used by the Norwegian Petroleum Directorate since 1977.

SLAG, "Super Long Air-Gun Array" has previously proved to give good results in the northern areas. The energy source has been prolonged to about 250 m in the direction of shooting, and this turned out to give a muffling effect on defraction noise in the direction of shooting and multiple energy (energy reflected between the seafloor and the surface).

To try to obtain an even better deep seismic data quality, two field experiments were also performed in 1980.

A similar effect as in the long energy source is obtained on noise coming in at right angles to the line direction by making the energy source wider (super wide). Experiments with such an energy force were performed in the autumn of 1980 offshore Helgeland. The energy source which consisted of 5 part sources had a total width of about 110 m and each part hose was kept in position on the side of the vessel with the help of steering boards fixed to the part sources. The processing of the test results from the experiment has not been completed.

Signal/noise relationships may in general be improved by increasing the number of registrations from the same refraction point and by summing them up afterwards. This autumn, such an experiment was performed in the Barents Sea by using two energy sources with about 50 m distance between these in a lignal direction. The sources transmitted energy in cycles by discharging the source closest to the vessel first and making registrations. Afterwards, the vessel moved 50 m and extra energy was discharged and registered. The data quantity from the same reflection point is doubled in this way, and this will half the noise energy in the later data processing.

The results of the test will be available in 1981.

About 2,500 km of seismic lines from Trænabanken have been reprocessed in 1980 with good results. A new program system was tested by a processing company for removal of multiple noise. The method has proven to be very effective on the Norwegian Petroleum Directorate´s data in the north.

2.1.2.4. Sale of data

In addition to buys mentioned in the Annual Report for 1979, the following companies have purchased the set of data from Trænabanken: Arco, Gulf, Hispanoil, Chevron, Phillips, Svanska Petroleum, Texaco.

This sale has provided about NOK 12 million for the State.

In addition Svenske Petroleum has purchased Trøndelag set I, while Volvo Energy has purchased data from Haltenbanken and the main package from Troms.

In total, data of about NOK 18 million was sold in 1980.

2.1.2.5. Geological and seismic seafloor surveys in the Barents Sea

The Norwegian Petroleum Directorate and the Norwegian Polar Institute made a joint expedition in the Barents Sea in the period August and September, 1980. The joint project was a combined geological and geophysical survey.

The geological sample taking was performed by a gravitational sample taker, a drum and chain scraper and an industrial grab. Ground photography was also done at some stage. A group from Woods Hole Oceanographic Institution gathered data with the help of a nephelometer (light fraction meter) and water sample collectors studied the present transportation of sediment in the water.

The geophysical part was a ground seismic survey with a sparkler and partly with a boomer as energy sources. The seismic equipment was provided by the Woods Hole Group. The navigation instruments used were an integrated satellite/omega receiver. The work procedures used were firstly to make sparkler registrations along a profile line, and thereafter to perform inspection of the samples.

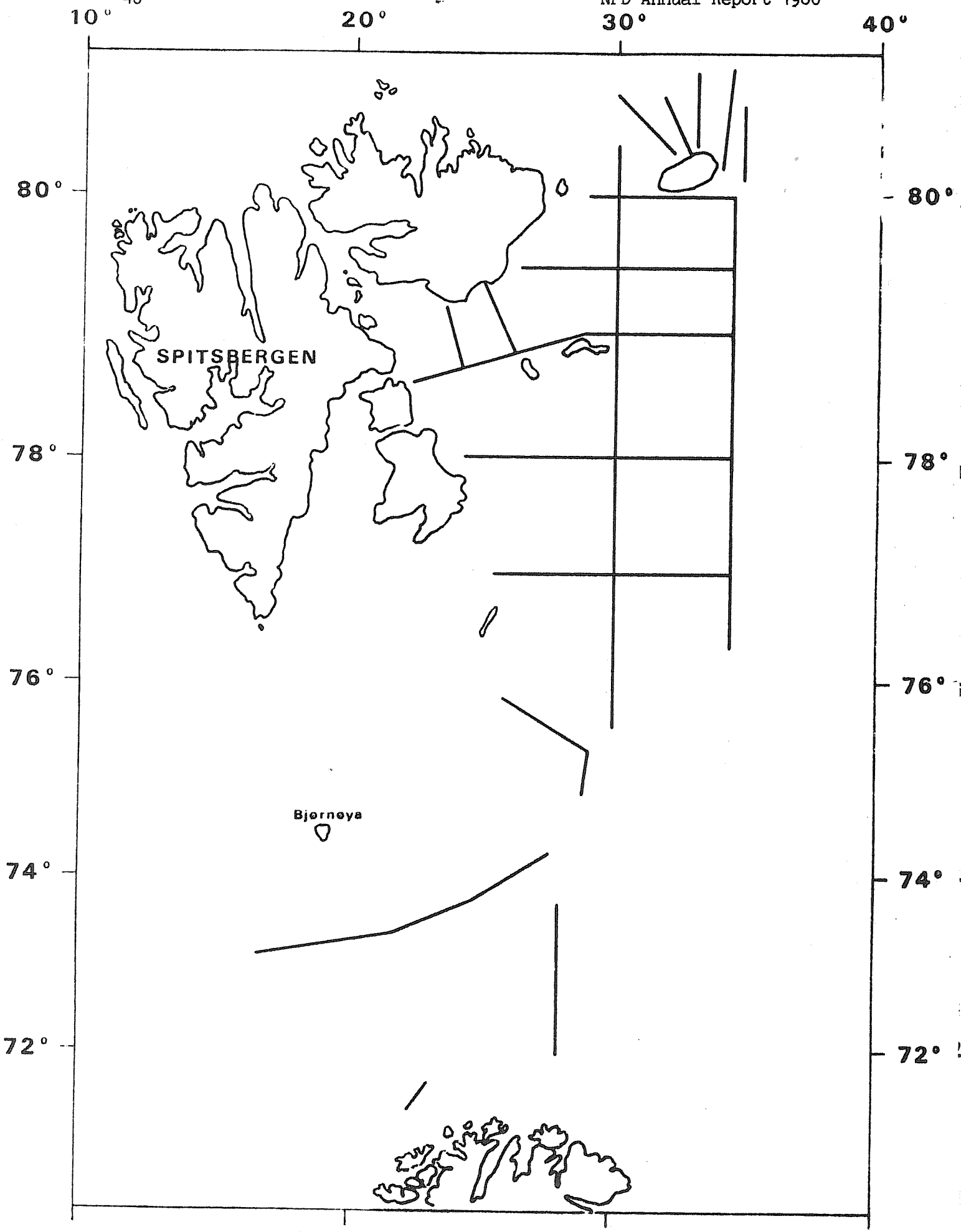
A large part of the expedition was made in north eastern parts of the Barents Sea which has not previously been surveyed. Because of relatively favourable icing conditions, good weather and a suitable boat (MS NORVARG) the expedition was very successful. Ground seismic registrations were made along 1900 profile kilometers, 10 sonar buoy measurements of sound velocity in the rock substructure were made and 262 sea bottom samples were collected from 148 stations (see fig 2.1.C).

The sample material collected was divided between the Norwegian Petroleum Directorate and the Norwegian Polar Institute

The Norwegian Petroleum Directorate's purpose with this expedition was to continue the regional geological surveying of the Barents Sea. By comparing data from the analysis of rock samples and the geophysical surveys, increased knowledge will be obtained on the geological development in the Barents Sea area. The analysis of rock fragments also provides important information on the properties of the rocks as source rocks and reservoir rocks for petroleum.

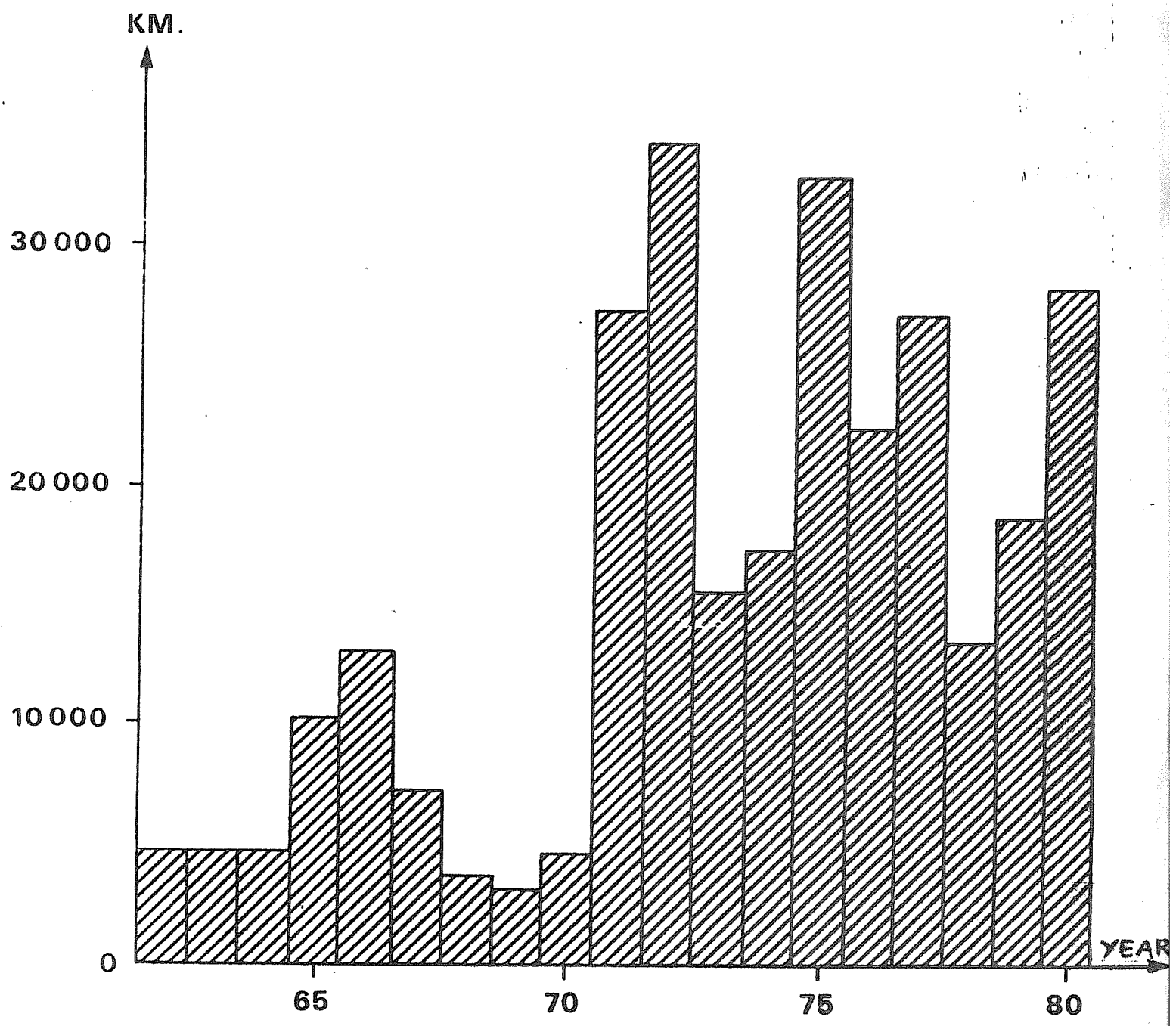
2.1.2.6. Geophysical surveys under the direction of the companies

In 1980 26,861 km of seismics were shot under the direction of the companies on the Norwegian Shelf in the North Sea. North of 62°N, 1,833 km of seismics were shot in the period covered by the report. Fig. 2.1.D shows the total number of km of seismics shot on the Norwegian Continental Shelf.



2.1.C SURVEY OF GEOLOGICAL TEST STATIONS, EXPEDITION 1980

FIGURE 2.1.D



GEOPHYSICAL SURVEYS PERFORMED ON THE WHOLE OF THE NORWEGIAN SHELF
(including North of 62°N)

2.1.3. Exploration and delineation drilling

At the turn of 1979/1980 5 exploration wells and 6 delineation wells were being drilled. All these wells were completed in 1980, but one of them, Amoco's 34/2-1, had to be abandoned at a shallow depth due to technical problems.

2 of the wells which had been temporarily left at the turn of the year, 31/2-1 (Shell) where testing still remains to be done, and 30/3-1 (Statoil) where drilling was suspended due to high formation pressures and where a drilling platform with 15,000 psi equipment must perform the remaining parts of the drilling, were not completed in 1980. It is expected that these will be completed in 1981.

In total 36 wells were started in 1980. Of these, 4 wells were abandoned due to technical problems. 28 of the wells are exploration wells, while 8 are delineation wells on structures where hydrocarbons have previously been shown.

At the end of the year, a total of 272 wells have been started on the Norwegian Shelf. These are made up of 200 exploration wells and 72 delineation wells.

Table IV gives a summary of the exploration and delineation wells which have been started or completed in 1980.

1980 started a new era in Norwegian oil drilling in that the areas north of the 62nd latitude were opened for drilling. 3 blocks were allocated, all to Norwegian operators. Norsk Hydro and Statoil became operators on Tromsøflaket (Troms I), while Saga Petroleum became the operator on Haltenbanken. 1 well was drilled on each of the blocks. Norsk Hydro well was the deepest, with a total depth of 3,548 m below the seafloor, while Statoil's well was the only one in which hydrocarbons were shown, although in small quantities. In Norsk Hydro's well, some gas was registered through parts of jurassic and triassic, but not to the effect that this could be characterized as discoveries. None of the 3 wells north of 62°N have registered abnormally high formation pressures.

The geological conditions north of 62°N did not present any major surprises and as expected, sandstone from the jurassic age was found in the surveyed prospects.

At the turn of the year, varying work was being done on 11 of the exploration wells and 1 delineation well, as can be seen from table VI. The level of activity has been high thoughout the season, with a maximum level at the end of the year of 13 drilling platforms operating simultaneously.

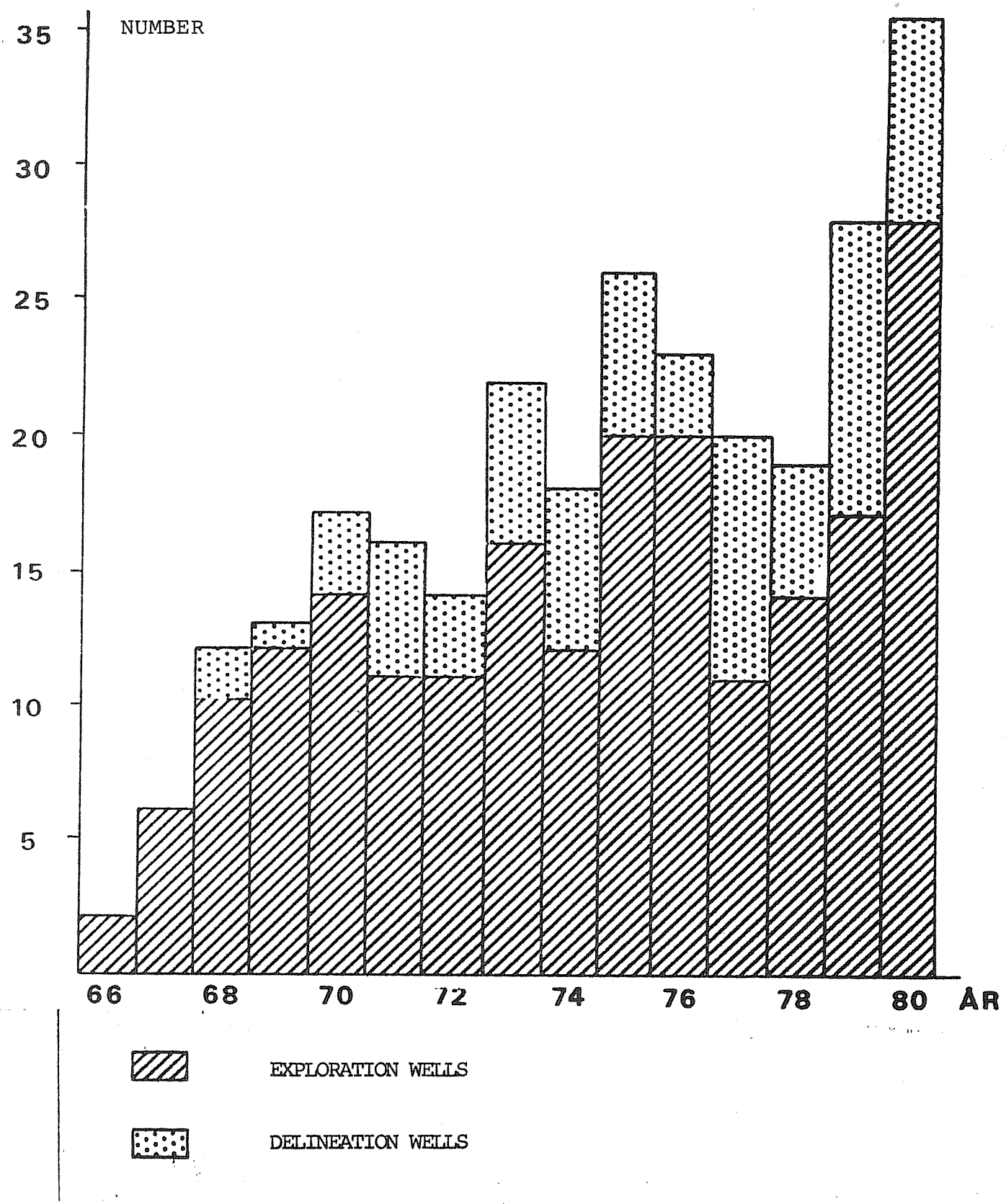
The drilling activity in 1980 compared with previous years, has been schematically figure 2.1.E. As can be seen there is a marked increase in the activity of earlier years. Above all this is due to the allocation of new blocks (4th licencing round), 9 in number, most of them subject to extensive work obligations. In addition, the discovery frequency in this allocation round has

been unusually high. Up until now, without exception, one or more discoveries have been made in the structures of all 7 blocks in which drilling has taken place. This situation has of course contributed in increasing the activity level considerably. Figure 2.1.F shows the geological distribution of wells drilled in the North Sea in 1980 and their location in relation to structural main features. Figure 2.1.G and 2.1.H shows the wells on Haltenbanken and Tromsøflaket located in relation to the block allocation and the main structural features.

As appears from these figures, the main emphasis of the exploration activity was between 60° and 62° N in the North Sea. A total of 18 wells (50% of the total number of wells) have been drilled on 4th round blocks. In blocks 34/10 (Statoil) and 31/2 (Shell) alone, 9 wells have been drilled this year, amounting to 25% of the total number of wells.

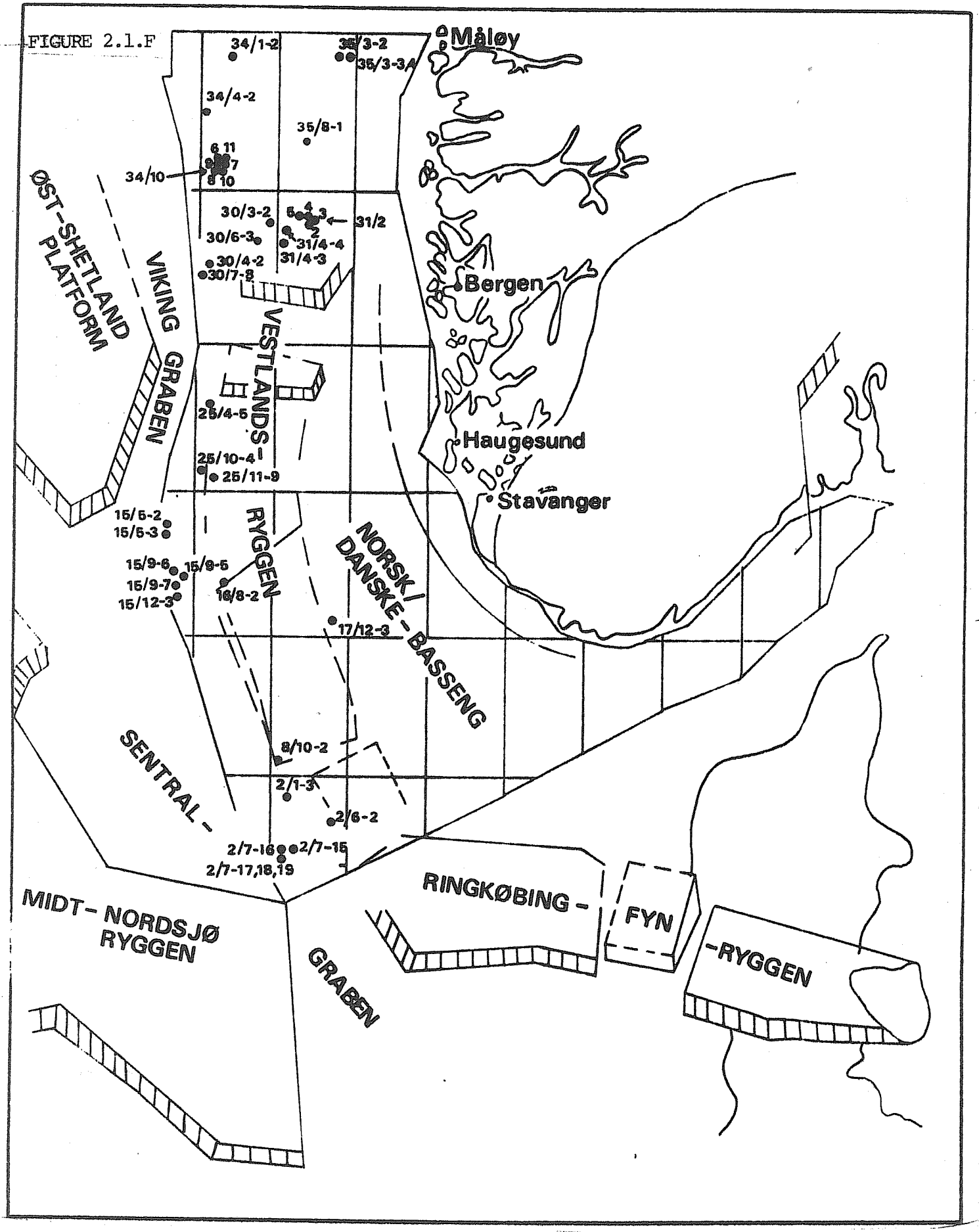
It should be noted that both Sleipner (Statoil and Norsk Hydro) and Balder (Esso) have been given priority in 1980. Phillips has kept 1 and at times 2 drilling platforms operating in the Ekofisk area. In this area 2 of the wells had to be abandoned at a shallow depth because of technical problems.

FIGURE 2.1.E



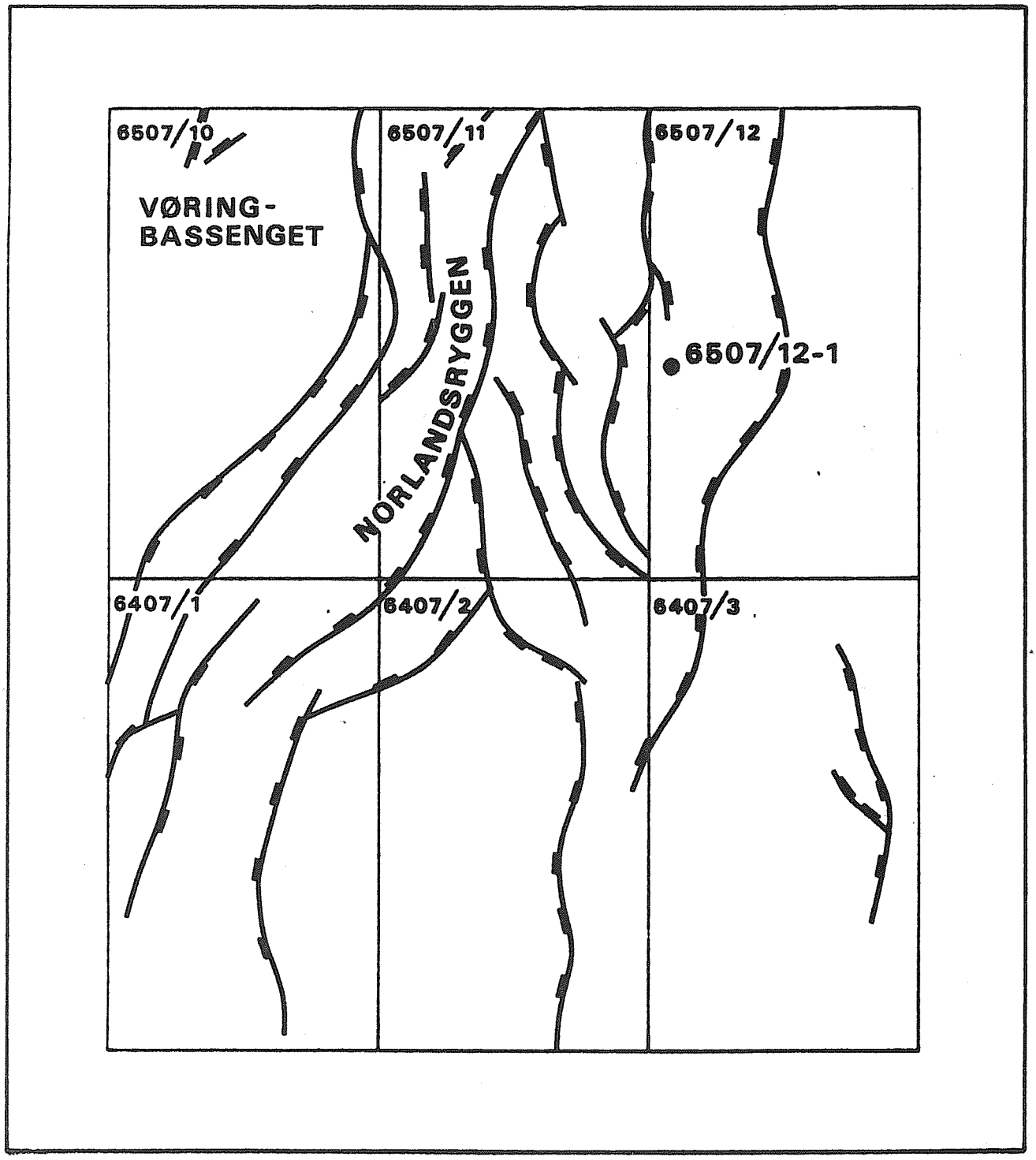
DRILLING ACTIVITY ON THE NORWEGIAN CONTINENTAL SHELF
(NUMBER OF WELLS STARTED PER YEAR)

FIGURE 2.1.F



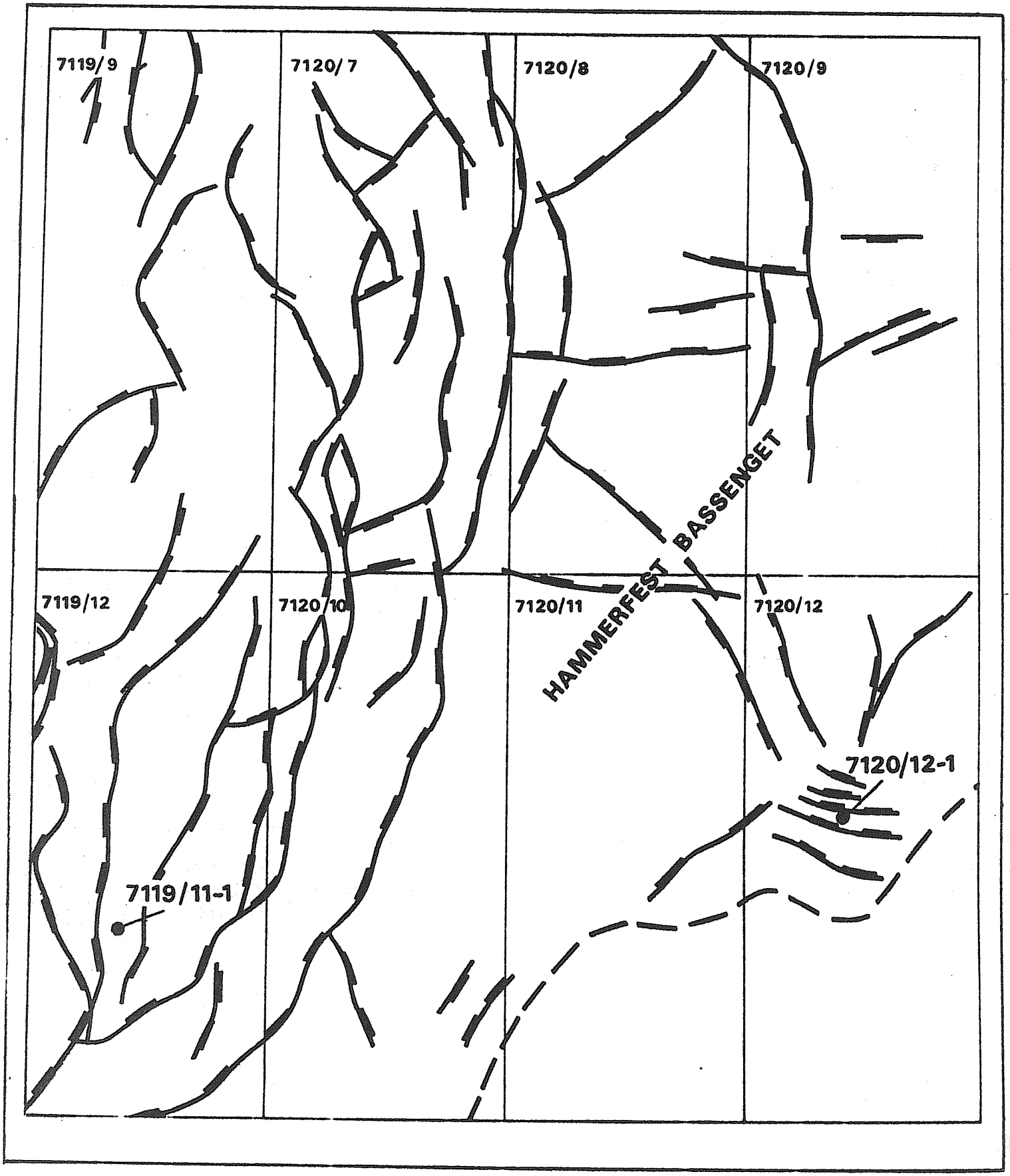
1980 WELLS IN RELATION TO STRUCTURAL MAIN FEATURES

FIGURE 2.1.G



1980 WELLS IN RELATION TO STRUCTURAL MAIN FEATURES
ON HALTENBANKEN

FIGURE 2.1.H



1980 WELLS IN RELATION TO STRUCTURAL MAIN FEATURES
IN THE EXISTING PART OF TROMS I

Distribution of prospect types

Also in 1980 the exploration activity was focused on jurassic sandstone reservoirs. If the 3 wells which were abandoned at a shallow level and replaced by new wells are disregarded, 28 (85%) of a total of 33 wells have had jurassic as the main prospect this year.

New this year is the increasing interest in sandstone reservoirs in structural and stratigraphic traps in lower cretaceous. Both Phillips in block 2/7 and Saga in 35/3 have obtained encouraging results in this respect. In addition, Norsk Hydro was drilling at the turn of the year on a very promising structure in block 31/4. We expect that great interest in this type of prospect will be shown in the years to come.

3 wells (31/4-3, 15/5-3 and 15/12-3) have this year tested deep permian prospects (rotliegendes sandstone). A narrow failure resulted in getting down the fourth (16/8-2). In addition, 2 were drilling at the turn of the year (31/2-4 and 25/10-4). These layers are often very deep, and the information on this type of prospect on the Norwegian Shelf is limited. None of the wells aim at jurassic sandstone as the primary prospect for oil or gas in Permian.

Drilling of prospects of the paleocian age in 1980 is limited to two wells on the border field whilst Phillips' wells in block 2/7 are combination wells, testing both upper cretaceous limestone projects as lower cretaceous/upper jurassic sand prospects.

The wells in the north were special in that they related to quite new geological basins, where the layer sequence is unknown. Sandstone of jurassic and triassic age was regarded however as a primary prospect.

Of the operators, Statoil drilled 9 wells, the largest number of wells last year. This is more than twice as much as any other operator.

Svalbard

This season Norsk Polar Navigasjon A/S has again started the work in Berzeliusdalen on prospect claim Fridtjovbreen No. 15. This well, Bellsund No. 1, was initially started in 1974 and the drilling continued in 1975. After having drilled to a depth of about 500 m, the drilling string became stuck and the drilling was finished. There has been no drilling activity on this location since 1975.

In the course of 1 1/2 months work in the summer, it was possible to drill past the tight drilling string by directional drilling. The drilling will continue next season when the well will be logged. The well has not penetrated prospective layers as yet.

TABLE VI

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

icence o.	Well No.	Position North East	Drilling started/ completed	Operator Licence	Platform Type	Well type class	Water Depth	Total Depth
1	0002/07-14	56 29 20.30	10.08.79	Phillips	Haakon Magnus	A	070	3665
		03 14 02.25	20.01.80	Phillips gr.	SS		26	
7	0018/10-01	58 04 38.25	19.10.79	Elf	Dyvi Alpha	U	096	2775
		04 07 00.83	01.01.80	Petronord	SS		25	
5	0034/10-05	61 11 25.35	17.10.79	Statoil	Ross Rig	A	136	2755
		02 10 23.93	02.01.80	Stat/Hydro/Saga	SS		25	
9	0002/01-03	56 54 41.39	03.11.79	BP	Sedco H	U	066	4267
		03 06 30.39	29.03.80	Stat/BP/Conoco	SS		30	
0	0030/04-02	60 31 01.10	16.11.79	BP	Sedco 707	U	123	4775
		02 02 46.22	15.05.80	Stat/BP gr.	SS		25	
1	0034/10-06	61 14 37.09	14.11.79	Statoil	Borgny Dolphin	A	223	2338
		02 13 43.68	22.01.80	Stat/Hydro/Saga	SS		25	
2	0015/09-05	58 24 12.47	20.11.79	Statoil	Norskald	A	108	3921
		01 42 29.20	09.04.80	Stat/Esso/Hydro	SS		25	
3	0017/12-03	58 11 32.84	14.12.79	Phillips	Nortrym	A	112	2705
		03 51 44.06	03.02.80	Phillips gr.	SS		25	

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

Licence No.	Well No.	Position North East	Drilling started/ completed	Operator Licence	Platform Type	Well type class	Water Depth	Total Depth
234	0030/06-03	60 34 52.98	16.12.79	Statoil	Deep Sea Saga	A	105	2915
		03 47 01.41	07.03.80	Stat/Petr. gr.	SS		25	
235	0034/02-01	61 46 28.06	29.12.79	Amoco	Byford Dolphin	U	389	0782
		02 33 06.20	19.02.80	Stat/Amoco gr.	SS		25	
236	0031/04-03	60 35 12.20	24.12.79	Norsk Hydro	Treasure Seeker	U	170	4956
		03 05 38.10	11.05.80	Stat/Hydro/Esso	SS		25	
237	0034/10-07	61 12 13.44	07.01.80	Statoil	Ross Rig	A	204	2225
		02 16 28.56	23.03.80	Stat/Hydro/Saga	SS		25	
238	0002/06-02	56 30 48.90	03.01.80	Elf	Dyvi Alpha	U	070	4735
		03 42 39.66	25.05.80	Petronord gr.	SS		25	
239	0002/07-15	56 23 46.82	29.01.80	Phillips	Haakon Magnus	U	069	4398
		03.18 54.63	02.06.80		SS		25	
240	0008/10-02	57 08 06.90	05.02.80	Phillips	Nortrvm	U	066	2972
		03 18 09.50	17.03.80	Phillips gr.	SS		25	
241	0031/02-02	60 46 47.80	27.02.80	Shell	West Venture	U	323	1858
		03 37 23.50	23.04.80	Stat/Shell gr.	SS		32	

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

Licence No.	Well No.	Position North / East	Drilling started/ completed	Operator Licence	Platform Type	Well type class	Water Depth	Total Depth
							32	
242	0034/04-02	61 30 30.93	06.03.80	Saga	Byford Dolphin	U	322	3575
		02 04 17.04	24.05.80	Stat/Saga/Amoco	SS		25	
243	0034/10-08	61 09 59.53	08.03.80	Statoil	Deep Sea Saga	A	133	2191
		02 12 03.44	25.05.80	Stat/Hydro/Saga	SS		25	
244	0015/09-06	58 27 13.52	06.05.80	Statoil	Norskald	A	112	3121
		01 41 31.60	09.07.80	Stat/Esso/Hydro	SS	T	25	
245	0002/07-16	56 25 21.68	21.03.80	Phillips	Nortrym	U	071	4793
		03 05 41.87	12.07.80	Phillips gr.	SS		25	
246	0016/08-02	58 20 59.81	03.04.80	BP	Sedco H	U	073	3555
		02 24 59.58	13.08.80	Stat/BP gr.	SS		30	
247	0031/02-03	60 50 27.84	28.03.80	Shell	Borgny Dolphin	A	334	2576
		03 35 10.82	20.07.80	Stat/Shell gr.	SS		25	
248	0034/10-09	61 12 55.34	24.03.80	Statoil	Ross Rig	A	202	2175
		02 15 00.54	09.05.80	Stat/Hydro/Saga	SS		25	

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

	Licence No.	Well No.	Position North / East	Drilling started/ completed	Operator Licence	Platform Type	Well type class	Water Depth	Total Depth
					Statoil	Deep Sea Saga	A	202	2396
			02 15 00.54	03.07.80	Stat/Hydro/Saga	SS		25	
249	0035/03-02		61 51 05.98	19.05.80	Saga	Sedco 707	U	273	4375
			03 46 28.22	26.10.80	Stat/BP/Saga	SS		25	
250	7120/12-01		71 06 48.70	01.06.80	Norsk Hydro	Treasure Seeker	U	192	2548
			20 45 20.10	12.10.80	Stat/Con/Hydro	SS		25	
251	7119/12-01		71 06 08.00	14.06.80	Statoil	Ross Rig	U	200	3088
			19 47 40.29	10.10.80	Stat/Esso/Hydro	SS		25	
252	0015/12-03		58 14 36.59	21.06.80	Statoil	Nordraug	U	086	4425
			01 52 45.67	22.12.80	Statoil/Esso	SS		25	
253	0002/07-17	X	56 20 13.00	24.06.80	Phillips	Borgsten Dolph.	U	073	1575
			03 06 04.00	12.07.80	Phillips gr.	SS		25	
254	0025/04-05		59 34 04.75	27.06.80	Elf	Dyvi Alpha	A	121	
			02 11 39.21	. .	Stat/Pan Ocean	SS		25	
255	6507/12-01		65 07 01.77	01.07.80	Saga	Byford Dolphin	U	225	3695
			07 42 49.89	26.10.80	Elf/Saga/Volvo	SS		25	
256	0030/03-02		60 47 49.23	05.07.80	Statoil	Deep Sea Saga	U	186	
			02 55 18.06	15.08.80	Statoil/Union	SS		25	

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

Licence No.	Well No.	Position North / East	Drilling started/ completed	Operator / Licence	Platform Type	Well type class	Water Depth	Total Depth
					Deep Sea Saga	U	186	3542
		02 55 18.06	. .	Statoil/Union	SS		25	
257	0034/10-10 X	60 10 27.95	15.08.80	Statoil	Norskald	U	154	0791
		02 14 43.12	04.10.80	Stat/Hydro/Saga	SS		25	
258	0035/08-01	61 21 26.37	28.07.80	Gulf	Sedco 704	U	375	4319
		03 21 44.09	. .	Stat/Gulf/Getty	SS		26	
259	0002/07-18 X	56 20 15.43	20.08.80	Phillips	Borgsten Dolph	U	073	0576
		03 06 12.77	31.08.80	Phillips gr.	SS		25	
260	0015/05-03	58 43 47.93	21.08.80	Hydro	Nortrym	U	110	5017
		01 38 12.05	06.12.80	Stat/Hydro/Elf	SS		25	
261	0031/02-04	60 51 23.57	01.09.80	Shell	Borgny Dolphin	U	335	
		03 30 44.33	13.09.80	Stat/Shell/Con	SS		25	
262	0002/07-19	56 20 18.36	02.09.80	Phillips	Borgsten dolph	U	073	
		03 06 13.61	. .	Phillips gr.	SS		25	
263	0031/02-05	60 46 16.58	26.10.80	Shell	West Venture	U	333	2500
		03 25 55.18	21.12.80	Stat/Shell/Con	SS		32	
264	0034/10-11	61 13 20.80	24.10.80	Statoil	Ross Rig	A	229	
		02 17 32.60	. .	Stat/Hydro/Saga	SS		25	

S = side-track, R = re-entry, X = prospect not reached, SS = semi-submersible, JU = Jack-up
DS = Drill-ship, T = dry, F = discovery

	Licence No.	Well No.	Position North East	Drilling started/ completed	Operator Licence	Platform Type	Well type class	Water Depth	Total Depth
265	0035/03-03 X		61 51 54.60	30.10.80	Saga	Byford Dolphin	U	252	0875
			03 52 25.80	28.11.80	Stat/BP/Saga	SS		25	
266	0025/11-09		59 10 14.36	04.11.80	Esso	Norskald	A	125	1885
			02 22 31.00	07.12.80	Esso	SS		25	
267	0031/04-04		60 40 01.10	10.12.80	Hydro	Nortrym	U	214	
			03 06 54.10	. .	Stat/Hydro/Esso	SS		25	
268	0034/02-02		61 46 18.32	27.11.80	Amoco	Sedco 703	U	384	
			02 33 09.43	. .	Stat/Amoco gr.	SS		26	
269	0030/07-08		60 29 43.08	19.11.80	Hydro	Treasure Seeker	U	103	
			02 00 20.56	. .	Stat/Petronord	SS		25	
270	0025/10-04		59 11 26.02	08.12.80	Esso	Glom. Biscay II	A	126	
			02 19 50.19	. .	Esso	SS		25	
271	0015/09-07		58 22 56.07	26.12.80	Statoil	Nordraug	A	132	
			01 42 45.99	. .	Stat/Esso/Hydro	SS		25	
272	0035/03-04		61 51 54.54	30.11.80	Saga	Byford Dolphin	U	232	
			03 52 26.35	. .		SS		25	

2.1.4. Production Wells

As shown in table III, 27 new production wells were started in 1980 so that a total of 197 production wells were drilled on the Norwegian Shelf by the end of the year. 8 of these wells have been temporarily abandoned or are being drilled. Of these, 24 wells have been drilled and are producing from the British part of the Frigg field.

The activity in 1980 is divided between 6 different fields, Ekofisk, Eldfisk, Albuskjell, Tor, Edda and Statfjord. The distribution between the fields is as follows:

	For 1980	Total	
Ekofisk	2	46	
Eldfisk	8	32	
Albuskjel	6	19	
Tor	1	13	
Edda	5	10	
Cod	-	8	
Vest-Ekof	-	12	
Frigg	-	48	(24 on the Norwegian side)
Statfjord	5	9	
	27	197	

Level of activity

Ekofisk

In order to maintain the production level for as long as possible it was decided in 1978 to drill 7 new production wells on Ekofisk. The drilling program was later increased by a further well (B-16) which shall be used in the water injection project. 7 of these 8 additional wells have been fully drilled and completed. None of the wells are being drilled at this time. It still remains for 1 well to be drilled. 37 wells are producing on the field.

Eldfisk

Drilling is done from 2 platforms (A and B) of which B has 2 derricks, so that 3 wells may be drilled at the same time. The drilling of 18 wells was completed on platform A, compared to 6 on platform B. In addition, 3 wells have been temporarily abandoned after the setting of 340 mm casing, and 2 wells are being drilled. In total 48 wells shall be drilled on this field.

15 wells are producing on platform A and 6 on platform B.

Albuskjell

On Albuskjell production drilling is taking place from 2 platforms, 1 in Shell's block 1/6 (on the western part of the structure) and 1 on Phillips' block 2/4 (on the eastern part of the structure).

At the turn of the year, 16 wells have been drilled and completed (8 on each platform), while 1 has been abandoned because of technical problems. in 1980, 6 wells were drilled and completed (6 on each platform) and 2 wells are being drilled.

In total, there will be 21 wells drilled on Albuskjell.

13 wells are in production on the field.

Tor

On Tor, 12 production wells have been drilled and completed, 1 of these was started in 1980. 1 well is being drilled.

In total 2 of a total 15 wells on the field remain to be drilled. 10 wells are in production.

Edda

On Edda 12 production wells have been drilled and completed; 5 of these were started in 1980.

For the time being, there is no drilling activity on the field where a total of 13 production wells shall be drilled.

6 wells are producing on the field.

Statfjord

On Statfjord, 9 production wells have been drilled and completed, 4 in the southern shaft and 5 in the northern. In addition 1 well is being drilled in the northern shaft. In total, 21 wells shall be drilled in each of the 2 shafts.

TABLE VII

PRODUCTION WELLS STARTED IN 1980

Prod. well nr	Well	Production	Started from 510 mm or 470 mm casing	Operator	Field	Comments
P 171	2/4-b-20	56°33'54.85" 03°12'13.20"	07.01.80	Phillips	Ekofisk	Well completed
P 172	1/6-a-13	56°38'33.97" 02°56'23.95"	09.01.80	Phillips	Albuskjell	Well completed
P 173	33/9-a-3	61°15'20.46" 01°51'13.95"	18.01.80	Mobil	Statfjord	Well completed
P 174	2/7-c-8	56°27'52.99" 03°06'15.66"	24.01.80	Phillips	Edda	Well completed
P 175	2/7-b-18	56°25'09.0 " 03°13'06.0 "	28.01.80	Phillips	Eldfisk	Well completed
P 176	2/4-f-16	56°37'13.51" 03°03'14.13"	04.02.80	Phillips	Albuskjell	Well completed
P 177	2/7-c-15		13.03.80	Phillips	Edda	Well completed
P 178	2/4-e-14	56°38'26.90" 03°19'39.30"	01.04.80	Phillips	Tor	Well completed
P 179	2/7-b-1		04.04.80	Phillips	Eldfisk	Well completed
P 180	33/9-a-7		12.04.80	Mobil	Statfjord	Well completed
P 181	1/6-a-20		17.04.80	Phillips	Albuskjell	Well completed
P 182	2/4-f-12		06.05.80	Phillips	Albuskjell	Well completed
P 183	2/7-c-3		28.05.80	Phillips	Edda	Well completed
P 184	2/4-b-16		10.06.80	Phillips	Ekofisk	Well completed
P 185	2/7-a-30	56°22'36.40" 03°15'56.80"	18.06.80	Phillips	Eldfisk	Well completed
P 186	1/6-a-16		25.06.80	Phillips	Albuskjell	
P 187	33/9-a-20		03.07.80	Mobil	Statfjord	Well completed
P 188	2/7-c-6		04.07.80	Phillips	Edda	Well completed

Prod. well nr	Well	Production	Started from 510 mm or 470 mm casing	Operator	Field	Comments
P 189	2/4-f-9		01.08.80	Phillips	Albuskjell	
P 190	2/7-a-27		22.08.80	Phillips	Eldfisk	
P 191	33/9-a-6		25.08.80	Mobil	Statfjord	Well completed
' 192	2/7-c-10		06.09.80	Phillips	Edda	Well completed
' 193	2/7-a-7		08.09.80	Phillips	Eldfisk	
' 194	2/7-b-6		29.09.80	Phillips	Eldfisk	
' 195	33/9-a-12		20.10.80	Mobil	Statfjord	
' 196	33/9-a-16		10.12.80	Mobil	Statfjord	
' 197	2/7-a-10		14.11.80	Phillips	Eldfisk	

2.1.5. Discoveries in 1980

In 1980 the drilling of 19 wild cat wells was completed. Petroleum was discovered in 10 of these. The exploration success in 1980 was thus a good 50% which is very high.

The new discoveries have been made by licence from the 1st, 2nd, 3rd, 4th and 5th allocation rounds. That the discoveries were made in licenced areas allocated up to 15 years ago may be due to many reasons.

One reason is a generally improved understanding of the geology in the areas drilled, another factor is that the older licenced areas have not been subject to a geologically justifiable work program which within certain limits secures that the minimum number of independent prospect types will be tested.

2.1.5.1. New discoveries

Block 2/1

Block 2/1 was originally allocated to Gulf in 1965. In 1971 Gulf decided to withdraw from the licence and Conoco took over. In connection with this transfer the State secured a 12 1/2% share. In 1975 BP took over parts of Conoco's share at the same time as it took over the operating responsibility. Statoil was given a 50% ownership interest and the group had to assume a further work program.

While drilling on 2/1-3, oil was discovered in a 55 m thick sandstone layer of upper jurassic age. 3 intervals were tested. Production while testing varied from 2,068 m^3 of oil per day through a 16 mm choke at the bottom of the reservoir to 10,503 m^3 of oil through a 13 mm choke in the best zones in the upper part of the reservoir.

No oil water contact was defined in the first well of the structure. For this reason, further drilling is necessary before justifiable reserve estimates may be indicated.

Block 2/6

Block 2/6 was allocated in the first licencing round to the Petronord Group with Elf as operator.

The well 2/6-2 south west of the block discovered traces of oil in limestone of upper jurassic age. The reservoir properties are very poor with low porosity. The discovery is therefore of little interest in a petroleum context.

Block 2/7 (Elver)

Block 2/7 was allocated to the Phillips group in the first licencing round. Well 2/7-16 was drilled on a flat structure just south of the Edda field. The structure is called Elver. While drilling, oil traces were observed in limestone of Danian Maastrichtian age. The oil traces were observed in an interval with a gross thickness of 200 m. The reservoir quality was however quite varied and it was not possible to produce oil.

2/7-19 (Ebba)

This well was drilled on a flat structure called Ebba just south of Elver. A Danian-Maastrichtian limestone contains non-producible oil.

In sandstone layers of the lower cretaceous age petroleum was proved to be present, probably gas in two separate layers. The upper of these layers has poor reservoir properties (under 10% positivity), but the lower layer which has not been penetrated has up to 15% porosity. Drilling was stopped because of high fluid pressure in the rock.

Block 30/3

Block 30/3 was allocated in the 4th licencing round with Statoil as operator. The structure was drilled on the border between 30/2 and 30/3 and traces of hydrocarbons were discovered in the poor reservoir rocks of lower tertiary age. The well was not drilled as far as the more interesting layers of jurassic because of the special requirement relating to the capacity of the blow-out well while drilling on the actual structure.

Oil was discovered in well 33/2 in a smaller structure of a larger complex in the south east part of the block. This structure complex continues into block 30/6. Further drilling is necessary to determine the importance of the discovery.

Block 30/4

Block 30/4 and 29/6 were allocated in the 3rd round with BP as operator. Well 30/4-2 was drilled on a pre-cretaceous complex which it shares with 30/7 and 29/9. The well confirmed the presence of gas in layers of middle jurassic age and indicated that the discovery in 30/7-6 extended to 30/4. Production testing of the well was encouraging in that 820,000 Sm^3 of gas per day and 174 Sm^3 of oil per day was produced through a 13 mm choke.

Block 30/6

Block 30/6 was allocated in the 4th licencing round with Statoil as operator. 3 wells were drilled on the same structure, with 1 completed in 1980. The wells have shown an interesting gas field

in lower and middle jurassic sandstone. The production of well 30/6-1 gave 688,000 Sm^3 of gas per day and 165 Sm^3 of oil. 30/6-2 produced more than 645,000 Sm^3 of gas per day and 190 Sm^3 of oil. The third well tested 493,000 Sm^3 of gas per day and 154 Sm^3 of oil. (All tests through a 19 mm choke.)

The three wells have been drilled so high on the inclined structure that they did not define the gas water contact. A minimum of one and probably two delineation wells are needed before the magnitude of the structure is clarified. From the point of view of the three wells drilled, it is possible to indicate reserves which are structurally higher than the bottom of the reservoir in 30/6-3 where the deepest reservoir has been discovered. This minimum estimate is 28 x 10^9 Sm^3 of gas and 3 x 10^6 Sm^3 of oil.

Block 31/2

Block 31/2 was allocated in the 4th round with Shell as operator. Seismic surveys ahead of the allocations will declare seismic indications of a flat liquid contact. This contact extends into the neighbouring blocks 31/5,3 and 6. In total, this liquid contact covers an area of about 750 - 800 km^2. The liquid contact was observed in several more or less consecutive structures. The first 4 wells were drilled on the same main structure and showed the liquid content indicated by seismics was from the gas oil contact. In the first 4 wells there was more than a 12 m oil reservoir. Production tests of gas in 31/2-2 showed 1.5 million Sm^3 per day through 2 nozzles each of 25 mm. The best oil test was performed on 31/2-2 and showed a maximum of 400 Sm^3 per day and 270 Sm^3 per day stable through a 25 mm choke.

Well 31/2-5 was built on a structure west of the complex where the first 4 wells had been drilled. The well confirmed gas/oil contact at the same level as in the other wells. However, the oil zone in this well was 21 m thick and of a lighter type than any other wells. This indicates that there is no communication between the oil reservoirs in the two structure complexes, whilst contact in the gas zone cannot be excluded.

The Norwegian Petroleum Directorate has estimated potentially recoverable reserves in blocks 31/2, 3, 5 and 6, to 1.9 x 10^9 t.o.e.. This is divided into 1.7 x 10^9 Sm^3 of gas and 0.2 x 10^9 t.o.e.. The reserve potential in the structures where hydrocarbons have so far been proven in 31/2 and 5 have been estimated at 560 x 10^6 Sm^3 of gas, 90 x 10^6 Sm^3 of oil.

Block 31/4

Block 31/4 was allocated in the 4th licencing round with Hydro as operator. Wells 31/4-1 and 2 where only well No. 2 reached the expected reservoir, were drilled on a smaller structure without positive results.

Well 31/4-3 discovered hydrocarbons in 2 sand layers of upper jurassic age. Production testing of the upper zone showed 150,000 Sm^3 per day and 240 Sm^3 of oil per day through a 19 mm

choke. The lower zone produced 175 Sm^3 of water per day and 175 Sm^3 of oil per day through a 19 mm choke. Well 31/4-3 does not define a hydrocarbon liquid contact. Further drilling is therefore necessary to define the size of the reserves. The structure is flat.

Block 35/3

The block was allocated in the 3rd licencing round. Saga Petroleum is oeprator. The first well in the block, 35/3-1 was drilled down to jurassic age without discovering hydrocarbons. The well was not approved as fulfilling work obligations since it was considered unsound to continue drilling because of unexpectedly high formation pressures, and thus the expected layers were not tested. Well 35/3-2 was drilled on the same structure as the first well, it was located somewhat higher on the structure. While drilling, hydrocarbons were discovered in sandstone layers of lower cretaceous, middle jurassic and lower jurassic age. The sandstone layers of cretaceous age were tested in two intervals. The upper zone produced over 1 million Sm^3 of gas per day through a 13 mm choke. The test result must be characterized as very encouraging.

The discovery in 35/3-2 is interesting in isolation, at the same time that it indicates a possibility for discoveries in lower cretaceous layers in other blocks in the most northerly part of the North Sea and the Shelf offshore Møre.

The magnitude of the discovery in 35/3 is very uncertain at the present time since the estimates may vary by a factor of 10. The well 35/3-3 will probably clarify some of the uncertainty.

Block 35/8

Block 35/8 was allocated in the 4th licencing round with Gulf as operator. The block is located in deep water in a geological province which has hardly been tested. The authorities therefore want to have this block allocated in order that not only low risk blocks should be allocated in the 4th licencing round.

Well 35/8-1 was drilled south west on the block in a structure extending to smaller parts of 35/7. Light oil or condensate in upper and middle jurassic sandstones was discovered.

Block 7119/12

Block 7119/12 was allocated in the 5th licencing round with Statoil as operator. Well 7119/12-1 discovered oil in sandstone of middle jurassic age. The well was not tested because of time limitations for drilling in the north. The discovery itself has little economic interest in isolation, but is very encouraging for further exploration activities in the area.

2.1.5.2. Fields declared to be commercial

Balder

In the course of the last half of 1980, an application to bring ashore oil from the Balder field has been submitted.

The Balder field covers blocks 25/10 and 25/11. In block 25/8 north east of Balder, there are smaller quantities of oil in similar sandstones.

Block 25/11 (licence 001) was allocated to Esso in 1965, block 25/8 (licence 027) and block 25/10 (licence 028) in 1969. Statoil has a 17 1/2% share of the profits before tax of licence 028.

Well 25/11-1 was drilled in 1966/67 and showed a good indication of oil in thin sandstone layers of paleocian age. On the basis of seismics shot in 1973, 25/11-5 was drilled in 1974. This well contained about 25 m net of oil bearing sand and may be considered as the first discovery on the Balder field. The next wells 35/11-6 and 7 both contained oil (maximum of 54 m net oil bearing sand). In 1979, 3 dimensional seismics were shot in the field.

Well 25/11-9 was drilled in the southerly part of the field in 1980. In this well, the top of the reservoir was discovered just 1 m higher than expected, but the well contained more shale in the lower part of the reservoir than expected. Well 25/10-4 was being drilled at the turn of the year and Esso plans a further 3 to 4 new wells in the course of 1981.

Sandstone of the paleocian age forms a reservoir in the border field. This was deposited by turbidite streams in an deep sea environment.

The reservoir sandstone is very poorly consolidated but in other respects the reservoir parameters are very good (porosity 30 - 35%, water saturation 7 - 20%, permeability 1 - 10 darcy). The oil is heavy and has a density of approx. 0.91 g/cm^3 (25^0).

The oil water contact is about 1760 m under the sea floor.

Production tests have been performed in 35/11-5, 6 and 8 whereof the best tests produced 635 Sm^3 of oil per day (full choke opening).

The Norwegian Petroleum Directorate has recently made reserve estimates for the Balder field. Present reserves in the southern parts of the field comprise about 140 million Sm^3 of oil. The northern part of the field where the oil bearing sand is thinner than 20 m has not been included. Recoverable reserves have been estimated at 50 million Sm^3.

34/10

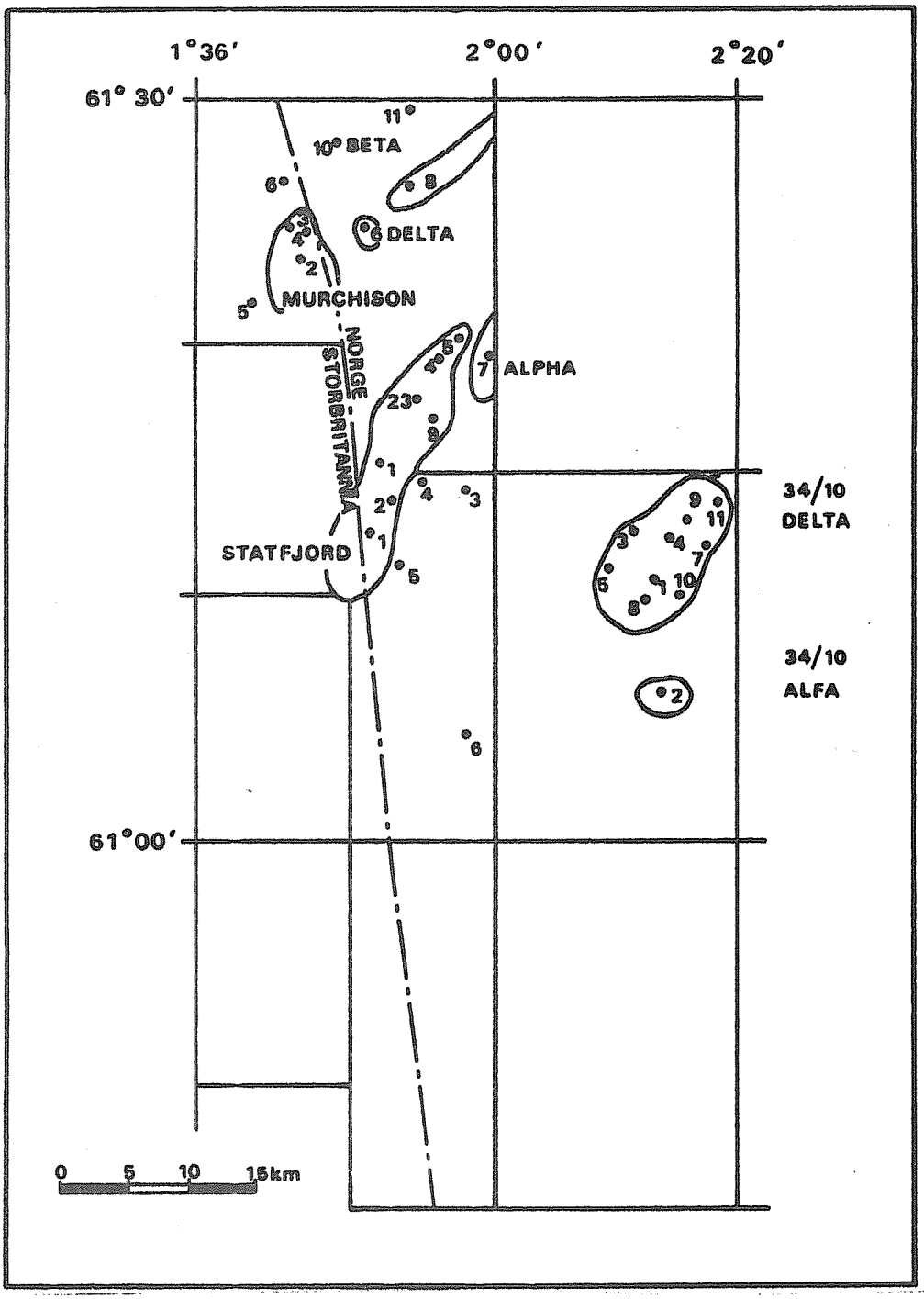
Statoil, being the operator, has, since the summer of 1978, drilled 11 wells in this block (figure 2.1.I). One well has been drilled in the Alfa structure. Of the 10 wells in Delta, 9 with oil bearing sands have been discovered.

The Delta structure which is relatively shallow (1,800 - 1,950 m under the seafloor) is divided into several fault blocks by faults in a north southerly direction. The oil bearing layers are inclined 10^0 - 20^0 towards the west. There are two sandstone formations containing oil (Brent and Cook) and they are of middle and lower jurassic age respectively. Because of the inclined layers, the reservoir conditions vary between the fault blocks. This variation and unclear seismics in the eastern part of the field leads to uncertainty in the reservoir estimates.

Of approx. 640 x 10^6 Sm^3 of oil, present in accordance with the Norwegian Petroleum Directorate's calculations, it is reasonable to assume that 205 x 10^6 Sm^3 can be produced

The field has been declared commercial by the licencees and a productivity report is being considered by the authorities.

FIGURE 2.1.I



THE STATFJORD AREA

2.1.6. Field development

2.1.6.1. The Ekofisk area

Utilization of the resources

The utilization of petroleum resources in the Ekofisk area was thoroughly discussed in the Norwegian Petroleum Directorate's Report for 1979. New fields have not been put into production in the course of 1980, but data gathered in the course of 1980 has to a considerable degree increased the knowledge of the 7 fields now producing. Development of the Ekofisk area is schematically shown in figure 2.1.J and the respective location of the fields in fig 2.1.K.

Drilling of production wells in 1980 has shown that the reservoir conditions in many of the fields is far more complicated than earlier assumed. This is particularly true for the fields Albuskjell and Eldfisk where new information shows that both reservoir geology, rock properties and composition of hydrocarbons may vary from well to well. Such conditions make it more difficult to produce a reservoir and the expected recovery factor has been reduced for several of the fields.

The behavior of wells earlier drilled indicates that the production methods selected are not the most optimal ones. True pressure discharge leads to recovery of between only 15% and 20% of the oil in the fields. Nearly half of this is the result of true expansion of the petroleum mixture before the pressure in the reservoir gets so low that gas starts to flow. This part will be recovered regardless of production methods selected, so that only between 7% and 15% of the oil is produced with the help of gas drive.

This makes it necessary to intensify the work in the Ekofisk area developing the petroleum quantities which may be lost. It may be mentioned that a 1% increase in the oil recovery factor amounts to about 17 million Sm^3. This corresponds to about 2 years oil consumption in Norway.

In the last Annual Report it was mentioned that gas injection in the Ekofisk field had resulted in an increase in oil recovery from this field of about 14 million Sm^3. Production data for 1980 indicates that gas injection has a clear positive influence on oil production. To secure that more gas becomes injected, the Ministry of Petroleum and Energy established a limit on July 1st, 1980 for how much gas may be sold each year from the Ekofisk area. In 1980, a total of 1.5 billion Sm^3 of gas was injected, corresponding to about 35% of the injection capacity. This has increased the oil production by approx. 1 million Sm^3.

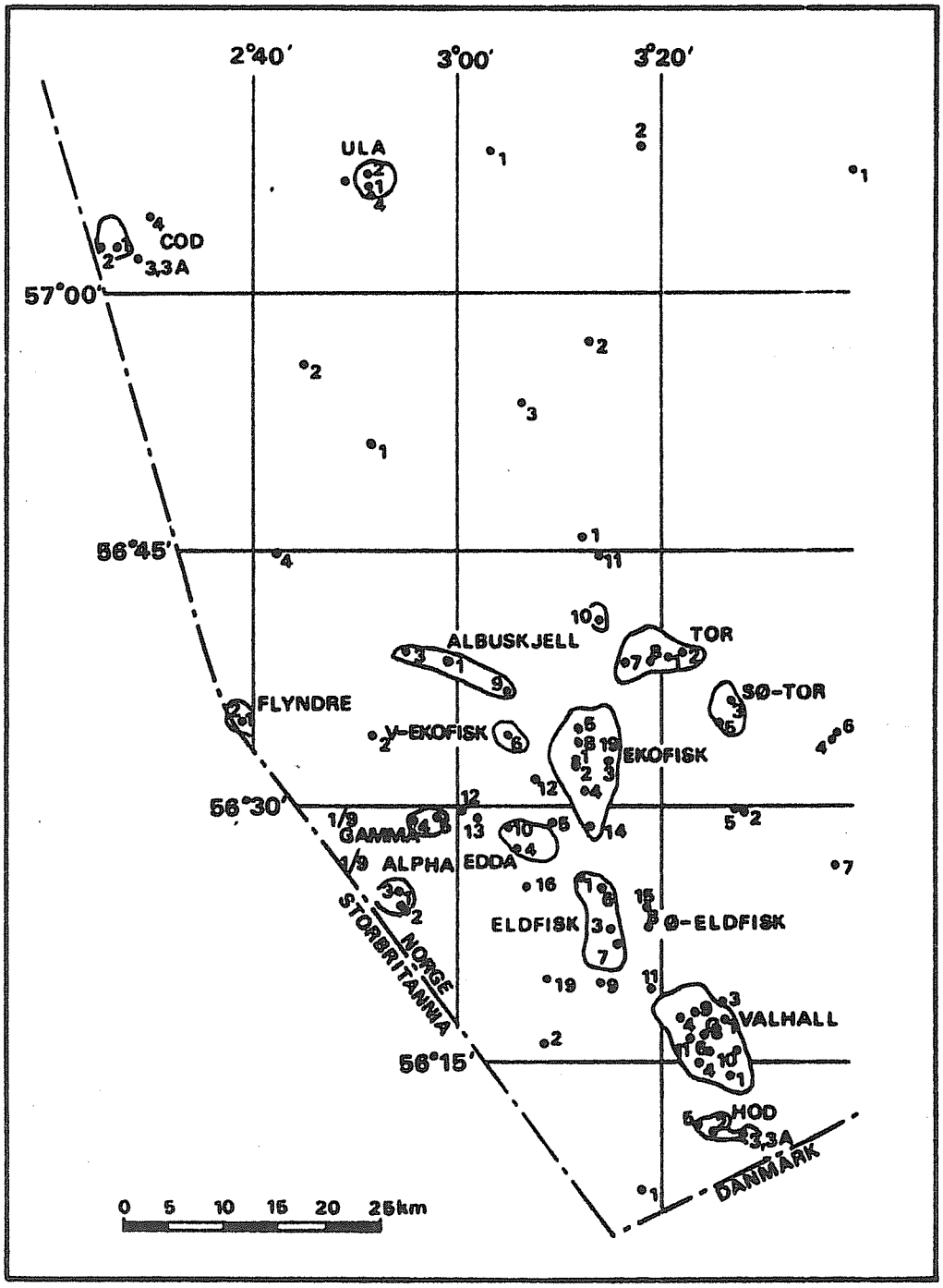
The operator for the Ekofisk area, Phillips Petroleum Company Norway, has done significant work in 1980 to find out whether

and to what degree injection of water may improve recovery from the reservoir and how water injection may be put into effect. Equipment for pilot projects of water injection has been installed and it is expected that the injection will be started in the first quarter of 1981. Detailed planning of full scale water injection in the Ekofisk field goes parallel with the pilot project so that unnecessary time will not be lost if it becomes interesting to start water injection on a larger scale. The effect will probably decrease the later the water injection is started.

Reservoir studies are also being conducted on Eldfisk and Tor to estimate the effects of water injection on these fields. On Tor, calculations have further been made showing that the platform may carry the additional equipment which is necessary to start limited water injection. Clarification on water injection in the Tor field is expected early in 1981.

There are reasons for emphasizing that the effect of water injection on the oil fields in the Ekofisk area is still not known. That which is available is data, giving a certain basis for optimism, but the uncertainty is considerable. If sucessful, water injection may increase recoverable oil reserves in the oil fields in the order of magnitude of 50% compared to the present production method. For the fields Ekofisk, Eldfisk and Tor, such an increase will correspond to about 125 million Sm^3 of oil.

FIGURE 2.1.K



THE EKOFISK AREA

Flaring of Gas

The quantity of gas flared from the Ekofisk field is shown in figure 2.1.L.

In phase I of the Ekofisk development, from 1971 to 1974, test production and loading onto a buoy were conducted. All gas was flared. Later, some of the gas was used for fuel on the platform, and from 1977 most of the gas was brought ashore through the Emden pipe line.

The quantity of gas flared was reduced after the gas flare was started. In percent of the total gas production the reduction is even more significant (fig. 2.1.M). In 1980, less than 1% of the gas was flared. This is a respectable result even on an international scale. Nevertheless great values are lost through flaring. In 1980, 0.11 billion Sm^3 of gas at a value of about NOK 80 million was flared. If it were sold today the total amount that Ekofisk has burned, 3,6 billion Sm^3, would have a value of approx. NOK 2.5. billion. The Norwegian Petroleum Directorate is therefore in 1980 also considering technical solutions which may reduce flaring still further.

Production Facilities/Permanent Installations

All seven fields in the Ekofisk area have been developed and are producing. Amongst those projects completed in 1980, these may be mentioned:

- installing of new living quarters with 56 beds on 2/4 H
- installing of equipment for pilot study of water injection on 2/4 B
- installing of equipment for cleansing of discharged water on all fields except West Ekofkisk. West Ekofisk does not have its own process equipment and water cleansing will be done on Ekofisk.

However, some smaller construction projects remain.

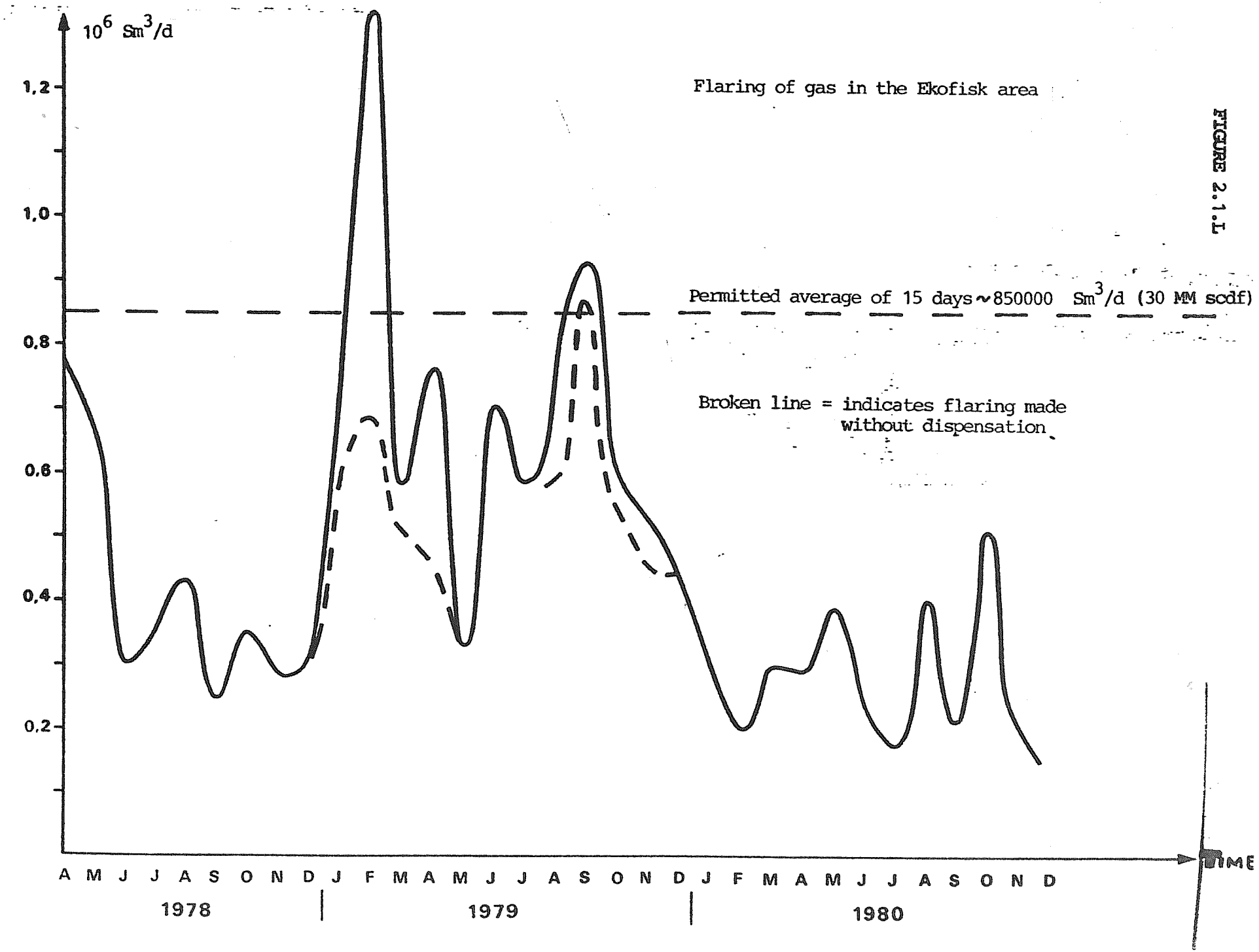
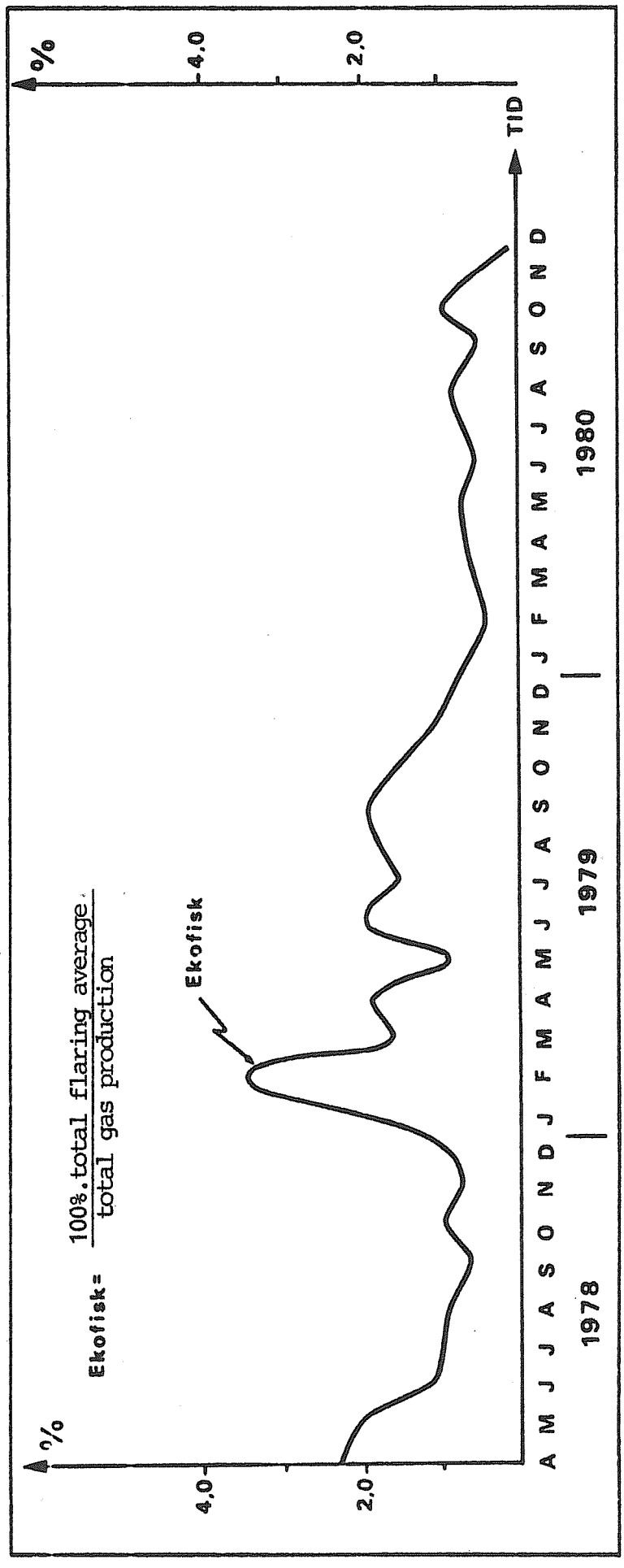
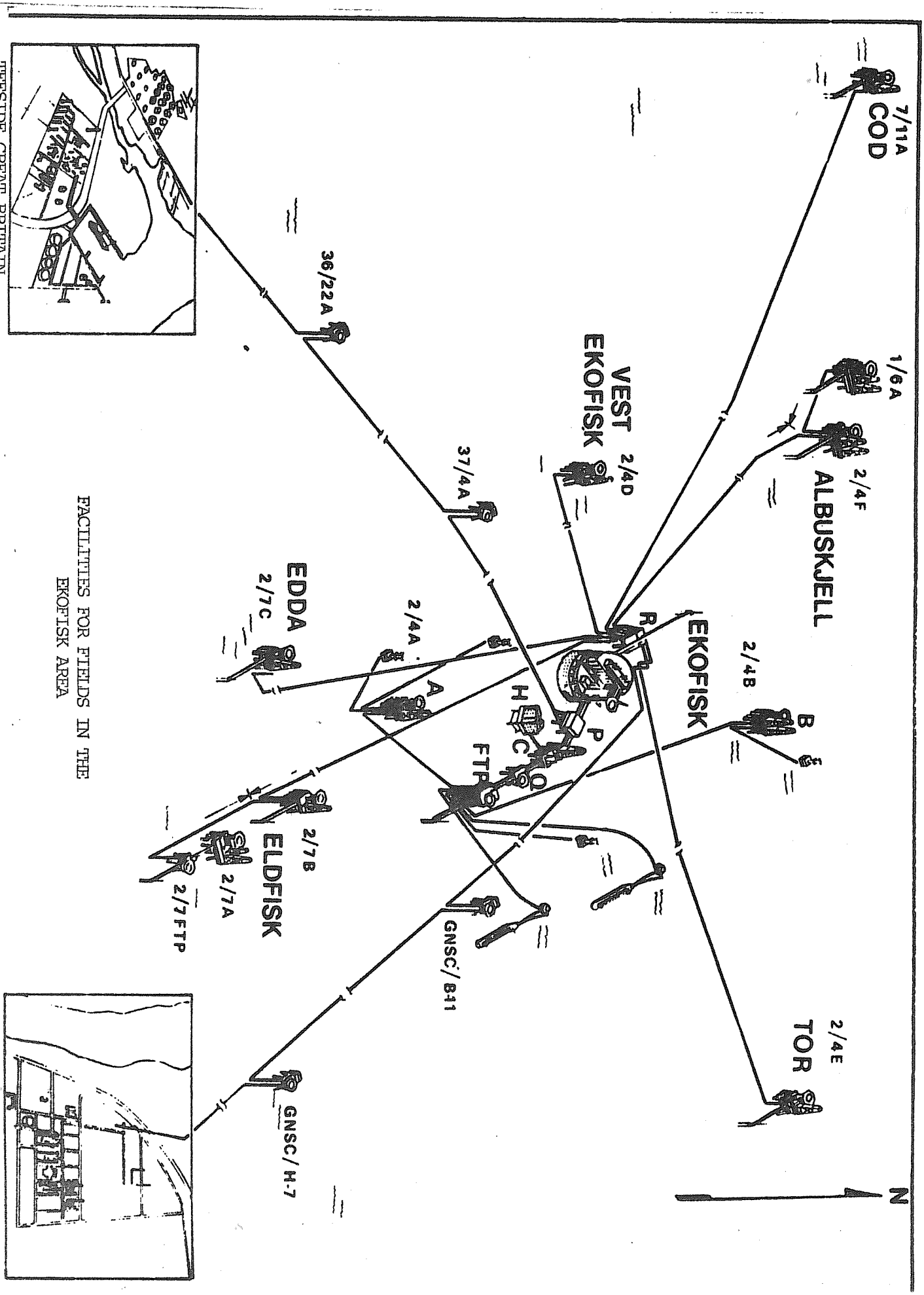

10^6 Sm^3/d
1,2
1,0
0,8
0,6
0,4
0,2
Flaring of gas in the Ekofisk area
Permitted average of 15 days ~ 850000 Sm^3/d (30 MM scdf)
Broken line = indicates flaring made without dispensation
A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1978
1979
1980
TIME

FIGURE 2.1.L

FIGURE 2.1.M



FLARING OF GAS AS A PERCENT OF THE TOTAL GAS PRODUCED IN THE EKOFISK AREA



FACILITIES FOR FIELDS IN THE EKOFISK AREA

2.1.6.2. Valhall/Hod

Utilization of the resources

Valhall and Hod are related to the other fields in the Ekofisk area from the point of view of geology and reservoirs. Other quantities in place in the Valhall field are estimated to be about 369 million Sm^3 of oil and 94 million Sm^3 of gas. Of these 43 million Sm^3 of oil and NGL and 38 billion Sm^3 of gas will probably be recovered through the Valhall-A development.

The utilization of resources on Valhall depends on two important factors:

i) the time for development of the parts of the field which are not included in Valhall-A.
ii) Production method both for Valhall-A and the rest of the field.

Experience from the other fields in the Ekofisk area indicates that resource recovery also on Valhall will be low. The Norwegian Petroleum Directorate has therefore intensified the work of having alternative production systems evaluated. Initially, injection of produced gas will be evaluated, but also injection of other gas or water may be possible. It is expected that the operator will submit an application for the production method on Valhall-A in the course of 1981.

Production of Valhall-A will be started in the course of 1982.

The Norwegian Petroleum Directorate aims at clarifying the question concerning gas injection so that this may be commenced at the start-up of production. The same problem is relevant for water injection.

Production facilities/permanent installations

A drawing of the planned fixed installations on Valhall-A is shown in fig. 2.1.N.

At the end of 1980, only the steel jacket of the accommodation platform had been set. The most critical factors for the progress of the project is making the drilling deck and the deck of the production platform ready. Delays in these projects will have a direct effect on the drilling and production start-up.

The steel jacket for the accommodation platform was delivered from VDC-Verdal so late that it could not be installed in 1980. The deck and bridge to the drilling platform are produced by VDC-Verdal-Egersund and have so far been delayed by about 1/2 a year. The drilling modules were practically ready for installation at the end of 1980.

The deck and part of the modules for the accommodation platform have been installed on the field. The installation of the remaining module has been delayed because of poor weather.

The steel jacket for the production platform will be installed as soon as the weather permits. About 1/3 of the work on the deck of the production platform was completed at the end of 1980. Delivery of this deck will determine when production is started.

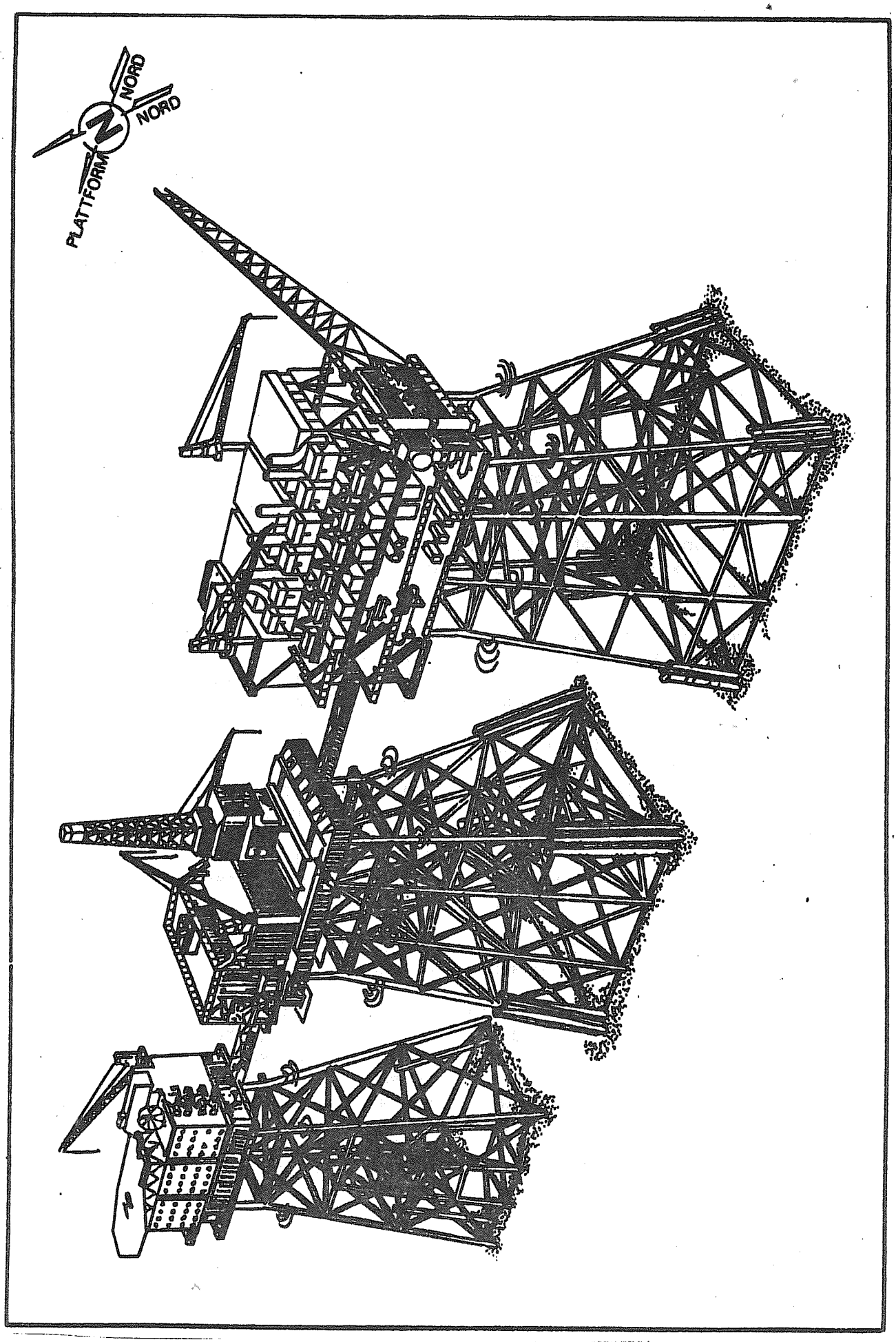
Transport

Petroleum from valhall-A will be brought ashore through the Norpipe system. The production will be processed on Valhall-A so that oil and gas may be sent directly into the Teeside and Emden pipelines, respectively, without being routed through process facilities on Ekofisk.

Two 20" pipelines to Ekofisk were laid in the summer of 1980. These will be hooked up to the Norpipe system through a new riser platform which the Amoco-Noco Group plans to install near Ekofisk in the summer of 1981 (2/4 G).

Oil will be transported to Teesside where the Amoco-Noco group will receive the end product in a marketable form. The Amoco-Noco group has also entered into an agreement under which the Phillips group will purchase Valhall-A gas on the Ekofisk field. However, the question still has to be answered as to when it will be prudent to start selling gas from Valhall from a conservation point of view.

In the Storting Report No. 92 (1976-77) on bringing petroleum ashore from the Valhall and Hod fields, the State reserved an option on NGL from the fields. The State later left it to A/S Noretyl to negotiate with the licensee on exercise of this option. It seems that relatively large NGL quantities will be transported with the oil stream to Teeside.



INSTALLATIONS ON VALHALL

2.1.6.3. Ula

The Ula field is located in block 7/12 about 70 km north west of Ekofisk. The field was declared commercial in 1979. Statoil acceded to this declaration in 1980.

The petroleum discovery is located in sandstone of jurassic age. The field consists of three main parts, whereof the middle or intermediate has the best reservoir properties. The Ula field contains relatively light oil with little dissolved gas. Even if the pressure can be reduced to over 300 bar before free gas starts to develop in the reservoir, the recovery factor by pressure discharge will be low.

The licencees will therefore produce a reservoir under relatively high pressure. They expect that there will be enough water in porous layers in connection with the oil zone, so that the pressure will be maintained by natural water infiltration. However, provision has been made in the design of the production facilities so that sea water may be injected if necessary.

The total quantities of oil and gas in the field have been estimated at 61 x 10^6 Sm^3 of oil and 7 x 10^9 Sm^3 of gas respectively.

The recovery factor from Ula will probably be around 35%. This is considerably lower than the water-drive is expected to give in for instance the Statfjord field (approx. 50%). The difference is caused by the fact that the Ula field seems to be more dehomogeneous from the point of view of a reservoir, so that water will not infiltrate into all parts of the reservoir.

The production rate from Ula will be high. The production rate will amount, at the most, to 14% of the oil reserves per year. If there is evidence of lack of water infiltration, time will be very short before water must be injected. The licencees will therefore monitor this reservoir more frequently than is otherwise usual.

At the expiry of the report period the operator announced that the present plans will be the subject of new evaluation.

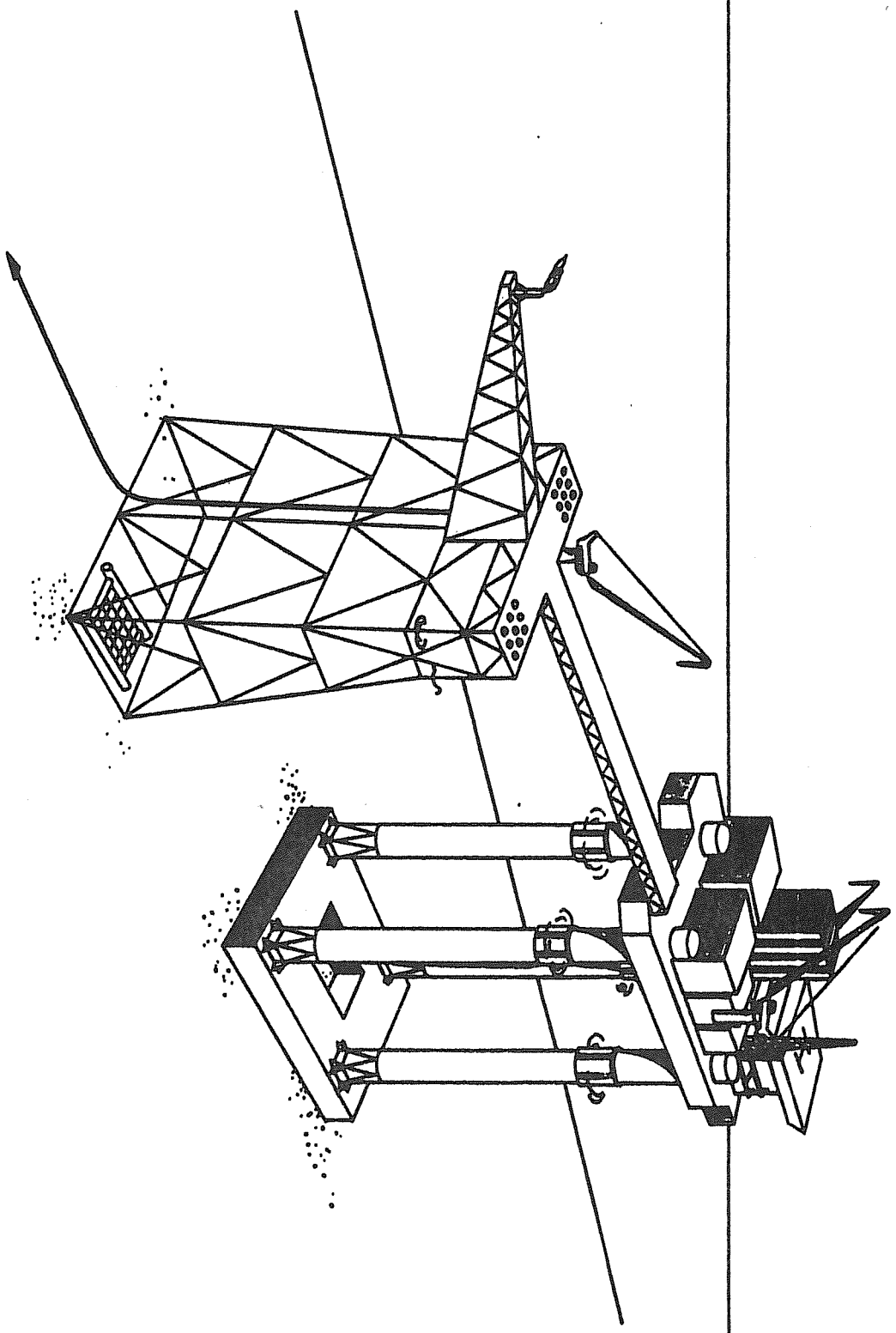
In the life of the field, water production will increase considerably. During the period of plateau production, the first 45 years, it is expected that water production will reach 2,000 Sm^3 per day. Later on in the life the share of produced water (water cut) will increase. One will then have the opportunity to inject part of this produced water so that the reservoir pressure may be maintained or increased. The operator expects to be able to produce, with the water cut over 50%, perhaps up to 90%. Reservoir similated studies show that it must be assumed that such a high water cut must be envisaged for production towards the end of the life of the field. The operator has decided to develop the water treatment capacity so that these circumstances may be met. The development plan for the Ula field was presented to the authorities at the turn of the year 1979/80

and was approved by the Storting in May 1980.

The plan is to develop the field with two platforms, one well head platform and one accommodation platform. The platforms will be connected by a bridge as shown on fig. 2.1.0.

At the outset it is expected that the field will be drained through 8 production wells. The first wells will be predrilled through a steel templet on the seafloor so tht these may be completed and put in production as soon as the processing facilities are ready. The processing platform itself will have a capacity of 80,000 barrels per day.

It was initially planned that produced oil would be brought ashore through buoy loading on the field. It was later concluded that it would be better to transport it through a pipeline to the Ekofisk facilities and into the Ekofisk Tesside line. The quantity of associated gas produced with the oil is relatively small. Instead of flaring it at the field it has nevertheless been found commercially sound to transport the gas to Ekofisk in a separate pipeline and from there to the continent through the Ekofisk Emden pipeline.



PLANNED INSTALLATIONS ON ULA

FIGURE 2.1.0

2.1.6.4. The Frigg Area (Frigg N.E. Frigg Odin)

Utilization of the resources

In the Annual Report for 1979. The utilization of the Frigg field with surrounding satellite fields was given a wide coverage. It was pointed out that gas would flow from the satellite fields to the main field unless production was started on the satellite fields. To avoid gas being lost in this way, the licencees decided in 1980 to develop a satellite field N.E. Frigg and Odin (fig. 2.1.P). It is expected that production from these fields will start in 1983 and 1984 respectively. The production rate will be so high that infiltration of gas into the main field will be stopped shortly after production has started.

The satellite fields are very similar to the main field both from the point of view of geology and reservoir (see the Annual Report for 1979). Production from such resources is simple and the recovery factor may be very high. In the case of the Frigg field, it seems that the recovery factor may be 80% or more. The reason is that the pressure in the reservoir can be lowered without influx of great quantities of water into the reservoir.

Observations in the last year may indicate that the water zone under the gas is somewhat smaller than earlier anticipated. This will hardly have any influence on the recoverable quantities from the Frigg field, and it is uncertain whether this will change the point of time and or when compressors must be commissioned.

The recovery factor for N.E. Frigg and Odin will hardly be as high as for the main field. First, it will not be possible to reproduce all the gas which has infiltrated towards the Frigg field. In addition, the height of the gas column in the reservoir is considerably lower than in the main field and the production rate significantly larger compared to total reserves. Therefore the satellite fields will be more exposed to influx of water than the main field.

The reserves in the satellite field are small and it is questionable whether they will cover the cost of the operation of the transport system in isolation. The production period of the satellite fields will therefore be determined by the Frigg field.

Joint utilization (unitization)

The Frigg field is unitized between Norway and Great Britain with a 60.82% Norwegian share and a 39.18% British share. The authorities signed a treaty in 1976 on the utilization of the field and the allocation was accepted by the licencees in 1977. This does not cover the satellite fields.

According to the agreement, the allocation could be taken up again in 1981 on the basis of earlier and new data or as a consequence of the production history of the field. None of the parties asked for new negotiations in 1980. In accordance with the Frigg treaty, reallocation may take place at the expiry of every four year period (next time in 1985) or whenever additional reserves in communication with the Frigg reservoir are discovered.

North East Frigg

Development Plans

The field will be developed with 6 wells completed on the seafloor. These will be operated from a control station located 150 metres from the well-heads. A template construction on the sea floor will, in addition to the well-heads and christmas trees, be equipped with a manifold to collect the gas from the 6 wells. The gas will be transported through a 16" pipeline to the Frigg field for processing. Each of the 6 christmas trees will be controlled through separate service and control lines from the control station (an articulated column). A hydraulic control and monitoring system will be used between the wells and the control stations. Remote control of the control station from the Frigg field will take place through a radio link. In addition, a cable will probably be laid on the sea floor between Frigg and North-East Frigg as a reserve or as a contingency communication system.

The 6 wells will be drilled from a semi-submersible drilling rig through a template construction on the sea-floor. The drilling platform will also be used for the completion work and for installation of the 6 sub-sea christmas trees and later for possible maintenance of the wells.

Steel pipes for the bottom template are being manufactured by Noroff, Sandnessjøen, while well-heads and valves will be supplied by Kongsberg Våpenfabrikk in conjunction with a foreign company. Control lines, also to be supplied by a foreign firm will be delivered. For production drilling, the drilling platform "Byford Dolphin" has been chartered and drilling will start in the autumn of 1981. The pipe lines are scheduled to be installed in the summer of 1982.

Odin

Development Plans

The chosen development concept consists of a platform with a four-legged steel jacket and an integrated deck. A semi-submersible drilling platform will be used as an auxillary platform in a drilling face. The production platform will only be furnished with processing equipment to a limited degree since the gas will be transported through a 20" pipeline to the Frigg field without being treated.

2.1.6.5. The Statfjord Area

The Statfjord area comprises the Statfjord field, 33/9-Alfa and 33/9-Beta (see figure 2.1.I). The Statfjord field itself was discovered in the spring of 1974 and was declared commercial in the same year. The first field development report was presented to the authorities in the spring of 1976. Since then, several field development reports have been presented, the last in January 1980. It has now been decided that the field shall be developed with a total of 3 fully integrated platforms (figure 2.1.Q).

The total quantities of oil and gas to be found in the fields were originally estimated by the licencees at 1033×10^6 Sm^3 of oil and 180×10^9 Sm^3 of gas. Later calculations made by the Directorate suggest 811×10^6 Sm^3 of oil and 142×10^9 Sm^3 of gas. By re-injecting water into the Brent reservoir and gas into the Statfjord reservoir, it is expected that a recovery factor of about 50% will be obtained. This means that the total recoverable oil quantities will be 405×10^6 Sm^3 (including the British part). The quantity of producible associated gas is estimated at 48×10^9 Sm^3 of dry gas and 15 million tons of NGL. The allocation of reserves in the field which was approved by the authorities in 1979 is 15.9068% on the British side and 84.0932% on the Norwegian side. If it had been desired by any of the parties, either a re-evaluation of reserves in accordance with the division or re-allocation should have been made as of January 1st, 1981. The next opportunity for re-allocation will be January 1st, 1983.

The final development plan for the Statfjord field was presented to the Storting in Storting Report No. in the spring of 1980. The report concluded that the field should be developed with a total of three platforms and that the oil should be brought ashore through loading buoys at the field. No decision on the design of the last platform (Statfjord C) or the bringing ashore of gas from the field has been made.

In the course of the summer of 1980 the licencees decided to build Statfjord C similar to the Statfjord B platform but with increased processing capacity. The total processing capacity means that Statfjord C can complete in the order of 35 million Sm^3 per year. All platforms will have equipment for gas and water injection. For optimum utilisation of this processing capacity, emphasis has been placed on designing the platforms in such a way that production from fields in the proximity may be received in the future.

Bringing ashore gas from the field has been given great attention in the course of 1980. The alternatives which have been evaluated are taking it ashore in Great Britain, via the British trunk pipeline system, to the Continent via the Ekofisk facilities or to the Continent via Norway (Kårstø or Mongstad) or further via Ekofisk.

The choice in the method for bringing it ashore is made particularly difficult by the time aspect, since it is considered desirable from the licencees' point of view to get the sale of gas started before the turn of the year 1985-1986. In its evaluations, the Directorate has placed particular emphasis on the opportunity to integrate the solution selected for bringing it ashore with a future coordinated gas transportation solution.

The production from the Statfjord field was started on 24th November 1979. Production experience and information from new production wells in 1980 has thereby increased our knowledge of the field considerably. However, the field development has only just started and the perception of our discovery may change rapidly in the years to come.

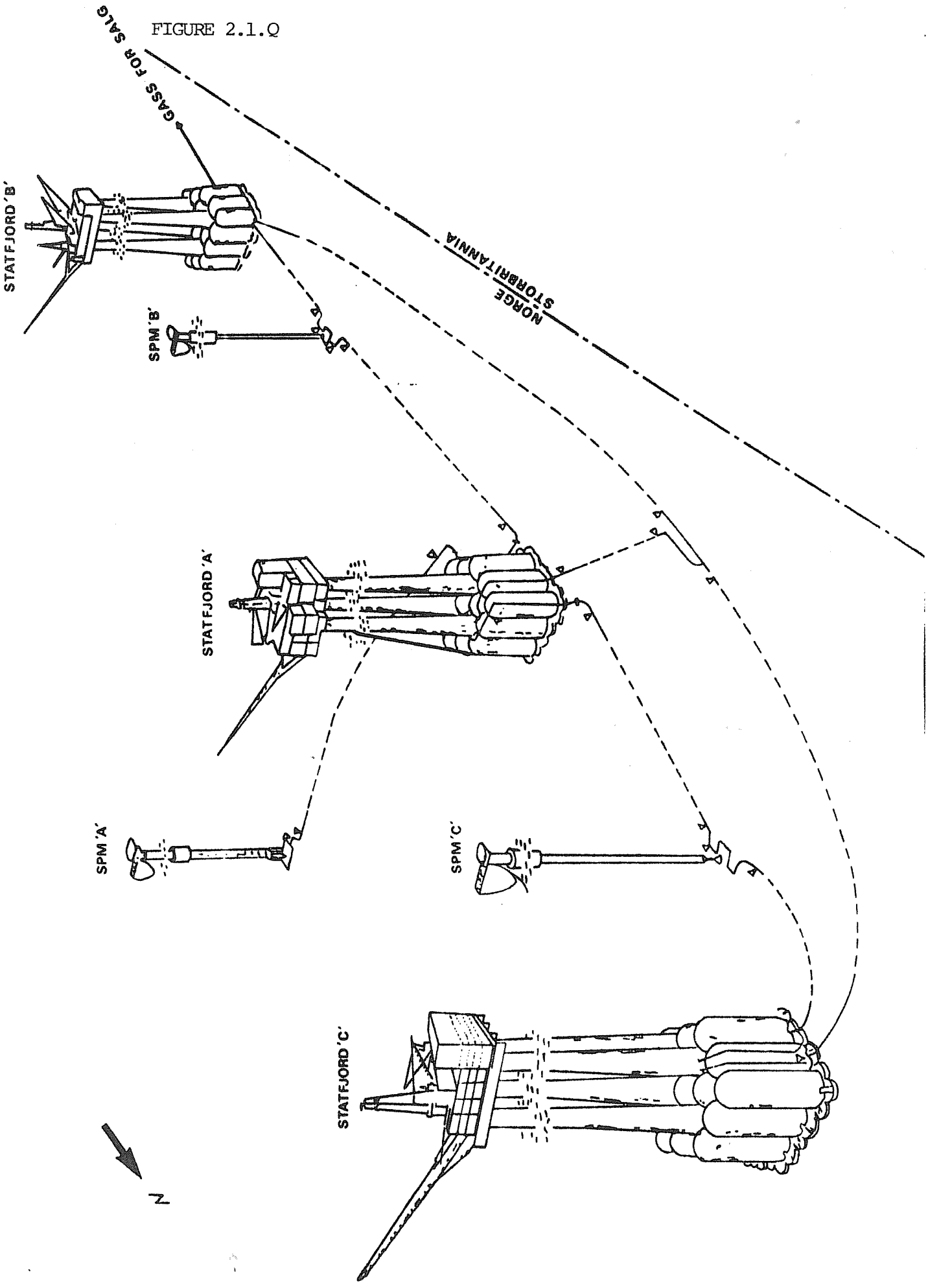
Drilling of production wells in 1980 shows that a great degree of uncertainty is associated with the surveying of the resources. The total reserves remain unchanged while it looks as though the lower reservoir (the Statfjord formation) may be somewhat reduced compared to the upper reservoir (the Brent formation). Since all gas from the Brent formation shall be injected into the Statfjord formation, this may mean that the Statfjord formation will be filled more rapidly with gas. It may therefore be necessary to also inject gas into the Brent formation. Two to three years' production experience is necessary before the influence of gas injection on the recovery factor may be determined, and thereby how much gas may be injected without problems.

Gas injection into the Statfjord reservoir will have a positive effect on oil recovery, but only for a limited time. On the basis of comprehensive reservoir studies in 1979 and 1980, the licencees decided to endeavour to sell the gas from 1986. In agreements on the sale of gas, it is recommended that clauses be incorporated to make it possible to inject gas to the extent that this is suitable from a conservation point of view. There is also a risk that gas sales may be started later than strictly desirable and the Oil Directorate will place emphasis on minimising the inconveniences this causes due to further planning.

In accordance with the development plan approved by the Storting in 1976, gas should be injected from the start. As mentioned above, the injection equipment was not ready for use until June 1980. The total quantities of gas that will be burnt by the end of 1980, 500 million Sm^3, may mean that oil development will be somewhat reduced.

In other respects, information has not been received in 1980 making it necessary to change the calculations for production from the Statfjord field.

FIGURE 2.1.Q



EXISTING AND PLANNED INSTALLATIONS ON THE STATFJORD FIELD

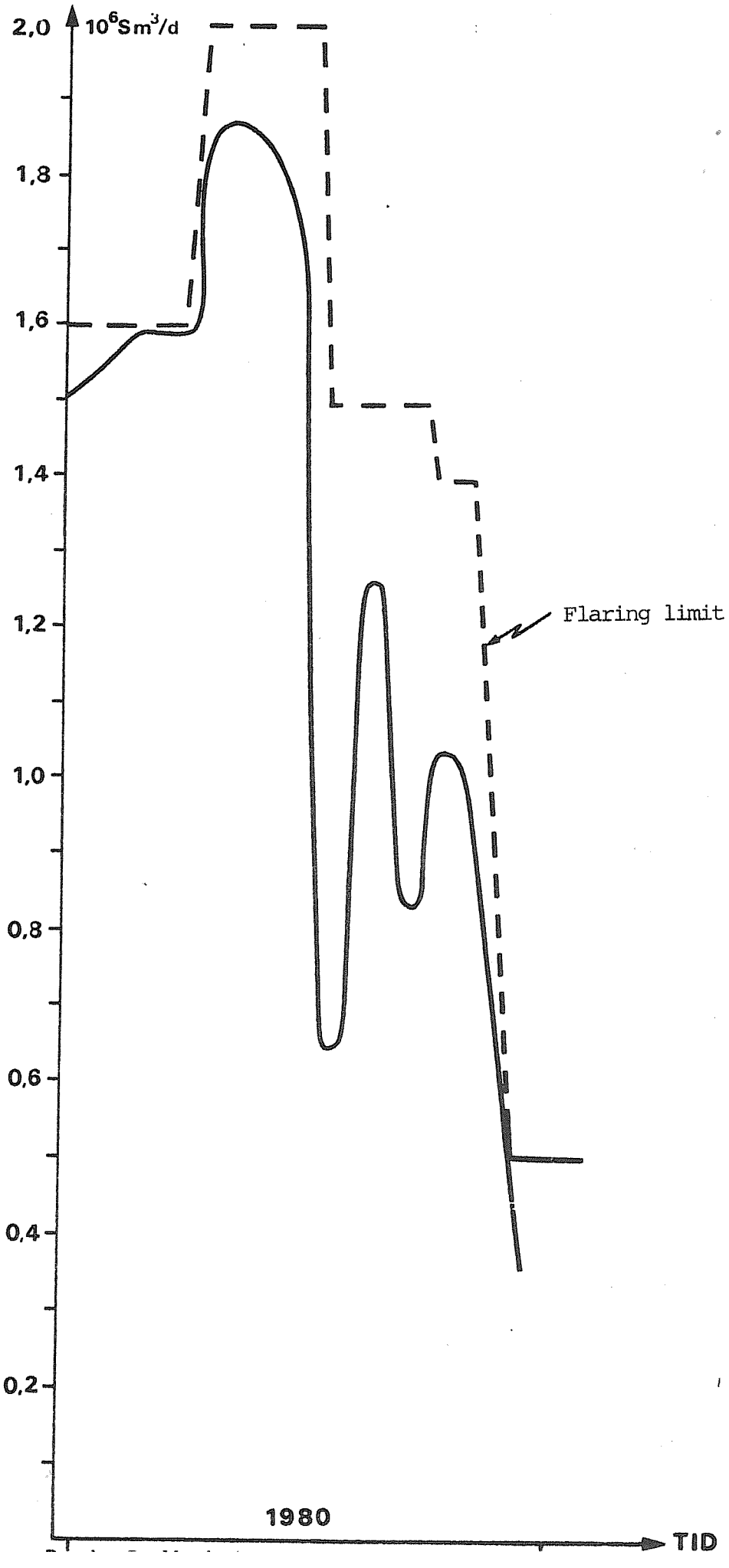
Flaring of Gas from Statfjord A

When the Statfjord A platform was ready for production in November 1979, the system for injection of associated gas was not completed. It was estimated that it would take about 6 months to complete these systems. Approval for oil production would therefore mean that approval to burn all associated gas in this period would have to be given.

In order to get started with the oil production, as well as to make a start on the necessary oil treatment facilities, it was decided that there should be a production crew on the condition that the associated gas to be flared should not exceed 1.6 million Sm^3 per day on average (figure 2.1.R). The quantity of oil which would then be produced was estimated as being the minimum quantity which the facility could process under normal operating conditions. However, from April 1st, 1980, the Ministry of Petroleum and Energy, upon application from the licencees, approved an increase in the quantity of gas flared from 1.6 to 2 million Sm^3 per day on average. Since completion of the injection system was delayed and the first injection tests were not started until June, the approval for 2.0 million Sm^3 per day in July was reduced to 0.5 in the middle of November when the injection systems were considered to be operating normally. Flared gas as a percentage of total gas production is shown in figure 2.1.S.

The total quantity of gas flared at the start of normal operations in November, 562 million Sm^3, amounts to considerable quantities of energy. If the equipment for injection of the gas had been mechanically completed at an earlier time, the quantity could have been considerably reduced. Compared with the running-in of injection systems in other places around the world, however, the running-in on Statfjord A must be said to be very satisfactory and the flaring of gas in this connection moderate.

Table 2.1.R



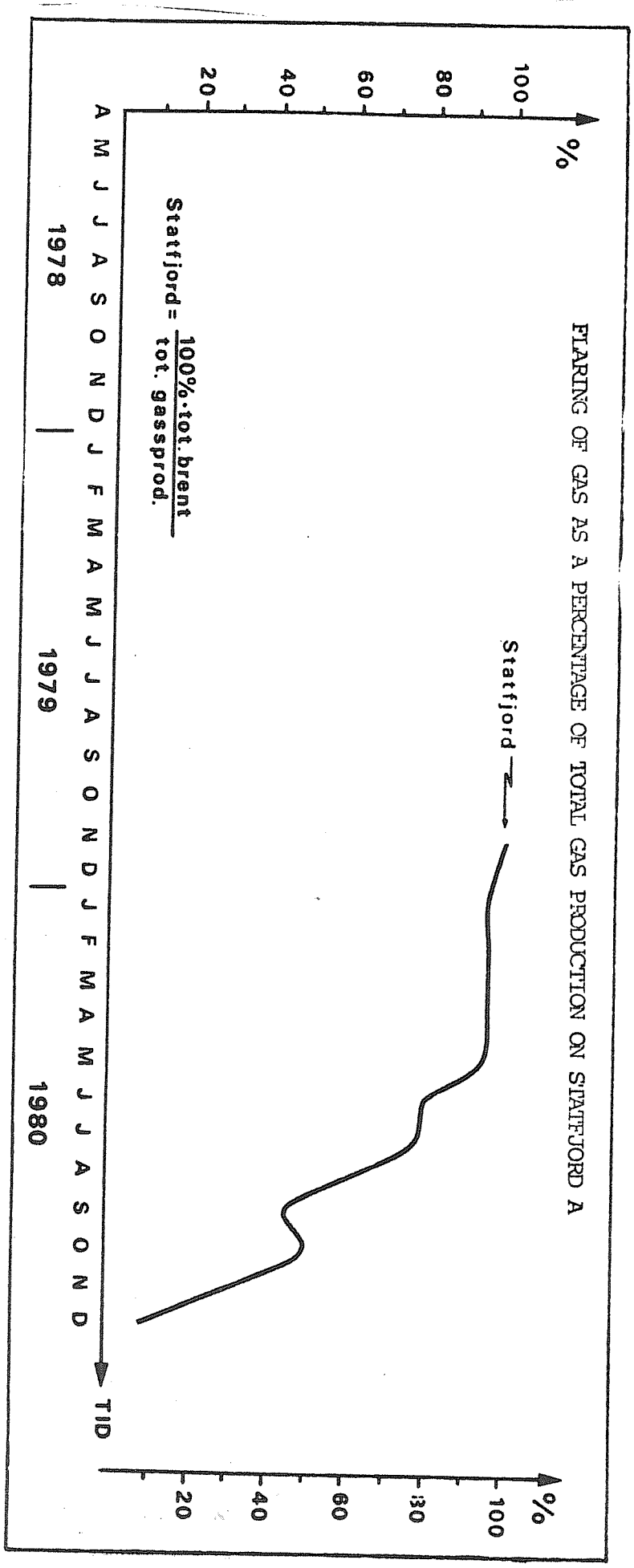

FLARING OF GAS AS A PERCENTAGE OF TOTAL GAS PRODUCTION ON STATFJORD A
%
100
80
60
40
20
Statfjord
Statfjord= 100%·tot.brent / tot. gassprod.
A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1978
1979
1980
TID
%
100
80
60
40
20

FIGURE 2.1.S

2.1.6.6. Murchison

The Murchison field was discovered in August 1975. The field lies on the border line between Great Britain and Norway and in the same geological formation as the Brent reservoir in the Statfjord field.

The development of the field was started in 1976 by the British licencees. The licence 037 group declared the field commercial in the summer of 1977 and Statoil took up their declaration in the summer of 1978.

The total quantities of oil and gas in the field are calculated at 117×10^{9} Sm^3 of oil and 1.6×10^{9} Sm^3 of gas respectively. It is estimated that a recovery factor of about 45% may be achieved by assisted production. Water will be injected during the life of the field, while gas will be injected in the first 5 years.

On April 5th, 1979 an agreement was entered into between the British and Norwegian licencees regarding joint exploitation of the field. The agreement stipulates the Norwegian share to be 16.25%.

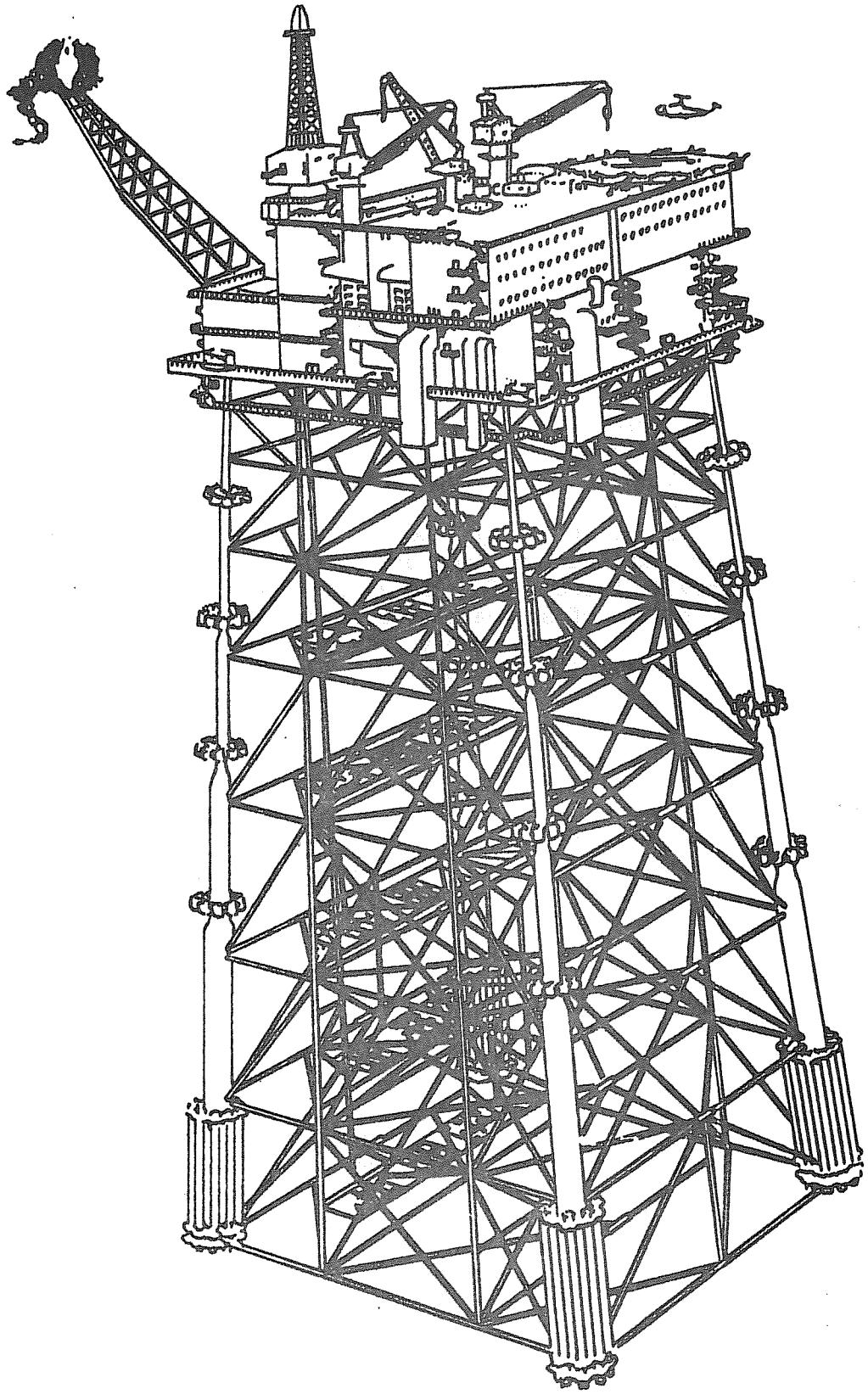
The field has been developed with an integrated drilling, production and quarter platform with a steel jacket (figure 2.1.T). From the platform itself, 10 production wells and 12 injection wells shall be drilled: 10 for water and 2 for gas. In addition, 3 sub-sea well completions have been installed, 2 for oil production and 1 for water injection.

It is planned that the platform can produce a maximum quantity of 150 thousand barrels of oil per day with an annual average of about 130. The oil produced contains substantial quantities of NGL which will be transported with the oil through the pipeline via the Cormorant field to Sullom Voe on Shetland where NGL will be extracted.

The development of the field has largely gone as scheduled and production was started on September 28th, 1980 from two wells which were completed on the sea floor while the platform was installed. The gas injection well is the fourth well to be drilled from the platform. Until this is ready in the spring of 1981, all gas produced must be flared. In addition, there are delays in the building of the NGL plant section in Sullom Voe on Shetland. The oil pipeline may in the meantime only transport stabilised crude oil, so that all NGL must be flared on the field. It is uncertain when the facilities on the Sullom Voe plant will be completed. The delay is nevertheless sufficiently large to reduce the NGL reserves on Murchison. It is still not clear whether the Statfjord formation contains producible quantities of petroleum. It is presumed that the gas injection well will be drilled through the Statfjord formation at a high elevation on the structure to clarify this. If there is petroleum in this formation, the substantial part will be on the Norwegian side.

There are still negotiations going on with Shell/Esso on hook-up to the Flag system for gas transportation. There are also negotiations with the British Gas Conncil about prices and quantities. Shell/Esso will accept that gas from Murchison and Thistle is transported in the Flag system, but there will be 2 years of production with start-up in 1981 until it is clear how much air capacity there will be in the pipeline to the said field. As long as Shell can thus not guarantee transportation, Conoco is also unable to guarantee reserves to fill the line.

FIGURE 2.1.T



INSTALLATION ON MURCHISON

2.2. Safety inspection

2.2.1. General

The safety inspection is made when the facility is planned, designed, manufactured, installed and operational. In performing the inspection, the objective is to primarily check the operator's internal control. In this connection, the Norwegian Petroleum Directorate studies the operators' procedures, administrative functions, documentation and the physical installations.

The basis for the inspection is the "Worker Protection and Working Environment Act", of February 4th, 1977, regulations for worker protection and working environment etc., in connection with exploration for and production of subsea petroleum resources given by the Royal Decree of June 1st, 1979 in accordance with the Working Environment Act § 2 No. 3(1), Royal Decree of October 3rd, 1975 on safety etc, for exploration and drilling for subsea petroleum resources, Royal Decree of July 9th, 1976 on safety regulations for production etc. of subsea petroleum resources and also rules and guidelines which have mainly been prepared by the Norwegian Petroleum Directorate. In the period covered by the report, guidelines for evaluation of platform concepts from a safety point of view have been prepared.

In 1980, new concepts for production facilities have been assessed. In this connection, work is aimed at arriving at the optimum inspection system regarding the use of public inspection resources and suitable allocation of responsibility for the inspection.

Also in 1980, work has been done to arrive at a completely satisfactory inspection system for diving activity, whether it relates to normal diving o diving with submarines.

The Norwegian Petroleum Directorate's approval procedures are being revised at this time to ensure that the safety aspects of development and operation will be taken care of in a sound manner and that the operators will have a clear understanding of the approval procedures. These procedures have been submitted for comment.

2.2.2. The licencees' internal inspection duties

The Norwegian Petroleum Directorate has experienced misunderstanding of the expression `in-house control' during the period covered by the report and has therefore replaced this with

the term `internal control´

The licencees´ internal control is the checking, and if necessary the implementation of measures to ensure that planning, design, manufacture, installation and operation are being carried out in a sound manner in accordance with applicable laws and regulations.

In connection with the guidelines issued for the licencees´ internal control, the companies undertaking concrete projects in 1979 were asked to submit a detailed description of the company´s system for internal control in January 1980.

These descriptions have been evaluated by the Norwegian Petroleum Directorate and further work on the control systems is underway in all companies.

In dealing with the descriptions and in the day to day control of the companies´ activities, basic control systems have been involved to an increasing extent such as: quality assurance systems, maintenance systems, operational control systems, training systems, etc.

The work which is done on internal control by all companies seems to have contributed positively to the safety work of the various organisations. The Norwegian Petroleum Directorate considers it important to follow up this positive tendency and to also further develop the Directorate´s control methods based on these experiences.

The Norwegian Petroleum Directorate has invited oil companies, professional organisations, Ministries and other Directorates to contribute to a revision of the guidelines for internal control. These will be available in a revised edition in the middle of 1981.

2.2.3. Qualification Requirements

The safety for the individual employee on the fixed installations depends on, among other things, proper reactions and actions in critical situations. A decisive factor is that the operations are performed by personnel with a high professional standard and that training in emergency situations, firefighting, first aid, etc. is given to each individual employee in a sound manner.

The Leirout Committee II, which evaluates the educational requirements for personnel serving on the productions facilities in the North Sea, has completed its work. A comprehensive recommendation includes:

- Safety training
- Training of safety personnel
- Training of operating personnel
- Training of production drilling personnel

- Training of electrical operations personnel
- Training of maintenance personnel
- Training of automation personnel
- Training of supervising and administrative personnel

and has now been presented to the Ministry of Church and Education.

Pursuant to Royal Decree of July 9th, 1976, authority has been delegated to the Norwegian Petroleum Directorate to stipulate qualification requirements for personnel working on fixed installations on the Continental Shelf.

In view of the proposals of the Leirout Committee II, the Directorate has issued guidelines to the operator companies on basic safety training, training of production drilling personnel, training of operating personnel and training of helicopter guards.

From the autumn of 1979, drilling activity increased on the Norwegian shelf. The demand for qualified drilling personnel indicated that the education had to be accelerated beyond what was possible under the direction of the government. The Directorate's access to dispensations from the qualification requirements resulted in a number of courses for drilling personnel being started under private direction from the spring of 1980. A plan for phasing out the dispensations has been prepared and the implementation of this is moving ahead as scheduled for the turn of the year 1980-1981, so that:

Drilling deck hands	- should all be qualified
Derrick men	- should all be qualified
Assistant drillers	- the scheduled education should be completed by December 31st, 1981.
Drillers	- should all be qualified. A small number with very much experience in the positions are in the process of finishing the education required.
Assistant drilling/supervisors	- should all be qualified by December 31st, 1982. Possible dispensation is conditional on completing the planned education within this point of time.

The education capacity within the basic safety training has improved considerably in 1980. In view of the great accumulative need, however, there are still some personnel lacking full training.

This is particularly the case for personnel who have already worked on the installations for some time.

2.2.4. Production and Auxillary Systems

2.2.4.1. Electrical

1980 was a year with a high level of activity in the building and operation of electrical facilities.

The checking of the facilities on Statfjord B, Hod-Valhall and the extensions of TCP-2 on Frigg have been most time-consuming.

On Ekofisk there have also been some new facilities which have taken a lot of time. There have been problems in executing as many operating inspection tours as desirable in the period covered by the report and this is mainly caused by the manning situation.

Besides the control work, there has been quite some activity regarding information and counselling. It is assumed that this will be time well spent.

Regulations have also been revised and particular mention should be made of the work of preparing guidelines and regulations for area classification, work which will be completed in 1981.

In addition, the use of electricity under water is becoming more practical. This has made it necessary to try to arrive at suitable regulations for this area also. On this point the Norwegian Petroleum Directorate has had good cooperation from the British authorities and we expect to have proposed regulations ready in the middle of 1981.

The qualification requirements for electrical technicians have also been revised in 1980. A new point has been added in the regulations of the Norwegian Waterfall and Electricity Administration for electrical facilities giving British electricians the opportunity to work on the Norwegian Continental Shelf under certain conditions.

2.2.4.2. Safety Systems

The control covers systems for active and passive fire security, process security, emergency shut-down systems and gas release systems.

In the construction and building phase, the control has been mostly concentrated on Valhall and Statfjord B. For platforms in the operating phase, more emphasis has been placed on following up the company's maintenance and test routines.

ACCIDENT DURING BUOY LOADING ON STATFJORD A

The accident during loading on Statfjord A on August 21st, 1980 has been given particular attention. The oil tanker "Polytraveller" was fixed up to the loading buoy (fig. 2.2.A) and loading was almost completed when the hauser moving the ship to the loading buoy broke. The tanker's automatic release system was immediately activated, but when it was released some oil was sprayed from the loading house and sparks were probably caused when the chain was released and slid over the bow of the ship. A fire occurred immediately and heavy smoke developed. After about 15 minutes the fire was under control and it was completely extinguished after approximately 40 minutes.

The accident killed one of the crew members and one was injured.

A number of studies/analyses have been performed and are being considered and several improvements of the loading and mooring systems have been made or scheduled. Among other things, a new type of hauser has been utilised, inspection and maintenance of the systems have been intensified and procedures and routines for loading operations have been impressed on those concerned.

2.2.4.3. Mechanical Equipment

The control work in the design and manufacturing phase on new fields such as North East Frigg, Valhall and the water injection project on Ekofisk has in the main been accomplished with our own personnel.

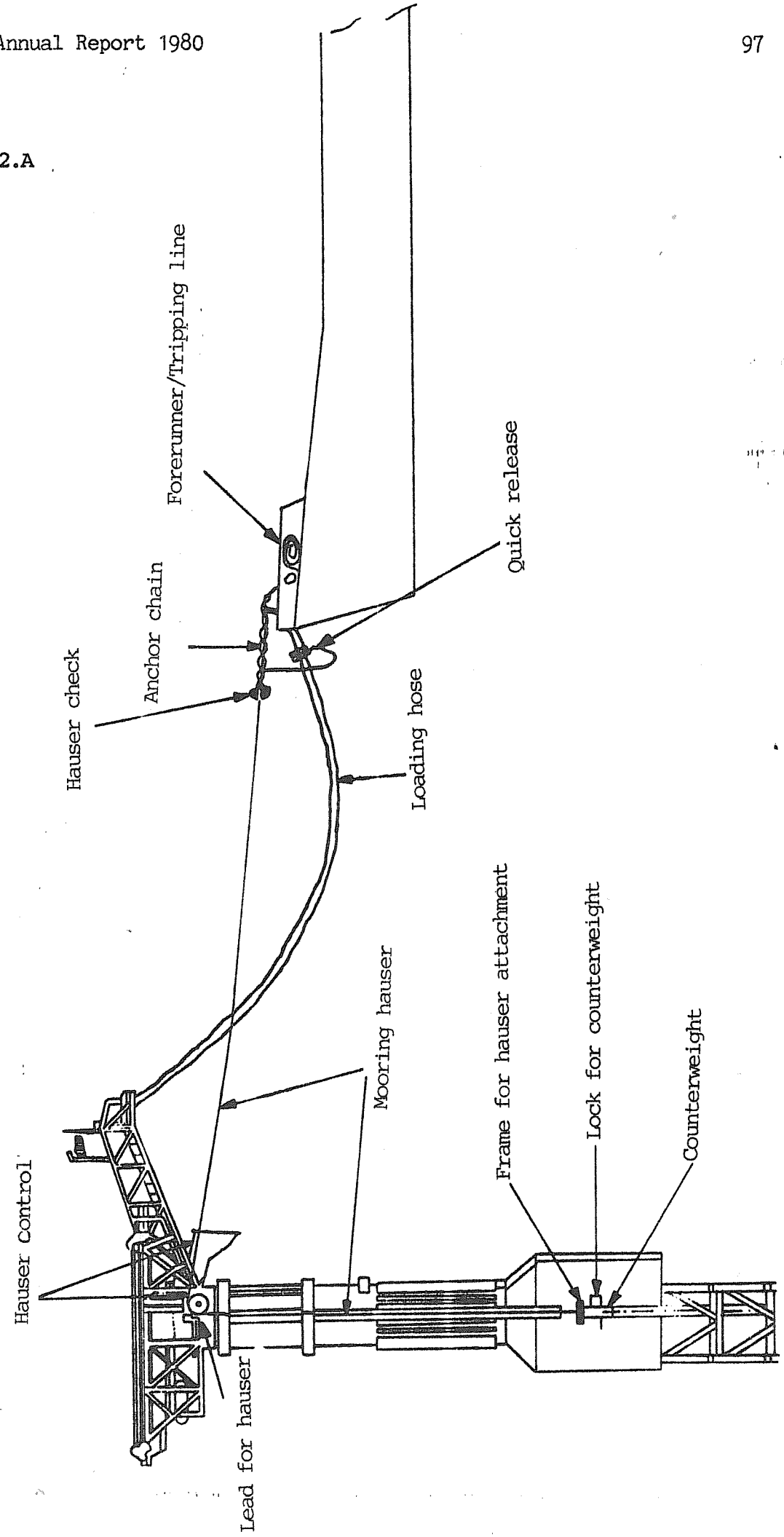
The checking of maintenance and injection in the operating phase has been directed towards the companies' internal control of the work and the systems.

Some locks for the safety valve in the production string (down hole safety valve) failed at the start of the year. Comprehensive studies have been made to find the reasons for this and to correct the circumstances.

The investigations have shown that the design of some types of locks was such that special combinations of unfortunate circumstances could make the lock fail.

It also turned out that the installation operation and associated procedures are very important. Considerable work has been done by the Norwegian Petroleum Directorate, suppliers and operators to improve the conditions. Design changes have been made, locks have been changed, administration and maintenance routines have been changed.

FIGURE 2.2.A



BUOY LOADING ON STATFJORD A

2.2.5. Drilling

Exploration and Delineation Drilling

36 drilling licences were issued in 1980. 28 of these are explorations wells, while 8 are delineation wells on structures where hydrocarbons have previously been discovered.

There has been a high level of activity throughout 1980, with 10-13 mobile drilling platforms in continual operation. At the end of 1980, 13 mobile drilling platforms were operating on the Norwegian Continental Shelf.

On Svalbard, Norsk Polarnavigasjon A/S has worked for about one and a half months on further drilling in the Berzelius valley. They have also done some cleaning up on Haketangen after earlier drilling.

There have been problems in accomplishing as many operational inspections as desirable. This is caused by a combination of the manning situation and the high number of drilling rigs in operation.

Irregularities while Drilling

Within exploration and delineation drilling, unintentional influx of formation liquid/gas in the well has been experienced in several cases in the period covered by the report. In several cases, however, this has been immediately detected and controlled with the help of safety equipment. 5 cases should nevertheless be mentioned as particularly critical situations, whereof one resulted in an uncontrolled blow-out.

On Thursday August 21st, 1980, a shallow gas blow-out occurred on well 34/10-10 during drilling with the drilling vessel Nordskald. The drilling rig was pulled away from the well by the anchor winches. Later the drilling platform Borgny Dolphin was pulled over the blowing well in an effort to stop the blow-out. After several days' efforts, the well was killed on Wednesday September 24th. The gas blow-out had then gone on for 34 days. The well was afterwards plugged with cement and finally abandoned on Thursday October 2nd, 1980.

While drilling well 35/3-2 a show of gas also gave rise to problems. The air release piping system was used, but it nevertheless took 4 days to regain control of the well.

During drilling of well 30/4-2, a strong, unintended influx of formation liquid occurred. The shut-down pressure was so high that instead of circulating the gas/liquid out in the normal way, it was decided to pump everything back to the formation. After 5 days the well was stabilised.

On well 35/8-1 there have been 2 strong unintentional influxes of formation liquid. Both were controlled with the help of the

safety equipment, but it nevertheless took 4 days to stabilise the well in each case.

Production Drilling

There has also been a high level of activity on the fixed platforms in 1980. On Ekofisk, 7-8 drilling rigs have been in operation, whilst one rig has been drilling on the Statfjord field. In addition, there has been an increase in activity concerning maintenance of production wells in the Ekofisk area.

The follow-up on maintenance work amounts to an increase in parts of the control work within production drilling.

The activity in 1980 with regard to production drilling and maintenance is divided into the following fields:

	Drilling		Maintenance
	For 1980	Total	For 1980
Ekofisk	2	50	15
Eldfisk	7	29	1
Albuskjell	6	19	-
Tor	1	12	2
Edda	5	10	-
Cod	-	8	-
W. Ekofisk	-	12	-
Frigg (Norwegian)	-	24	1
Statfjord	5	9	-

Ekofisk

Two wells have been drilled on the Ekofisk field in 1980. The drilling of 7 out of 11 additional wells has thereby been completed.

Eldfisk

On Eldfisk 7 wells were drilled in 1980. The drilling of 29 wells has been completed. The total number of wells has been reduced from 48 to 43. One well remains on the A-platform, while 11 remain on the B-platform.

Albuskjell

6 wells have been drilled on Albuskjell in 1980. In total 19 wells have now been drilled.

Tor

1 well has been drilled in addition to the 11 which have been drilled previously. Drilling will be terminated at this well and the 13 wells will be delayed until a decision on water-injection on the field has been made.

Edda

Also in 1980 5 wells were drilled on Edda so that 10 wells have been drilled in all. The drilling has been terminated after 10 wells instead of 13. 3 of the 10 wells drilled have been plugged and abandoned after having been classified as dry wells.

Statfjord

In the southern shaft 4 wells have been drilled, with one for gas injection.

In the northern shaft 5 wells have been drilled, with 1 for gas injection.

Approval for all drilling and production in the same shaft on Statfjord A was given by the Norwegian Petroleum Directorate on June 2nd, 1980, whilst simultaneous drilling and production was not started until November 8th, 1980.

Problems while drilling

In the period covered by the report major problems have not been experienced while production drilling. However there have been several minor cases of unintentional influx of formation liquid/gas in the well which has been brought under control in the normal manner.

2.2.6. Control of operations

In the present year the section for inspection of operations has mainly been involved in the evaluation and follow-up of the licencees's inspection program and implementation of the new internal control system. The control covers fixed primary and secondary structures for production and shipment facilities as well as underwater pipeline systems in the operating phase.

The inspectors of the section have performed regular offshore inspections, also with a view of checking the efficiency of the licencees internal control system. Visual inspections have also been made of both above water and underwater structures and underwater pipeline systems.

2.2.7. Diving

The diving activity on the Norwegian Shelf in 1980 has been of about the same extent as the year before. On an annual basis there has been approx. 145,000 manned hours in saturation.

In 1980 there have been no serious accidents in connection with diving operations on the Norwegian Shelf.

The Norwegian Petroleum Directorate has performed over 50 inspectionss of diving systems, whereof some were outside the Norwegian Continental Shelf. Since the end of 1979, the Norwegian Petroleum Directorate on behalf of the Maritime Directorate has inspected diving systems on Norwegian ships, mobile drilling platforms etc outside of the Norwegian Continental Shelf.

Some inspections have also been performed on systems under construction. With a view to possible later use on the Norwegian Continental Shelf the users want the system to be delivered in such a way that they satisfy the requirements stipulated by the Norwegian authorities. The diving systems operating on the Norwegian Continental Shelf at present have a technically acceptable level. Inspections in the time to come will be more directed towards the operational aspects.

On April 1st, 1980, rules for divers were issued which among other things limit the time the divers may stay under water as well as the periods when the divers may be exposed to pressure in excess of one atmosphere.

In the spring of 1980, qualification requirements were stipulated for divers who shall participate in diving operations where diving bells are used. At the same time a certification system was implemented for bell divers. As of December 31st, 1980, the Norwegian Petroleum Directorate has issued 1,350 bell diving certificates. About 10% of the applications made have been turned down. All those working as bell divers on the Norwegian Continental Shelf today have certificates.

The preparation of qualification requirements for diving personnel have been made in close cooperation with the British authorities. An agreement for reciprocal approval of diving certificates has been prepared between the authorities of the two countries. Also France wishes to accede to this system.

There is a great emphasis put on the work of international harmonization of regulations. Of the institutions used, the European Diving Consultative Organization (EDTC) and the

Intergovernmental Maritime Consultative Organization (IMCO) and ILO may be mentioned.

As suggested in last year's Annual Report, an increase in the use of manned underwater vehicles with atmospheric pressure could be expected. 6 drilling rigs on the Norwegian Shelf have such equipment now, and two more are expected in 1981. It has still not been formerly clarified who shall have the responsibility for controlling these vehicles. All equipment in use on the Norwegian Shelf has been inspected, however, by the Norwegian Petroleum Directorate's inspectors. At present, regulations for this form of diving have now been laid down but the Norwegian Petroleum Directorate has completed the draft for such regulations. In expectation of the clarification mentioned above the work on these regulations has not progressed.

The Norwegian Petroleum Directorate's "Provisional Regulations for diving on the Norwegian Continental Shelf" were issued on July 1st, 1978. The regulations were amended on April 1st, 1980. Comprehensive work has been started for updating and improving the regulations. Other public institutions with responsibility for diving have been involved in this work. The limits of responsibility and harmonization is a continual process. It has turned out however that this work is more complicated and will take more time than expected.

The future development of fields at greater depths will result in higher requirements for equipment and personnel. To attain the safest possible execution of operations in this area, it will be necessary to follow up the development of underwater technology.

2.2.8. Cleaning up of the seafloor in the North Sea

The administration of the pilot project for cleaning up the seafloor of the North Sea was assigned to the Norwegian Petroleum Directorate. The pilot projectt has been further described in Storting proposition No. 72 (1979-80)

The cleaning up started on May 19th and was temporarily finished at the beginning of October. After this a trawler was engaged for three weeks in November.

4 trawlers, a surveying vessel and a vessel for visual inspection were engaged. The main part of the work was done by the trawlers and the Norwegian Petroleum Directorate is very pleased with the efficiency of this cleaning up method. In the pilot project, about 250 tonnes of litter were picked up. About one half of this was wire of different dimensions. A report has been prepared for the project giving a summary of the progress and discoveries of the project.

The pilot project had a stirring committee when the Norwegian Petroleum Directorate, the Fisheries Directorate, the Norwegian Fishermens' Association and NIFO as well as the Maritime Mapping

Association were represented.

The administration of the project has led to considerable additional work for the Norwegian Petroleum Directorate.

The areas which have been cleaned up, - approx. 2,000 km^2 - were clearly littered, and, even if the methods used were to be characterized as efficient, no guarantee may be given that no object remains. The main part of the litter should however be removed and the conditions for fisheries in the cleaned up area should be clearly improved. There have been several indications of this.

2.2.9. Pipelines

A total of 1800 km of pipelines have now been installed in connection with the activity on the Norwegian Continental Shelf. The allocation of the pipelines is as follows:

Bringing ashore:

- Ekofisk - Emden	492 km	(915 mm pipe)
- Ekofsik - Teeside	345 km	(864 mm pipe)
- Frigg - St Fergus	363 km	(813 mm pipe)
Total	1150 km	

Facilities on the Shelf: 650 km

In total, 70 km (2 x 35) of pipe lines from Valhall to Ekofisk which have been laid in the Report period have been included. The testing of this line is not complete.

Significant damage from fisheries for shipping has not been discovered. Nor have there been leaks in the transportation system. The natural backfill of the ditches is still going on.

2.2.10. Working Conditions

In the course of 1980 the number of Norwegian employees on the fixed installations has increased to about 84%.

The plans for shift work for the individual companies shall be submitted to the Norwegian Petroleum Directorate for approval. After the Directorate has verification that the conditions required by the Working Environment Act shall be capitalised, the plan is approved. Control of the provisions in the regulations

followed takes place by contacting employers and maybe Unions, by following up the monthly report and by inspection at the company's offices. On the installations, the checking takes place through regular inspection and by conversation with the management, safety representatives and shop stewards. So far, it seems that the system has worked satisfactorily.

In connection with the system of shifts in use on the shelf, these mainly vary from 8/8 to 16/21. Seen in relation to the number of employees, there is a clear movement towards a 14 day rotation period. Furthermore, the tendancy shows that the longer periods are split up in each individual period, for instance 14 on 21 off or 16 on 21 off or 16 on 24 off.

For a long time discussions have taken place between the Norwegian Petroleum Directorate and the companies on the Norwegian shelf concerning the personnel who should be classified under the Working Environment Act § 41 A and so-called "Leading Personnel" so that they may be accepted as specified in the chapter on working hours in the Act. This now seems to be closer to being clarified.

2.2.11. Working Environment Factors

The Working Environment Act shall facilitate an improvement of the standard of the environment on the work sites. The Act has been established to improve the working environment and shall be carried out in order to satisfy the Working Environment Act.

The companies shall themselves uncover and find solutions for their working environment problems, and besides the employer, the individual operator is responsible for ensuring that the Act is complied with.

It is hardly possible in an Act to fix the individual working environment requirements in detail. The Act must by necessity include criteria on appraisal. However, it points out the working environment factors which must be taken into account in the activities. These factors must be evaluated individually and jointly with a view to possible influence on the work risk, physical and psychological, health and welfare.

Some of the working environment requirements are set out in regulations stipulated by the Norwegian Petroleum Directorate. Furthermore, the Inspectors of the Norwegian Petroleum Directorate who control the working conditions on the offshore installations must satisfy the requirements which have been established in special regulations or given in the concrete directives in pursuance of the Working Environment Act.

The Norwegian Petroleum Directorate's work in connection with solutions and improvement of the working environment problems on production facilities in the present year has mainly been a furthering of the work task started in 1979. In this connection a

solution for occupational hygiene problems with the use of oil based drilling mud has been given great attention.

To survey the occupational hygiene consequences of daily work with oil based drilling mud, the Norwegian Petroleum Directorate started a project in 1979 in cooperation with the Institute for Occupational Hygiene. The project is almost completed, and even if the measurement results have not been sufficiently analysed it seems that the ventilation improvement over the mud pits has reduced the exposure to diesel oil to an acceptable level.

MERCURY

In the course of 1980, the Norwegian Petroleum Directorate has received reports that personnel on offshore installations have been exposed to mercury in concentrations far exceeding the level which can be accepted on the basis of the applicable rules regarding protection technology and occupational hygiene. On this basis, the Norwegian Petroleum Directorate has ordered a contractor company to remove five employees from all work where mercury exposure is present.

The demand for suspension of personnel exposed to mercury is only for preventive health measures. In connection with the ventilation the relevant work site must be surveyed and improved so that further mercury exposure may be reduced/eliminated.

In the view of the Norwegian Petroleum Directorate the existing transfer equipment for testing from the bottom of the well hole must stipulate the requirements for the handling of mercury which is acceptable from an occupational hygiene point of view

On this basis, the Norwegian Petroleum Directorate has presented demands for improvement of equipment/techniques from January 1981 for this type of work. In particular the order covers an evaluation of the introduction of equipment where transfer of formation liquid takes place without the use of mercury.

A more detailed treatment of the working environment problems caused by the use of mercury offshore has been given on page in this publication.

ASBESTOS

Bearing in mind the experience of occupational hygiene which is gained by exposure from asbestos fibre as well as the Working Environment Act which requires that injurious substances shall always be replaced by harmless substances when this is technically possible, the Norwegian Petroleum Directorate has issued a prohibition against use of asbestos and such products containing asbestos offshore.

The prohibition against use of asbestos or materials containing asbestos as mixing material has led to certain technical problems for an operator. In the opinion of the Norwegian Petroleum Directorate, there are additives with similar valuable properties as asbestos from a technical drilling point of view which will not lead to a health risk for the workers. In view of this, the

Norwegian Petroleum Directorate has recommended that the operator is more active in gaining experience with alternatives to asbestos thus making himself independent of using materials containing asbestos on the installation.

POLYMERIC FEVER

In 1979, reports were made on occupational diseases among electricians using polyetylen franking plastics for marking of P.V.C. isolated cables. The described symptoms such as shivering, fits of freezing, listlessness and rise in temperature are a typical toxicalogical reaction called polymeric fever.

In view of this, prohibition of smoking was introduced while working with packing of marking plastics, at the same time guidelines have been prepared for good personal hygiene, particularly in connection with smoking breaks.

The Norwegian Petroleum Directorate also informed the producer that the Directorate will ban this type of marking plastic offshore and recommended that the marking plastic be coated with a grease which did not represent a health danger.

In April 1980 the Norwegian Petroleum Directorate was told that the producer of the said plastic brand had replaced the earlier grease with a calcium stearate. Studies that the Norwegian Petroleum Directorate has had performed at the Central Institute for Industrial Research have confirmed that the heating of the new type of brand plastic will not release any toxic combinations.

The Norwegian Petroleum Directorate has ordered the operator companies to establish as soon as possible and at the latest by August 15th, 1980 an internal file of all fixed installations on the Norwegian Continental Shelf where toxic or injurious subjects/products are used. This also applies to substances/products used or stored by contractors and sub-contractors.

The operator companies were further ordered to apply the necessary resources so that these files could be completed as soon as possible and no later than December 31st, 1980.

Since it concerns information and the producers responsibility for marking of injurious and toxic substances and products, the Norwegian Petroleum Directorate is aware that new and more detailed regulations for marking are being prepared in coordination with the State Polution Control Authority.

In the preparation of the new set of rules, an effort is made to harmonise this with the classification and marking regulations which are applicable in or are being prepared by the other Nordic countries and Europe. The Norwegian Petroleum Directorate has therefore recommended that the E.E.C. rules should be used as guidelines in supplimenting the Working Environment Act, § 11 until more detailed Norwegian regulations have been issued.

NOISE

In 1980 the Norwegian Petroleum Directorate made preparations for a larger project where the objective is to survey the exposure to noise for the offshore personnel. The main point of the projects will be:

- surveying exposure to noise on the offshore installations in the North Sea
- calculation of the noise exposure (exposure profile) among offshore personnel
- comparison of estimated noise exposure with the estimated exposure profile for Norwegian industrial workers
- calculation of the cost of noise reducing measures, or evaluation of the costs of alternative equipment if applicable
- presentation of draft regulations on noise
- evaluation of cost and profit from introduction of basic regulations relating to noise.

2.2.12. Fire damage

Fires on which the Norwegian Petroleum Directorate has received reports in accordance with the positions of the national prosecuters have been set out in Table VIII.

In practice the report which has been introduced is so comprehensive that it will include practically all the fires that occur.

In 1980, all fixed installations have been in the operative phase. This means that fires reported this year are from platforms in operation, other than Valhall.

In total for 1980, the Norwegian Petroleum Directorate has registered 25 fires (against 36 in total and 18 in the operating phase in 1979) on fixed installations.

One case led to one fatality and one serious injury. This happened on Polytraveller in connection with an accident during loading of a buoy on Statfjord in August. All of the fires have led to little or no physical damage.

TABLE VIII FIRE DAMAGE ON FIXED INSTALLATIONS IN 1980

DAMAGES RESULTING FROM THE FIRE	CONSTRUCTION PHASE	OPERATION PHASE		
		A	B	C
Injuries and great material damage	0	1	0	0
Injuries and lesser or no material damage	0	0	0	1
No injuries, but extensive material damage	0	0	0	0
No injuries and minimal or no material damage	0	12	11	2
TOTAL	0	13	11	3

A - Cause of fire : As a result of operation/operational accident

B - Cause of fire : Construction work

C - Cause of fire : Other causes

2.2.13. Registration of injuries

All personal injuries shall be reported in writing to the Norwegian Petroleum Directorate. In cases of serious occupational accidents and fatalities the Norwegian Petroleum Directorate and Stavanger Police Station shall be notified in the quickest way possible. Representatives from both Authorities will investigate the accident.

2.2.13.1. Occupational accidents

Tables IX-XIII give a summary of the occupational injuries reported to the Norwegian Petroleum Directorate for the years 1976 - 1980 which have led to absence from work or death. The summary does not take into account the length of absence from work and will therefore not give a basis for comparison with statistics from other activities.

This concerns back injuries reported, most of these will normally not be recognised as occupational injuries in accordance with the National Insurance Act.

Injuries in offwork periods are not systematically reported and have therefore not been incorporated into this summary.

The figure for 1979 has been corrected and incorporated in the joint summary for 1976 - 1980. The summaries include occupational accidents on fixed installations on the Norwegian Continental Shelf as well as the platforms on the pipelines to Teesside and Emden. The basis for the summaries are the reports of occupational injury which the employers are obliged to submit to the Norwegian Petroleum Directorate.

For 1979 and 1980, two new summaries have been included, one for accident causes split up into occupations and one for accidents causes split up into activities.

The supervisory category covers all personnel holding positions above the level of foreman.

The division of activities has been based on three main activities: construction, drilling and projection. The maintenance work is divided into these three depending on which activity the injury has been reported under by the party making the report.

This division has been arbitrarily made since simultaneous activities are frequently going on.

The summaries have been based on the computer programme which the Norwegian Petroleum Directorate has worked on for the last two report periods. This work will continue in order that it shall be easier to find preventative measures.

Injuries for the 1,000 hours worked for the last four years show small variations. An improvement in this area seems to be dependent on greater resources being spent by the employer and the employees, and particularly for the injuries in the categories of falling, stepping, pushing and squeezing.

It still seems that the follow up on the work sites is not good enough, particularly in relation to new employees and personnel with little experience of the work operations to which they have been assigned. General training and inspection with a view to the work being performed in a sound manner, as well as correct use of tools and protective equipment must be better incorporated. There are many indications that a more conscious attitude to the question of personal safety in the working environment is necessary for further reduction in injury to be obtained.

2.2.13.2. Fatal accidents

Accidents resulting in fatalities have not been experienced on fixed installations in 1980. Casualties in connection with the loss of the "Alexander L. Kielland" have not been included in these summaries. In addition to 123 fatalities, 15 personal injuries have so far been reported among the 89 survivors. The accident is mentioned under § 2.2.14.

TABLE IX

INJURIES/DEATHS OR FATALITIES PER MAN YEAR (1976-1980), FIXED PRODUCTION FACILITIES, ETC.

Years	Working hours	Hours per Man Year	Man Years	Injuries	Injuries per 1000 Man Years	Deaths	Deaths per 1000 Man Years
1976	4,876,316	1852	2,633	213	80.9	2	0.76
1977	7,926,742	1802	4,399	282	64.1	2	0.45
1978	14,932,154	1752	8,523	624	73.2	6	0.70
1979	10,809,590	1752	8,327	603	72.4	0	0.00
1980	10,809,590	1752	6,169	448	72.6	0	0.00
Total	53,133,530		31,051	2170	69.9	10	0.32

TABLE X

Working accidents 1979 - 80. Fixed production installations etc.
(Injury cause/profession)

Injury Cause \ Profession	Management	Builder of scaffolds	Painter/ Sand blaster	Pipe worker	Construction worker	Welder	Electrician	Instrument mechanic	Production personnel	Catering	Driller	Derrick man	Roughneck	Roustabout	Others	Total	%	Year
Engine	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0.33	-79
Generator Transmission	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-80
Working machine Splinters, etc., from same	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0.17	-79
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-80
Lift, crane, lifting devices, transporters	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2	4	0.66	-79
	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	5	1.12	-80
Vehicles Vessels airplanes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-79
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-80
Hand tools, splinters, etc., from same	2	0	6	24	4	10	3	5	0	1	0	3	4	8	6	76	12.60	-79
	2	0	0	5	2	6	3	2	2	3	1	1	2	4	1	34	8.04	-80
Hot or cold substances, solid, liquid or gaseous	1	0	0	3	0	2	1	2	1	2	0	0	2	1	0	15	2.49	-79
	0	0	0	2	3	3	2	1	2	1	0	0	1	3	3	21	4.69	-80
Electric currents	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	4	0.56	-79
	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	4	0.69	-80
Explosion, blasting, fire, etc.	0	0	0	0	2	0	1	4	0	0	0	0	0	0	2	9	1.49	-79
	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	4	0.59	-80
Toxic and/or corrosive substances, radiation	0	0	1	0	1	1	2	1	2	2	0	0	0	6	1	17	2.82	-79
	0	0	3	1	1	1	0	1	0	1	0	0	3	4	5	20	4.46	-80
Falling (person to lower level)	1	4	7	5	2	3	11	4	3	0	2	2	8	9	8	64	10.61	-79
	4	3	3	5	3	2	3	3	0	1	1	3	6	6	13	56	12.50	-80
Falling (person to same level)	2	4	4	9	3	7	6	8	3	7	2	2	5	8	8	60	12.87	-79
	5	1	0	7	2	4	11	6	4	3	2	2	4	4	6	61	12.62	-80
Falling object not handled by the injured	1	4	0	10	9	6	1	3	1	0	0	0	11	8	2	56	9.29	-79
	1	3	2	3	2	2	2	2	0	1	2	0	4	7	6	27	8.26	-80
Stepping on, shove by or against an object, squeezing	6	11	9	23	22	11	14	12	6	3	4	17	40	30	15	223	36.98	-79
	8	8	5	12	7	8	12	6	3	2	1	11	25	35	11	154	34.37	-80
Lifting, carrying performed by the injured	2	0	3	8	2	1	1	3	2	4	1	3	3	4	2	39	6.47	-79
	1	3	0	5	0	3	3	3	0	1	0	0	3	4	4	30	5.70	-80
Other causes	0	2	1	2	0	1	1	1	1	0	0	0	2	1	1	12	2.16	-79
	2	0	1	4	0	2	1	1	0	0	0	0	3	2	3	19	4.24	-80
Occupational diseases	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	-79
	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.22	-80
SUM	15	25	31	84	45	42	45	44	21	20	8	27	76	76	45	504		-79
	23	18	14	46	20	31	43	26	12	13	7	20	52	70	53	448		-80
%	2.49	4.25	5.14	13.93	7.46	6.97	7.46	7.30	3.48	3.32	1.49	4.48	12.60	12.60	7.19		100	-79
	5.13	4.02	3.13	10.27	4.46	6.82	9.60	5.80	2.68	2.90	4.56	4.46	11.61	15.63	11.83			-80

Table XI. Work accidents 1979-80. Fixed production installations, etc. (Injury cause/activity)

Injury cause \ Activity	Construction	Drilling	Production	Transport	To and from work	Other	TOTAL	%	Year
Engine Generator Transmission	1 0	0 0	1 0	0 0	0 0	0 0	2 0	0,33 0,00	-79 -80
Working machine Splinters, etc., from same	0 0	0 0	1 0	0 0	0 0	0 0	1 0	0,17 0,00	-79 -80
Lift, crane, lifting device transporter	1 1	1 2	2 2	0 0	0 0	0 0	4 5	0,66 1,12	-79 -80
Vehicle Vessel Airplane	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0,00 0,00	-79 -80
Hand tool splinters, etc., from same	50 12	16 7	9 16	0 0	0 0	1 1	76 36	12,60 8,04	-79 -80
Hot or cold substances Solid, liquid, gaseous	6 7	4 2	4 12	0 0	0 0	1 0	15 21	2,49 4,69	-79 -80
Electric current	2 1	0 0	1 3	0 0	0 0	1 0	4 4	0,66 0,89	-79 -80
Explosion, blasting fire, etc.	5 0	0 1	4 3	0 0	0 0	0 0	9 4	1,49 0,89	-79 -80
Toxic and/or corrosive substances, radiation	4 1	8 6	4 13	0 0	0 0	1 0	17 20	2,82 4,46	-79 -80
Falling (person to lower level)	19 12	19 14	13 24	0 0	13 5	0 1	64 56	10,61 12,50	-79 -80
Falling (person to same level)	20 11	12 9	10 20	0 0	35 19	3 2	80 61	13,27 13,62	-79 -80
Falling objects not handled by the injured	23 10	19 12	7 14	0 0	6 0	1 1	56 37	9,29 8,26	-79 -80
Stepping on, shove by or against an object, squeezing	67 24	89 58	22 55	1 0	38 16	6 1	223 154	36,98 34,37	-79 -80
Lifting, carrying performed by the injured	19 6	12 8	5 13	0 0	1 0	2 3	39 30	6,47 6,70	-79 -80
Other causes	5 2	4 4	0 12	0 0	2 0	2 1	13 19	2,16 4,24	-79 -80
Occupational diseases	0 0	0 1	0 0	0 0	0 0	0 0	0 1	0,00 0,22	-79 -80
TOTAL	222 87	184 124	83 187	1 0	95 40	18 10	603 448		-79 -80
%	36,82 19,42	30,51 27,68	13,76 41,74	0,17 0,00	15,75 8,93	2,99 2,23		100	-79 -80

TABLE XII
Work accidents 1979-80. Fixed production installations, etc.
(Injury cause/injured part of body)

Injury cause \ Injured part of body	Head	Eye	Stomach Chest	Back	Hand Finger	Arm Shoulder	Toe Ancle	Foot Leg	Dead	Other	Total	%	Year
Engine Generator Transmission	0	0	0	0	1	0	0	0	0	1	2	0,33	-79
	0	0	0	0	0	0	0	0	0	0	0	0,00	-80
Working machine Splinters, etc., from same	0	0	0	0	1	0	0	0	0	0	1	0,17	-79
	0	0	0	0	0	0	0	0	0	0	0	0,00	-80
Lift, crane, lifting device transporter	0	0	0	1	3	0	0	0	0	0	4	0,66	-79
	1	0	0	0	1	1	0	2	0	0	5	1,12	-80
Vehicle Vessel Airplane	0	0	0	0	0	0	0	0	0	0	0	0,00	-79
	0	0	0	0	0	0	0	0	0	0	0	0,00	-80
Hand tool splinters,etc., from same	8	28	3	1	26	3	3	4	0	0	76	12,60	-79
	4	9	2	0	18	1	1	1	0	0	36	8,04	-80
Hot or cold substances Solid, liquid gaseous	0	10	0	0	2	2	0	0	0	1	15	2,49	-79
	2	13	0	0	4	1	0	0	0	1	21	4,69	-80
Electric current	0	0	0	0	3	0	0	0	0	1	4	0,66	-79
	0	2	0	0	1	1	0	0	0	0	4	0,89	-80
Explosion, blasting fire, etc.	3	0	0	0	2	0	0	1	0	3	9	1,49	-79
	1	0	2	0	1	0	0	0	0	0	4	0,89	-80
Toxic and/or corrosive substances, radiation	1	14	0	0	1	0	0	0	0	1	17	2,82	-79
	0	13	0	0	0	0	0	1	0	6	20	4,46	-80
Falling (person to lower level)	7	0	7	8	5	13	4	13	0	7	64	10,61	-79
	7	0	3	8	3	5	6	14	0	11	56	12,50	-80
Falling (person to same level)	6	1	6	11	12	6	16	17	0	3	80	13,27	-79
	9	0	3	8	6	3	3	22	0	3	61	13,62	-80
Falling objects not handled by the injured	10	0	0	2	13	2	3	25	0	1	56	9,29	-79
	5	0	0	1	17	0	3	8	0	3	37	8,26	-80
Stepping on, shove by or against an object, squeezing	27	1	9	12	93	14	21	42	0	4	223	36,98	-79
	20	0	7	4	65	8	11	34	0	5	154	34,37	-80
Lifting, carrying performed by the injured	0	0	0	27	2	7	1	2	0	0	39	6,47	-79
	0	0	1	23	2	1	0	3	0	0	30	6,70	-80
Other causes	1	1	0	1	4	3	0	2	0	1	13	2,16	-79
	1	2	0	5	4	2	0	3	0	2	19	4,24	-80
Occupational diseases	0	0	0	0	0	0	0	0	0	0	0	0,00	-79
	0	0	0	0	0	0	0	0	0	1	1	0,22	-80
TOTAL	63	55	27	63	168	50	48	106	0	23	603		-79
	50	39	21	49	122	23	24	88	0	32	448		-80
	10,45	9,12	4,48	10,45	27,86	8,29	7,96	17,58	0,00	3,81		100	-79
	11,16	8,71	4,69	10,94	27,23	5,13	5,36	19,64	0,00	7,14			-80

TABLE XIII
Work accidents accumulated 1976-80. Fixed production installations, etc. (Injury cause/injured part of body)

Injury cause \ Injured part of body	Head	Eye	Stomach Chest	Back	Hand Finger	Arm Shoulder	Toe Ancle	Foot Leg	Dead	Other	Total	%
Engine Generator Transmission	1	0	0	0	4	1	0	1	0	1	8	0,37
Working machine Splinters, etc., from same	2	2	0	1	7	0	0	3	0	0	15	0,69
Lift, crane, lifting device transporter	4	0	2	3	21	2	4	4	1	3	44	2,03
Vehicle Vessel Airplane	0	0	0	0	1	0	0	0	0	0	1	0,05
Hand tool splinters, etc., from same	21	135	6	2	102	8	5	12	0	2	293	13,50
Hot or cold substances Solid, liquid gaseous	6	90	1	0	12	6	0	3	0	4	122	5,62
Electric current	0	3	0	0	9	1	0	0	0	5	18	0,83
Explosion, blasting, fire, etc,	6	2	2	0	4	0	0	1	5	3	23	1,06
Toxic and/or corrosive substances, radiation	4	38	0	0	1	1	0	1	0	16	61	2,81
Falling (person to lower level)	19	0	24	49	17	31	24	64	4	52	284	13,09
Falling (person to same level)	20	1	26	37	34	20	45	73	0	13	269	12,40
Falling objects not handled by the injured	24	3	1	4	52	6	16	57	0	7	170	7,83
Stepping on, shove by or against an object, squeezing	61	4	22	22	245	39	60	131	0	13	597	27,51
Lifting/carrying performed by the injured	1	0	7	105	44	19	5	13	0	0	194	8,94
Other causes	3	23	1	14	10	6	1	7	0	5	70	3,22
Occupational diseases	0	0	0	0	0	0	0	0	0	1	1	0,05
TOTAL	172	301	92	237	563	140	160	370	10	125	2170	
%	7,93	13,87	4,24	10,92	25,95	6,45	7,37	17,05	0,46	5,76		100

2.2.14. The loss of "Alexander L. Kielland"

On Thursday March 27th, 1980 at about 18.30 hours mayday signals were sent from "Alexander L. Kielland" a mobile semi-submersible platform used as living quarters for personnel on the Ekofisk Field, stationed near the fixed installation on Edda.

Normally the living quarters platform was connected to Edda by a 30 meter long bridge, but in poor weather conditions the platform was hauled further away with the help of its own anchor chains, and this was the situation just before the mayday signal was transmitted.

The weather in the area was very poor, and there was a full storm and hurricane squals which reached heights of 8 - 10 meters. In addition the visibility was poor.

"Alexander L. Kielland is of a pentagon type with five verticle steel columns with pontoons at the bottom. These legs are about 35.6 meters high and make up the buoyant body of the platform together with the pontoons. The platform is a drilling platform with a drilling tower, drilling derrick, but has been used as an accommodation platform since it was built in 1976.

For this purpose it has also been equipped with extra accommodation units.

The accident occurred after one of the platform's steel columns with pontoon was torn off, whereupon the platform started listing and turned over.

A very comprehensive rescue operation was started at once under the direction of the main rescue centre in southern Norway.

123 people died and 89 people were rescued.

Even if the accident had been dealt with as a maritime accident, the Ministry of Local Government and Labour, to which the preparation of emergency and safety areas of activity on the Continental Shelf has been assigned, was in charge of the overall coordination and follow up on behalf of the authorities.

On March 28th, 1980 the government appointed an investigation commission for the accident. The report of the commission was not available at the expiry of the report period.

The Maritime Directorate's council of experts was convened on March 31st, 1980 and discussed immediate measures for improving safety.

On April 8th the Ministry of Local Government and Labour appointed a coordinating task force with the following terms of reference:

- "examine existing rules/guidelines/procedures for safety and emergency preparedness control for monitoring fixed or

permanent and mobile installations associated with the petroleum activity on the Norwegian Continental Shelf.
- Evaluate necessary measures for safety training."

The Group primarily looked at measures that might be implemented in a short period of time, and its report was available on April 29th, 1980.

The main points of the report:

- Control principles
- Training and education
- Preparedness
- Registration of personnel
- Technical evaluations

Also, in view of this, professional evaluations, examination of routines and problems implementational measures etc. have been carried out and are being followed up by the authorities involved, companies, institutions and organisations etc.

2.3. Petroleum economy and technical control measurements

2.3.1. Costs associated with the activity on the Norwegian Continental Shelf

For the period up until 1981 the Norwegian Petroleum Directorate has estimated annual costs in oil exploration, investments in field development and operating costs for developed fields, fields under development and fields with approved development plans as per December 31st, 1980. In the same way, estimates have been made for the same factors for the years up until 1990.

In the estimates for fields located on both sides of the border line between Norway and Great Britain, the Norwegian share has been included.

The following fields are included in the calculations (Norwegian share):

Ekofisk carrier
Valhall
Ula
Frigg (20.82%)
North East Frigg
Odin
Statfjord (87.09%)
Murchison (16.25%)

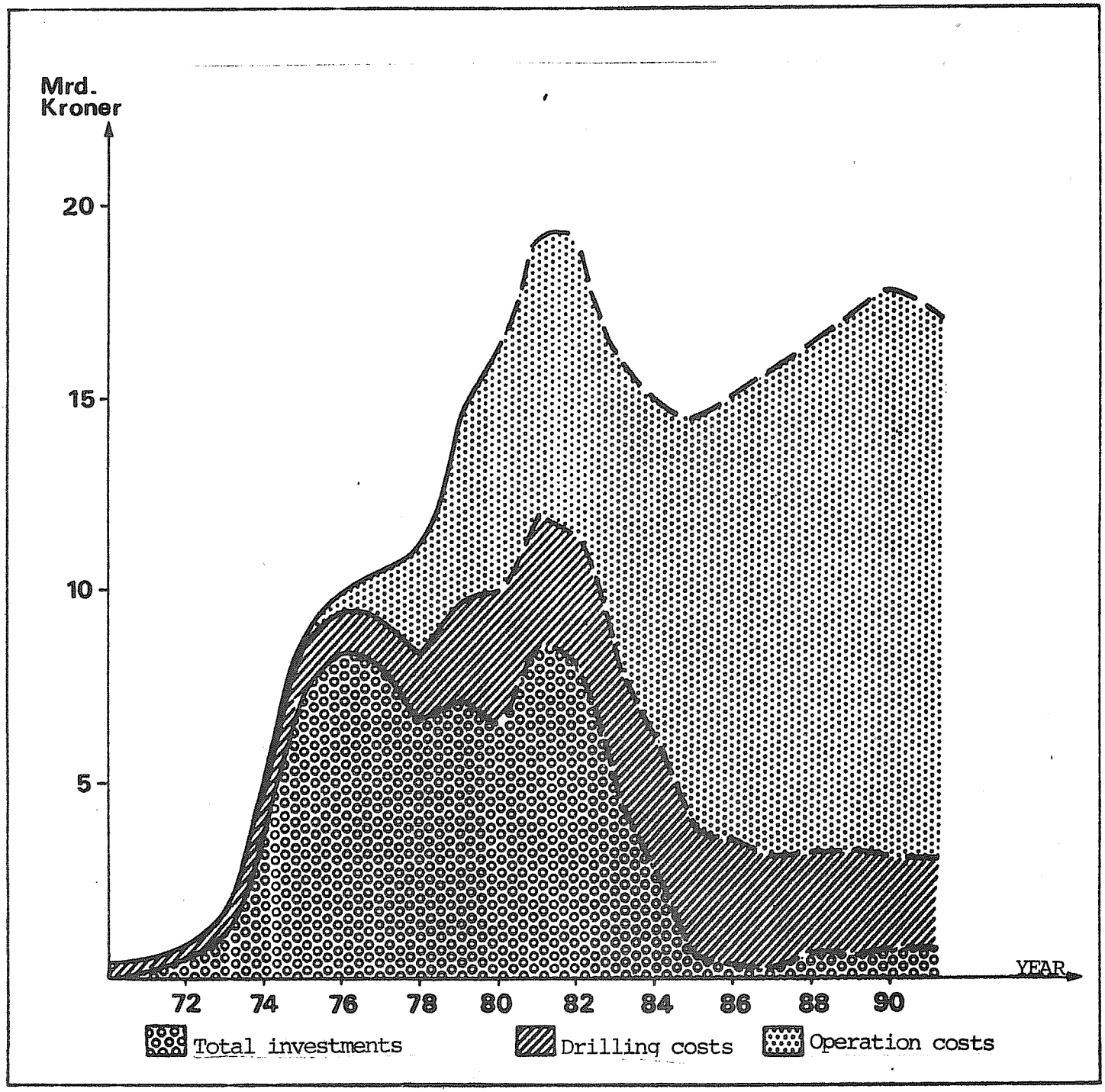
In addition, the Norwegian pipeline from Frigg to St. Fergus and Norpipelines from Ekofisk to Teesside and Emden have been included.

All numbers are in Norwegian kroner at the current money value. From 1981 - 1990. different profiles have been escalated by 10% per year. In cases when the figure material has been prepared in U.S. dollars, the dollars have been recalculated in accordance with the actual rate of exchange up to 1981, and afterwards a rate of exchange of $/NOK=5 has been used.

Based on this assumption, the Norwegian Petroleum Directorate's presentation may be different from estimates already given in other public volumes.

As appears from figure 2.3.A., the total volume of goods and services for exploration drilling, field development, production drilling and the operation of fields at current prices has increased from about NOK 9 million in 1975 to a little more than NOK 16 million in 1980. Even when no new project is carried out apart from those included in this new analysis, goods and services at a value of between NOK 14 and 19 million per year will be used in the 1980's. If new projects are carried out, for instance a drain pipeline system for gas, full scale water injection on Ekofisk or a new field development, these projects will lead to a further increase in the demand for goods and services. The effect of possible new projects decided on in the future will only be considered from 1982-83, for example, when the curve on figure 2.3.A. starts to decrease. It is important to emphasis that the curve shows demand in current kroner. At fixed prices, the demand will be substantially reduced after 1982 if no new projects are started.

Fig. 2.3.A TOTAL INVESTMENTS, DRILLING COSTS AND OPERATION COSTS



The figures show delivery of goods and services for exploration drilling, field development, production drilling and operation of fields. Only fields for which a decision to develop has been reached as per December 31st, 1980 have been included. Furthermore, an estimate for future costs for exploration drilling has been included. The unbroken line shows actual values and the broken line shows estimated values.

2.3.1.1. Cost of seismic surveys

The annual cost of seismic surveys is just over NOK 100 million. The cost for 1980 was about NOK 150 million.

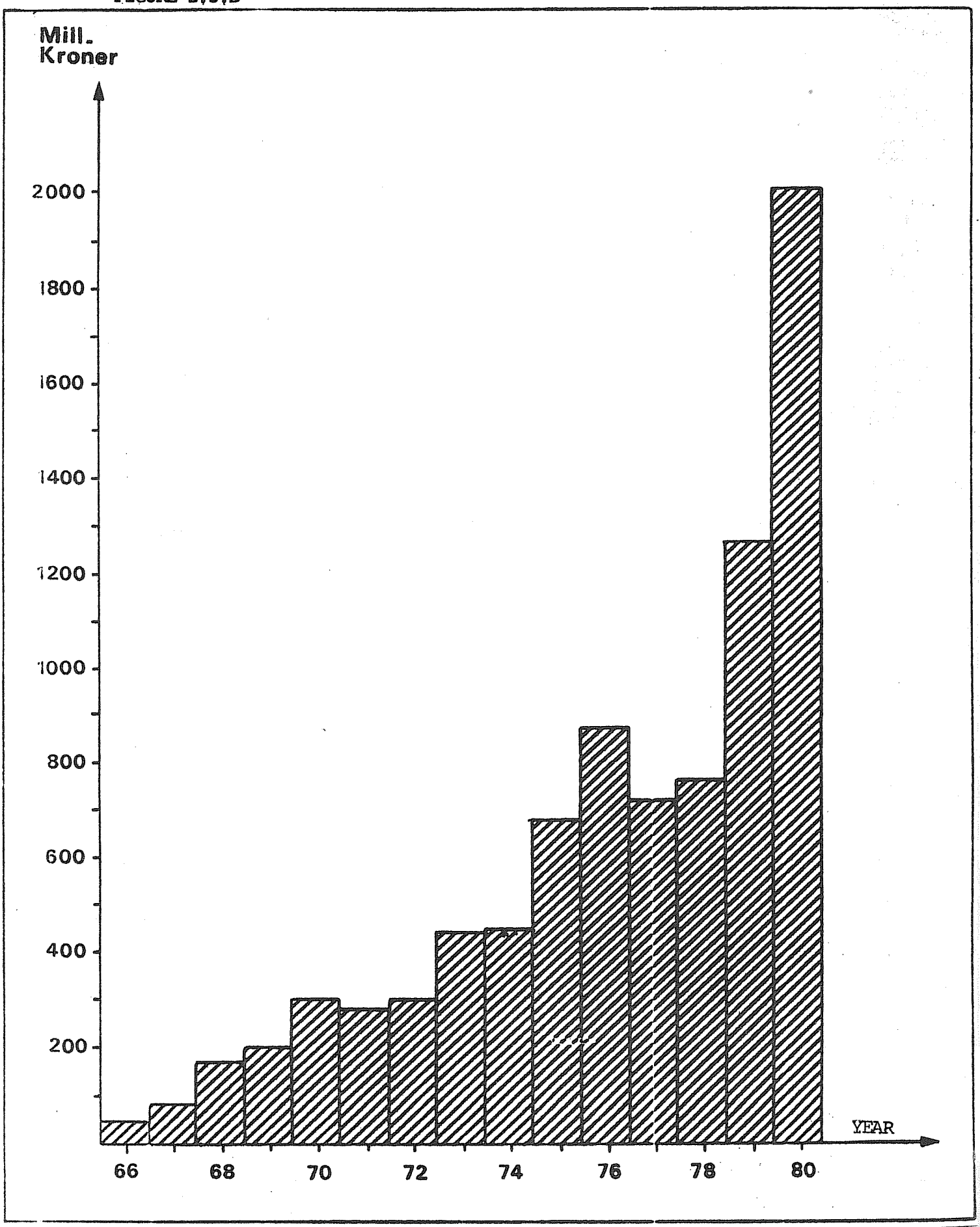
2.3.1.2. Cost of exploration drilling

The Norwegian Petroleum Directorate has calculated our estimated costs of exploration drilling in 1980 at approximately NOK 2 million. The figure for 1979 was NOK 1.2 million. The reason for the large increase is mainly that 36 new wells were started in 1980 against 26 in 1979. In addition to the general price increase, the daily rent for mobile drilling rigs has increased considerably in the course of 1980. In the case of contracts entered into in the last part of the year, the rig rental was approximately NOK 400,000 per day, as against NOK 180,000 per day at the end of 1979.

The annual exploration costs include drilling of true exploration wells (wildcats) and wells drilled to delineate structures which have previously been discovered.

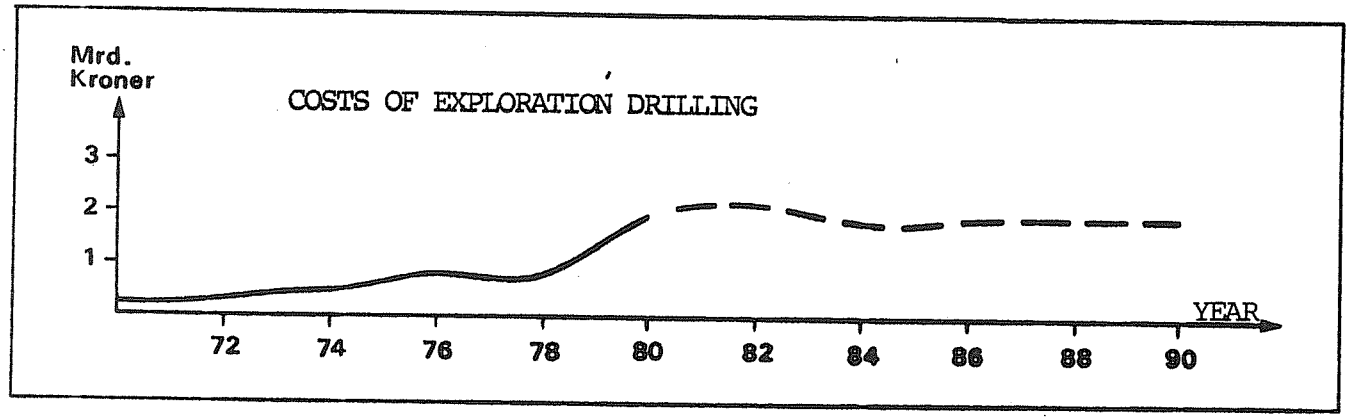
In the annual aggregate costs for exploration drilling, the costs of all wells started in the course of the year have been included. Figure 2.3.B. shows the cost of exploration drilling for the period 1966-1980. In total this amounts to NOK 8.5 million. Figure 2.3.C. shows a rough estimate of expected costs up to 1990. It is emphasised that this estimate is associated with great uncertainty, since both the annual activity and the rate level for rigs fluctuates considerably.

FIGURE 2,3,B



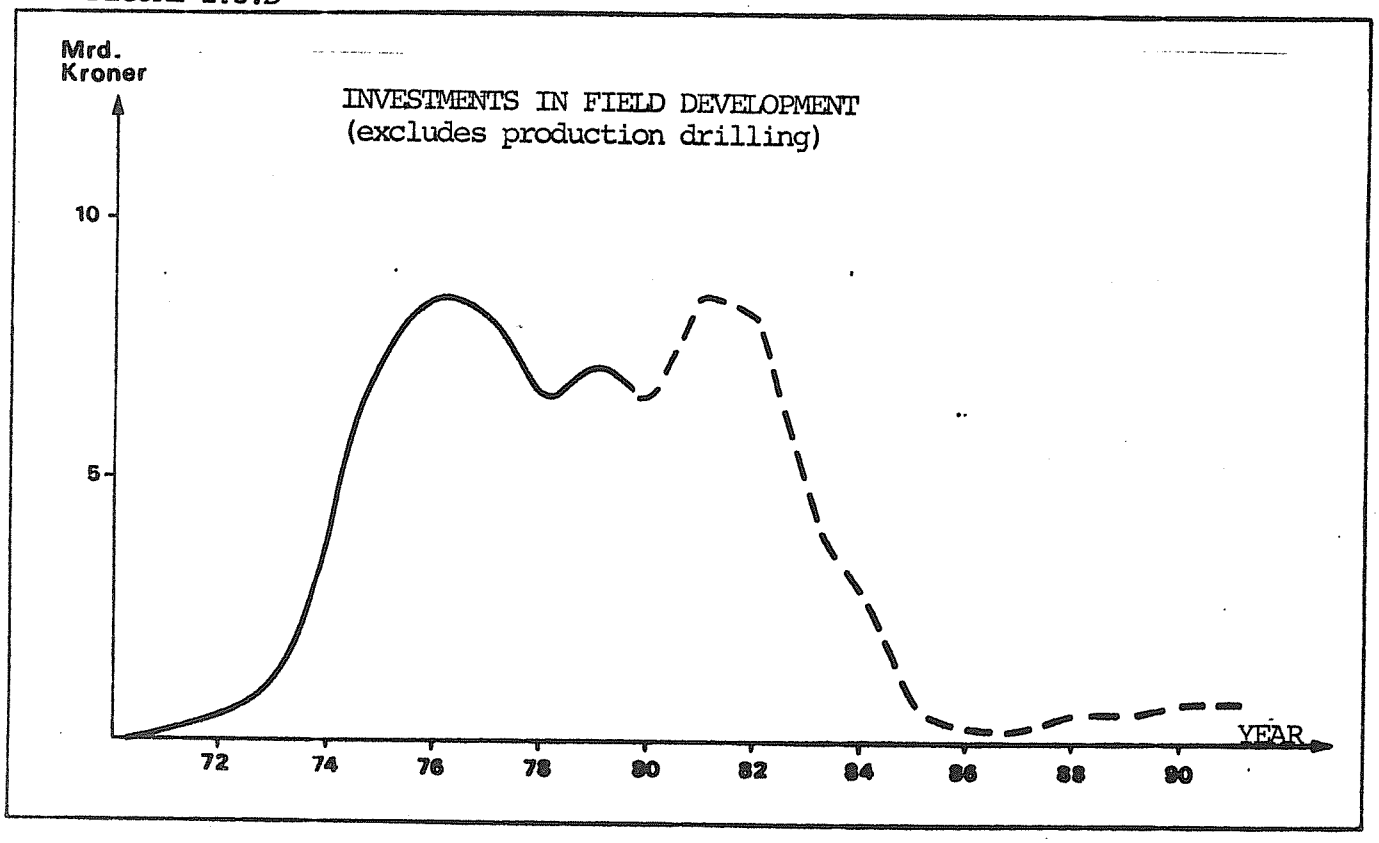
ANNAUL EXPLORATION COSTS IN THE PERIOD 1966-1980

FIGURE 2.3.C



The unbroken line shows real costs, the broken line shows estimates for exploration drilling in the period 1981-1990.

FIGURE 2.3.D



Investments in field development for fields already developed, fields under development and fields with approved development plans as of December 31st, 1980. The unbroken line shows the true cost. The broken line shows estimates for the remaining investments in this purchase.

2.3.1.3. Investments in field development and production drilling

Figure 2.3.D. shows the annual investments in field development up to the end of 1980 and an estimate up to 1990. As mentioned, only the fields for which a development decision has been reached as of December 31st, 1980 have been included in the calculations. In 1980, about NOK 6.5 million was invested in field development. The investment level will remain high in 1981 and 1982, after which the activity will fall rapidly with fewer new projects started.

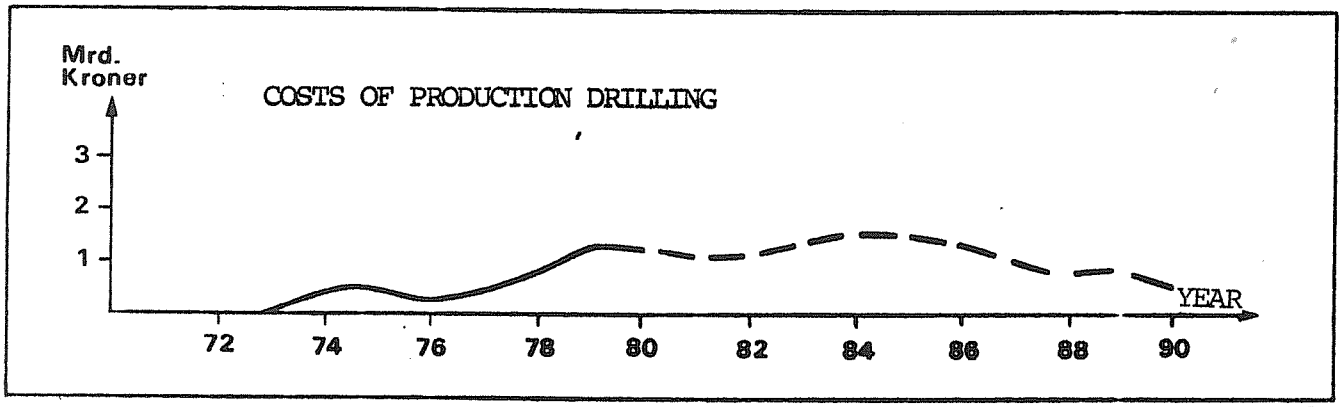
Fig. 2.3.E. shows the cost of production wells. In figure 2.3.F. the cost of both exploration and production drilling has been assembled. As it appears from the latter figure, the drilling market increased considerably at the end of the 1970s and it is expected to remain relatively stable at around NOK 3 million per year up to the end of the 1980s.

Fig. 2.3.G. shows the total investment in field development and production drilling. The share of the investments owned by Norwegian companies is also shown in the figure.

2.3.1.4. Operating costs

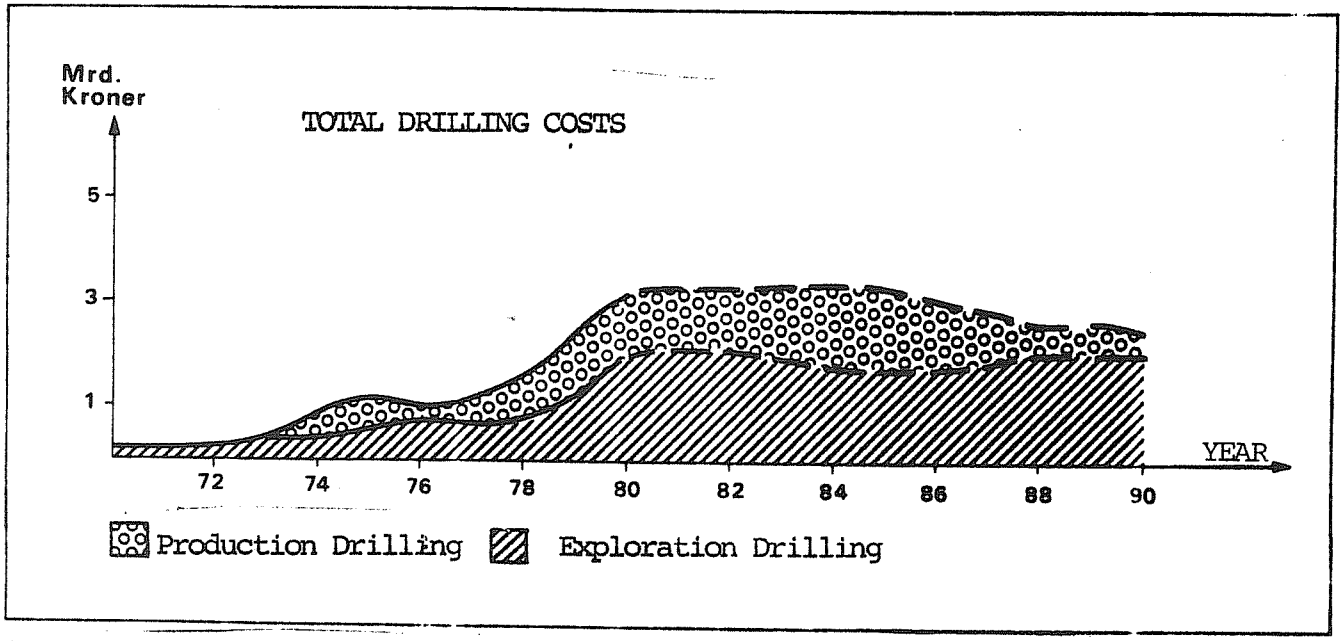
In fig. 2.3.H. the annual operating and maintenance costs, for the fields for which a decision to develop has been made, are shown. This market amounted to more than NOK 6 million in 1980. In connection with the increase in the number of platforms in operation, the operating and maintenance costs have shown a strong increase which amounts to a strongly growing section of the offshore market.

FIGURE 2.3.E



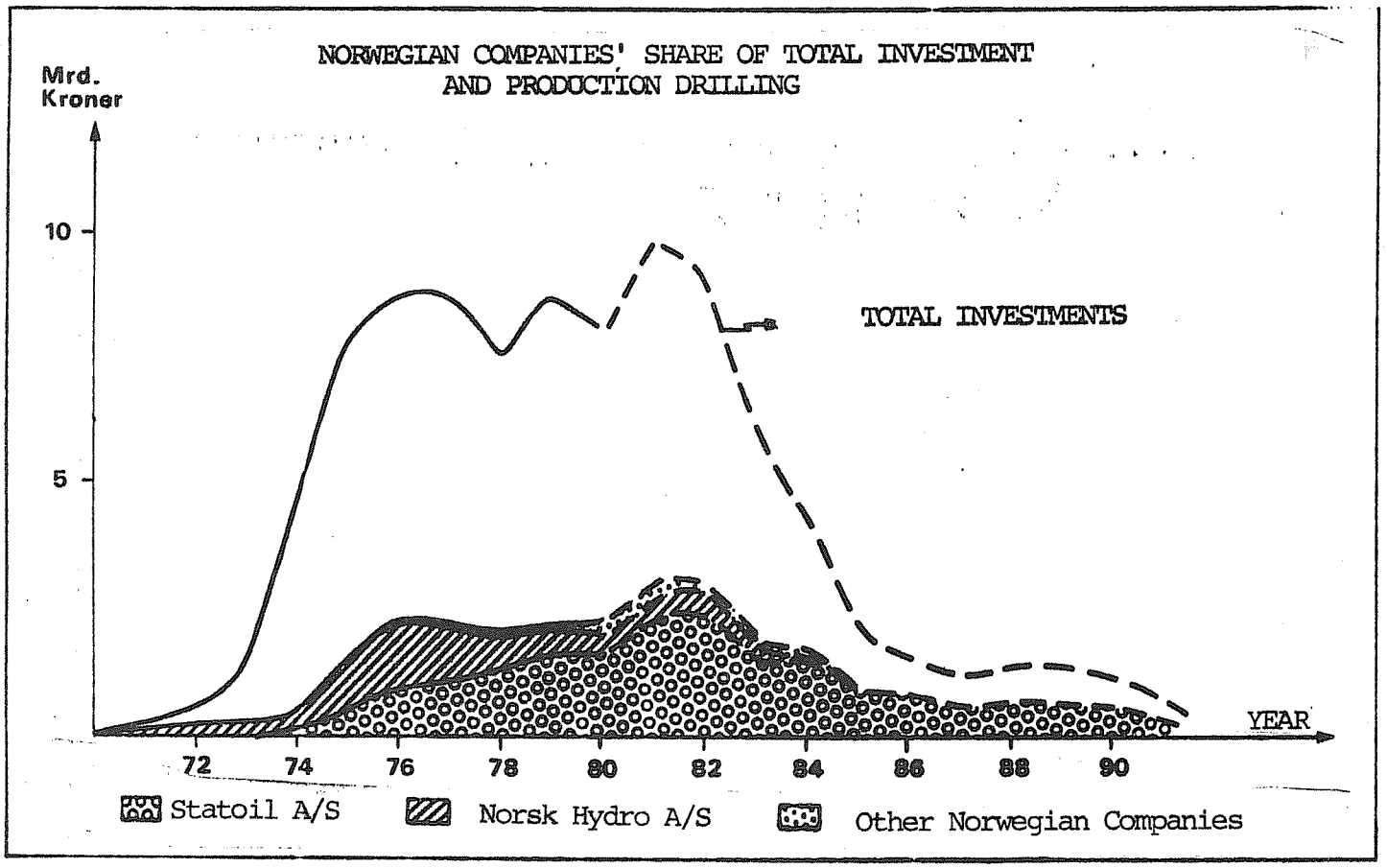
The unbroken line shows true costs up until 1981. The broken line shows estimates for production drilling for the fields which are being drilled or for which a decision to develop has been made as of December 31st, 1980.

FIGURE 2.3.F



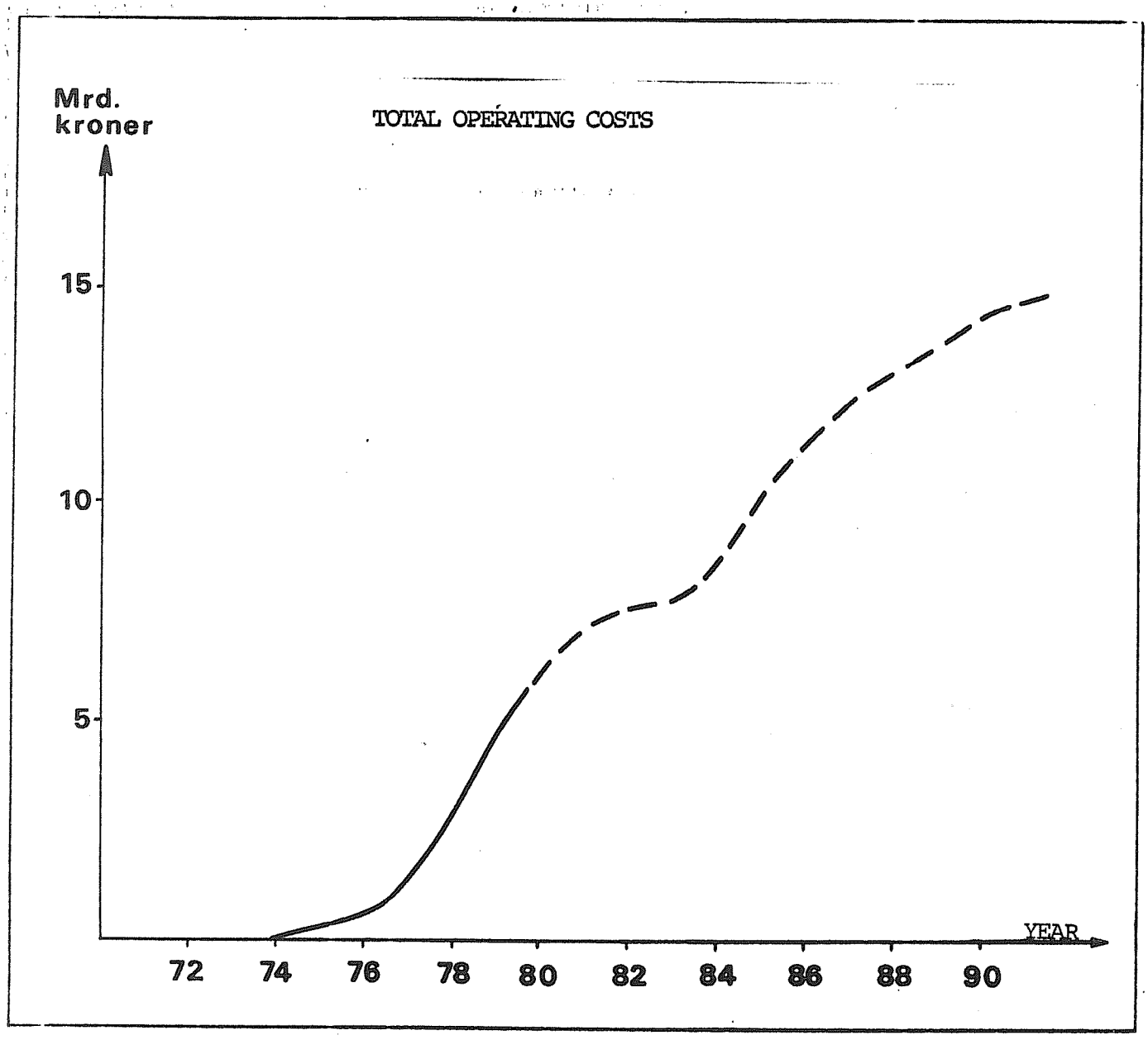
The figures show the amount of the curve in 2.3.C. and 2.3.E. The same assumptions are valid.

Fig. 2.3. G



The figure shows the Norwegian companies' share of total field investments including production drilling for developed fields, fields under development and fields with approved development plans as of December 31st, 1980. From 1981 the calculations are based on estimates. This is shown by the broken lines in the figures.

FIGURE 2.3.H



Total operating and maintenance costs for developed fields, fields under development and fields with approved development plans as of December 31st, 1980. The unbroken line shows the true cost. The broken line shows estimated costs for the period 1981-1990.

2.3.2. Production fees

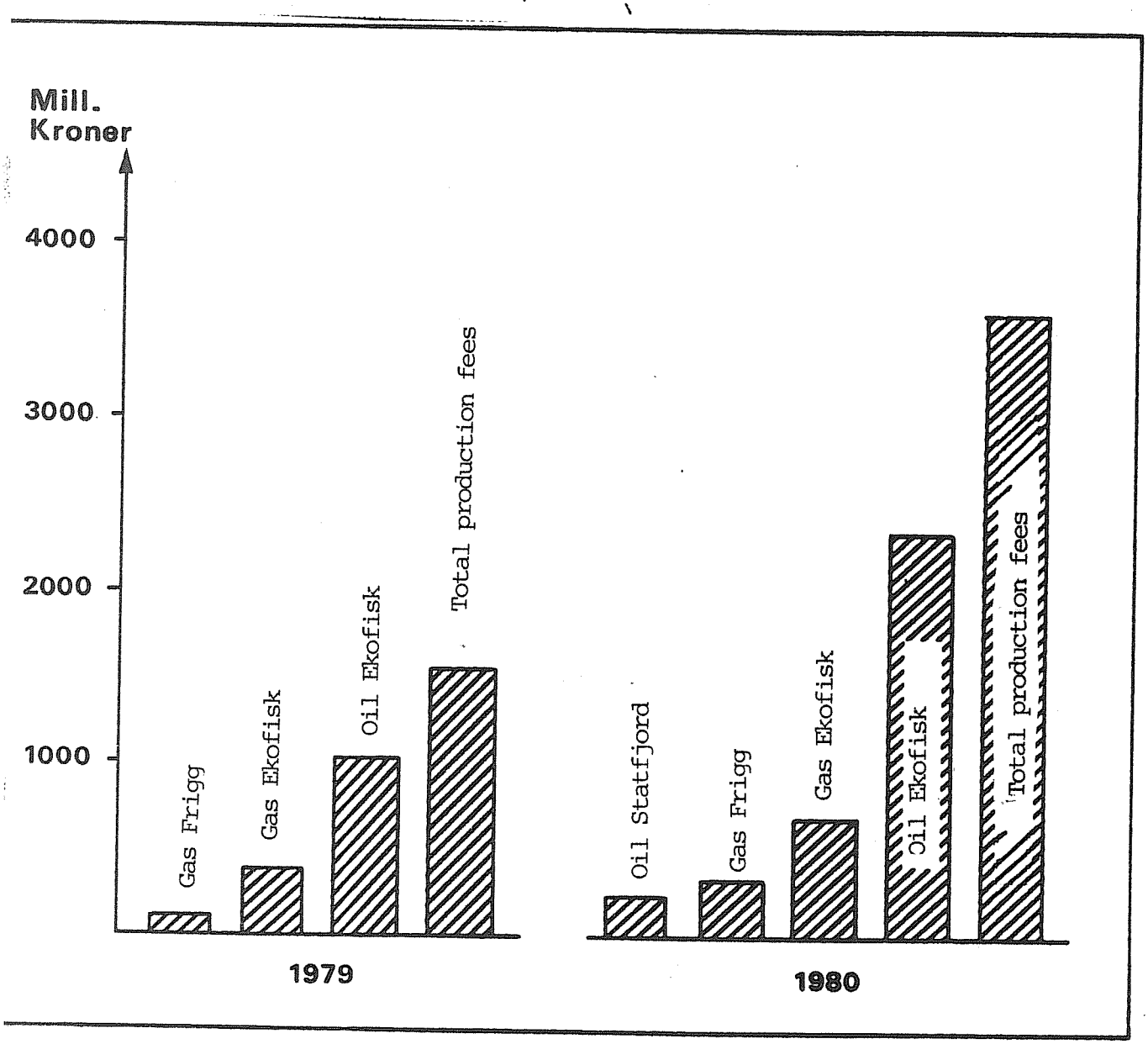
In 1980 a total of NOK 3,639,491,751,- has been paid in production fees. Table XIV shows the total production fees on the Norwegian Continental Shelf in 1979 and 1980 divided between the products oil, gas, NGL and condensate.

Fig. 2.3.I shows the total production fees in 1979 and 1980 in column form.

Table XIV. Production fees paid in 1979 - 1980

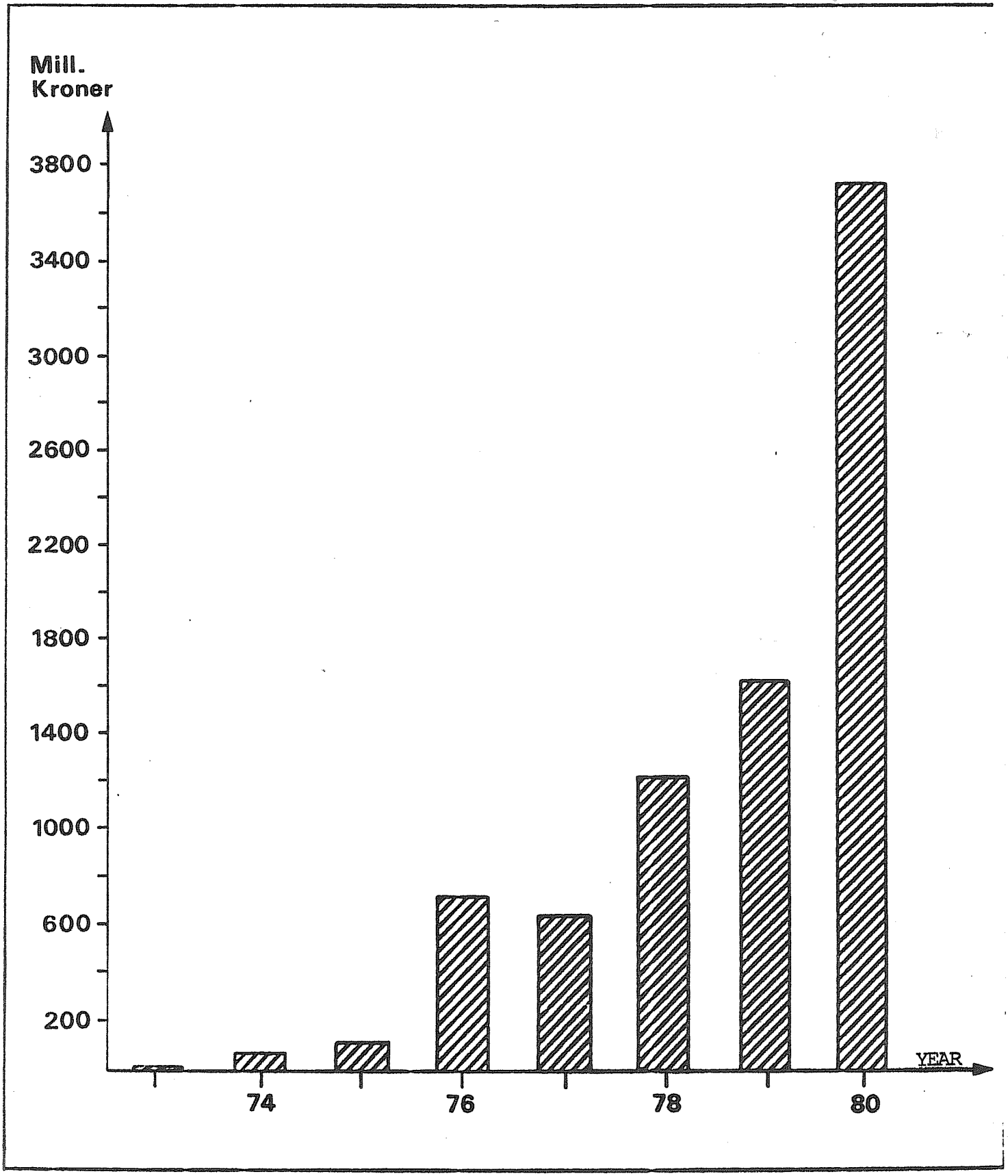
	Paid in 1979	Paid in 1980
Oil Ekofisk	1,005,911,360,-	2,326,668,959,-
Oil Statfjord		257,972,003,-
Gas Ekofisk	395,633,735,-	701,598,893,-
NGL Ekofisk		13,928,658,-
Gas Frigg	156,006,026,-	333,172,126,-
Condensate Frigg		6,152,112,-
	1,607,551,121,-	3,639,491,751,-

FIGURE 2.3.I



PAID PRODUCTION FEE 1979 AND 1980

FIGURE 2.3.J



PRODUCTION FEE PERIOD 1973-1980

2.3.2.1. Oil

In 1980 the Norwegian Petroleum Directorate received NOK 2,326,668,959,- in production fees for crude oil from the Ekofisk area and NOK 257,972,003,- in production fees for crude oil from Statfjord.

The settlement for crude oil in 1980 has taken place in accordance with normal prices. Quarterly production fees are made up in the following way:

Ekofisk

1980			Paid production fees
Temporary settlement for 4 qtr	1979	NOK	357,112,783,-
Price adjustment for 3 & 4 qtr	1979	NOK	200,344,494,-
Temporary settlement for 1 qtr	1980	NOK	659,293,078,-
Temporary settlement for 2 qtr	1980	NOK	435,235,243,-
Price adjustment for 1 & 2 qtr	1980	NOK	404,556,976,-
Temporary settlement for 3 qtr	1980	NOK	270,126,386,-
		NOK	2,326,668,960,-

Statfjord

1980			Paid Production fees
Temporary settlement for 4 qtr	1979	NOK	17,190,726,-
Temporary settlement for 1 qtr	1980	NOK	53,392,923,-
Temporary settlement for 2 qtr	1980	NOK	72,743,237,-
Price adjustment for 1 & 2 qtr	1980	NOK	39,537,949,-
Temporary settlement for 3 qtr	1980	NOK	74,907,168,-
		NOK	257,972,003,-

TABLE XV
DEVELOPMENT OF NORM PRICES STIPULATED FOR NORWEGIAN CRUDE OIL

QUARTER			PRICE PR BARREL NORWEGIAN KRONER		PRICE PR BARREL DOLLAR (US $)		NORWEGIAN KRONER
1975	1. kv	Offshore	NOK	59.62	US $	11.90	5,0101
	2. kv	"	"	58.35	"	11.80	4,9449
	3. kv	"	"	63.38	"	11.70	5,4171
	4. kv	"	"	68.89	"	12.45	5,5333
	4. kv	Teesside	"	69.12	"	12.60	5,4857
1976	1. kv	"	"	70.40	"	12.70	5,5433
	2. kv	"	"	70.50	"	12.79	5,5121
	3. kv	"	"	71.00	"	12.89	5,5081
	4. kv	"	"	69.25	"	13.15	5,2662
1977	1. kv	"	"	75.50	"	14.33	5,2687
	2. kv	"	"	76.00	"	14.39	5,2814
	3. kv	"	"	76.25	"	14.26	5,3471
	4. kv	"	"	75.75	"	14.04	5,2953
1978	1. kv	"	"	73.25	"	13.98	5,2396
	2. kv	"	"	75.25	"	13.94	5,3981
	2. kv	Offshore	"	75.90	"	14.06	5,3983
	3. kv	"	"	74.60	"	14.13	5,2795
	3. kv	Teesside	"	74.00	"	14.02	5,2782
	4. kv	"	"	71.75	"	14.29	5,0210
1979	1. kv	"	"	81.65	"	16.05	5,0872
	2. kv	"	"	103.50	"	20.05	5,1621
	3. kv	"	"	120.45	"	24.00	5,0188
	4. kv	"	"	137.20	"	27.50	4,9891
	4. kv	Statfjord	"	134.00	"	26.86	4,9888
1980	1. kv	Teesside	"	166.95	"	33.75	4,9467
	2. kv	"	"	177.95	"	36.00	4,9431
	1. kv	Statfjord	"	166.70	"	33.70	4,3466
	2. kv	"	"	177.70	"	35.95	4,9430

2.3.2.2. Gas

The Norwegian Petroleum Directorate has received NOK 1,034,770,019,- for production fees for gas in 1980. Payment relates to settlement for the Ekofisk area and Frigg with the following divisions:

Ekofisk

Paid by Dyno/Methanor		NOK	165,156,885,-
" " Sydvaranger		NOK	14,372,617,-
" " Shell		NOK	30,779,052,-
" " Amoco/Noco Group		NOK	8,915,296,-
" " PPCo	NOK 492,357,444,-		
Refunded by the Norwegian Petroleum Directorate	NOK 9,977,621,-	NOK	482,374,043,-
		NOK	701,597,899,-

Frigg

Paid by the Petro-nord Group	NOK	333,172,126,-
	NOK	1,034,770,019,-

It is emphasized that the amount of fees are net after certain deductions.

Settlements for gas have taken place in accordance with contract prices. These are different for the individual groups and change in the course of the year.

The settlements from Dyno/Methanor and Sydvaranger represent settlement for the part of the production fees which have been taken "in kind"in 1980. The remaining settlement is cash settlement.

The refunded amount of NOK 9.98 million is payment to Phillips Petroleum Company to cover costs on Ekofisk which relate to the State's share of levies on gas taken "in kind".

2.3.2.3. NGL/Condensate

In 1980, the Norwegian Petroleum Directorate received payment of NOK 20,766,048,- in production fees for NGL and condensate. Payments relate to settlement for Ekofisk and Frigg divided into the following:

Ekofisk

Paid by Shell	NOK	188,729,-
Paid by the PPCo Group	NOK	14,228,862,-
Negative settlement from the Amoco Group	NOK	488,933,-
	NOK	13,928,933,-

Frigg

Paid by Petronord Group	NOK	6,152,112,-
	NOK	20,080,770,-

As appears from the statement, net paid production fees amount to only a fraction of the total production fees paid for 1980. The settlement for the Amoco-Noco group has also been negative. The negative result has further been deducted from the Amoco-Noco group's settlement for gas.

There are two main reasons for arriving at negative results and/or relatively low positive results in the NGL settlements:

1) Low prices from sales to Rafnes.
2) High processing costs at Teeside.

2.3.3. Acreage and other fees

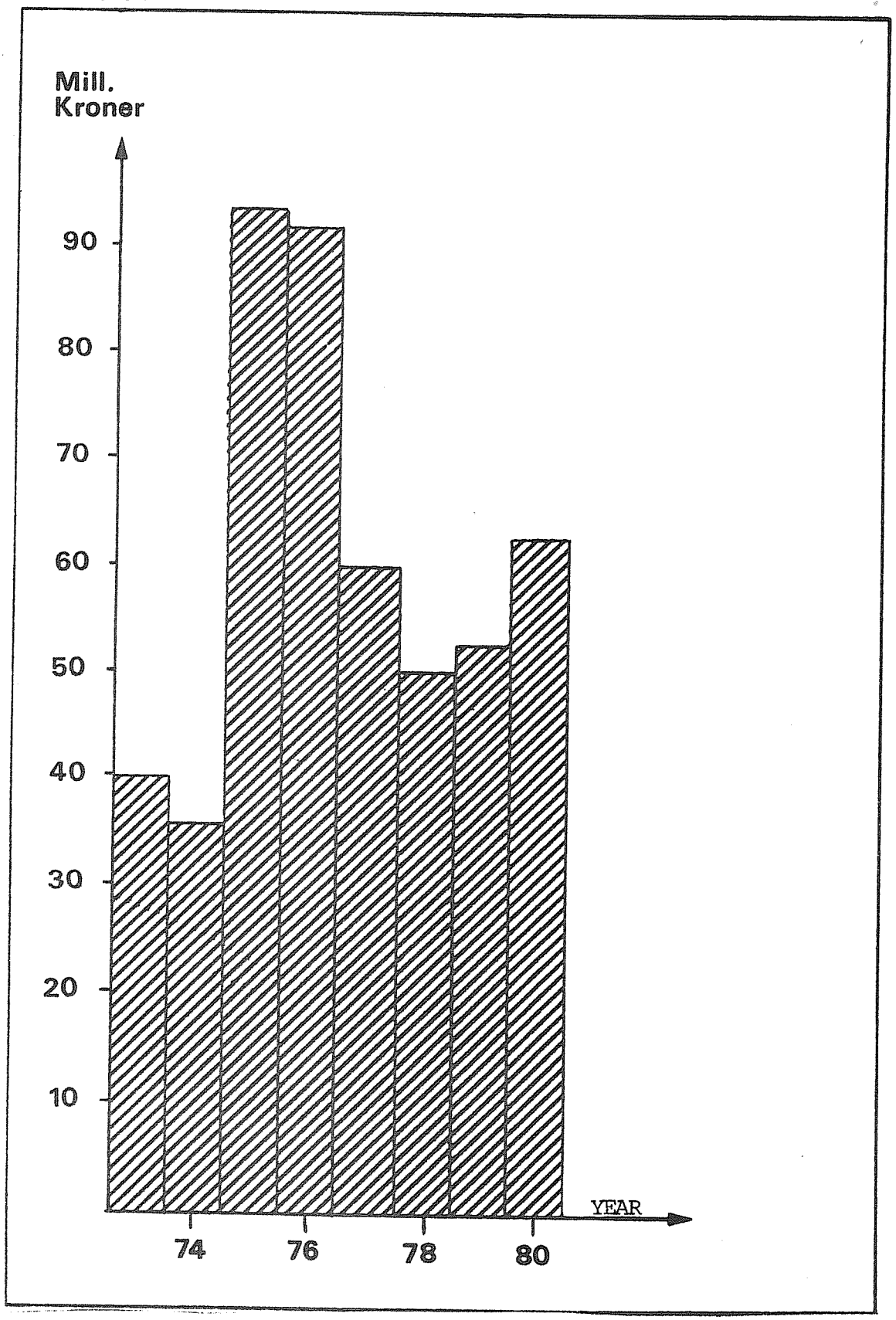
In the course of 1980, the Norwegian Petroleum Directorate has collected NOK 63,299,850,- This is divided in the following way:

Licences granted in 1965:	NOK	55,204,800,-
Licences granted in 1969:	NOK	16,105,998,-
Licences granted in 1971:	NOK	969,400,-
Licences granted in 1973:	NOK	584,000,-
Licences granted in 1980:	NOK	838,630,-
	NOK	73,702,828,-
Refunded in 1980:	NOK	10,402,978,-
Net payment:	NOK	63,299,850,-

The amount refunded is repayment of acreage fees to the Phillips group, the Amoco/Noco group and the Statoil/Mobil group.

It is expected that NOK 79.5 million in gross acreage fees will be paid in 1981.

FIGURE 2.3.K



AREA FEES PAID IN 1983-1980

2.3.4. Technical control measurements

2.3.4.1. Concerning the control in general

The accuracy of the systems used to measure production from platforms on the Shelf is of vital importance both for the oil companies and the authorities. Errors in these systems will give similar errors in the company's gross income and the fees and taxes paid to the authorities. It is therefore important for the authorities to look after their interests by inspecting measurements.

Checking of produced quantities of oil and gas is done on measurements before landing and partly on measurements made on the treated products sold from the land terminals. The first measurements are made to establish the quantities liable to production fees and/or to calculate the contribution made by the individual field. The measurements of processed products are partly related to production fees and partly to sales for which the Norwegian Petroleum Directorate has been given the task of inspecting the determination of the companies' income.

The technics for measurement control covers all stages in the development of a field, meaning control of the design of the metering stations in the planning and construction phase, testing of the systems before they are put into service and control of the operative phase.

The control in the operative phase requires great resources. This is not only caused by the extent and complexity of the metering system, but also by the fact that the control must cover, i.a. routines for operating and servicing the equipment, as well as processing of data. Another factor which may make it necessary to use large resources for control of the operative phase is that the companies almost at all times are fighting one or more technical measurement problems on the metering systems which are in operation. The work of solving these problems as well as an evaluation of the improvised systems used before a solution is found, frequently require a great deal of follow-up on the part of the Norwegian Petroleum Directorate. A short summary of the activity in 1980 in connection with the different metering stations in operation or with the planning will be given below.

2.3.4.2. Metering systems on the field in the Ekofisk area as well as the land terminals in Teeside and Emden

Technical metering inspectors have been present on Ekofisk at all times in 1980. In the course of the year, all satellite fields have been producing. This has made it necessary to a larger degree than before to plan the controlled procedures with a view to monitoring a larger number of metering systems at the expense of individual detailed inspections.

One of the problems to which great attention has been paid in 1980 is the tax reference point for production from the fields in the Ekofisk area. A solution to this problem is necessary to arrive at the correct priority over efforts for control.

As the priorities have been laid down, inspection and follow-up of the metering system at the Teeside terminal has been at a relatively low level. Some of the metering systems for liquified wet gas have turned out to give unexpected problems. Work is still being done to solve these problems. This means that sounding of tanks is still used for measuring wet gas or NGL shipped. The metering systems for flow to the terminal (leakage protection on the pipeline) and the sale's metering system for stabilized crude oil have been brought up to a satisfactory standard.

In Emden, monthly inspections are made as before in accordance with fixed procedures. The only technical problem that has occured with these metering systems in 1980 has been some cases of accumulation of solid particles from the pipeline or processing facilities in the metering element.

For most of the inspections in Emden, the Norwegian Petroleum Directorate's inspection period will coincide with the times when the local German weights and metering authorities are present to make calibrations. To a certain degree, there is therefore informal contact with German control authorities.

Of other control activities in the total metering system for the fields in the Ekofisk area, it may be mentioned that computer programs have been prepared and implemented in 1980 to check the ownership calculations which are used as a basis for dividing income and taxes between the licencees in the Ekofisk area.

2.3.4.3. Metering systems on Frigg MCP01 as well as the land terminal in St Fergus

The Frigg pipelines are also used for the transportation of gas from fields on the English shelf. The gas from the English fields, Piper and Tartan, is introduced into the Frigg pipelines

on the compressor platform MCP01 at the central point between Frigg and Scotland. The gas hauled from the terminal in St Fergus is thus a mixture where the ownership of the individual fields which have contributed must be known at any one time. For the ownership calculations made, data for quantities and composition both from the metering system on Frigg, MCP01 and the terminal are used. To maintain Norwegian tax and other interests it is therefore necessary to maintain measurements on Frigg, MCP01 and St Fergus. Furthermore the ownership calculations must be shown.

As in 1979 the Norwegian Petroleum Directorate performs inspection on Frigg and MCP01 in accordance with a fixed system which has been prepared in cooperation with the English authorities. To some extent the inspections have been done jointly with these authorities.

In St Fergus, the Norwegian Petroleum Directorate performs technical metering inspection every month, in accordance with special fixed inspection systems.

A systematic form of control for the calculations over ownership has not yet been established for the Frigg system. It is assumed that computer programs for this purpose will be completed and put into service in the last half of 1981.

2.3.4.4. Metering systems for N.E. Frigg and Odin

In the course of 1980 agreement was reached between the authorities and the oil companies involved on the general system for measuring the gas from N.E. Frigg and Odin. Both the Norwegian and British authorities are entitled to control of these systems because they form part of the measurements which determine the allocation of ownership of the gas from the Frigg pipelines. Because of the special conditions governing the development of these two fields, it was natural to take into accout to a greater extent than is usual the development costs when the metering system was evaluated. The approved system means among other things that the gas contribution made by the Frigg fields in the pipeline is calculated as the difference between the total stream from the Frigg platforms and the quantities arriving on Frigg from N.E. Frigg and Odin.

It is expected that the operators will submit detailed proposals in 1981 for the development of the metering system for the two fields. As in the earlier stages of the approval, the Norwegian Petroleum Directorate will perform further control work in cooperation with the Department of Energy.

2.3.4.5. Statfjord

Statfjord A started production loading from a buoy in November, 1979. On the basis of some problems with the metering system in the first operating period, the Norwegian Petroleum Directorate agreed with the operator to check loaded quantities with the help of an independent inspection firm. A tank bearing was then used as a place for unloading. When the problems were solved, the metering systems on the platforms were put into full use.

On the basis of the situation governing the personnel side in 1980, it has not been possible to perform inspection of the operating of the metering system to a desirable extent.

The metering system for Statfjord "B" was built and tested in the course of the year and inspected at the manufacturers.

Control of the metering system for Statfjord C at the design stage will be started at the turn of 1980/81.

2.3.4.6. Murchison

Murchison, together with Frigg and Statfjord, is one of the fields where hydrocarbons produced are shared in a percentage between Norwegian and British licencees. The Norwegian percent this year is 16.25%.

The field started producing in the Autumn of 1980.

Control of the testing of the metering system before start-up as well as approval of operating and maintenance procedures have not been made. This is i.a. associated with a special formal relationship governing authority in this area. The Norwegian Petroleum Directorate will continue work on the matter in 1981.

2.3.4.7. Ula

As regards the metering systems on the Ula field, the Norwegian Petroleum Directorate is checking the design at the present time.

2.3.4.8. Valhall

In 1980 the Norwegian Petroleum Directorate approved the design of the metering systems for oil and gas from the Valhall field. At the end of the year, the status of these systems is that the mechanical part has been approved and shipped to the place where the platform was manufactured where it shall be installed. Before the other parts of the metering system may be shipped, further tests must be made at the manufacturers.

3. ACTIVTY LEVELS OBJECTIVES AND PERSPECTIVES

3.1. Summing up of the present situation and conditions for the oil activity

The level of activity is primarily determined by political evaluations. This is discussed in i.a. Storting Report No. 53 (1979-80). Definition of the level may be done in many ways. In Norway it has been decided to use the production level as a basis, and an annual production rate of 90 x 10^6 t.o.e. has been used as an example of a moderate production level.

Within this framework it is important to facilitate the conditions so that large variations are avoided to the greatest extent possible within all the most important areas of activity. These are:

- seismic surveys
- exploration and production drilling
- field development (planning, building, installation)
- operation facilities

Large variations and/or too rapid an acceleration in the level within the individual activity areas will lead to considerable problems possibly associated by weakening quality, cost coverance and other chain reactions.

To contribute to a suitable activity pattern it is very important that the rational total planning is made on an objective basis. The Norwegian Petroleum Directorate considers it to be an important function to contribute with consequence and perspective analysis in connection with the planning of the future activity.

3.1.1. Activity level

3.1.1.1. Exploration and delineation drilling

In 1980, 36 exploration and delineation wells have been started. This is the largest number in one year on the Norwegian Shelf. In view of the companies' plans it is expected that this level will be further increased in 1981.

Without further allocation of blocks the level will be reduced considerably. Some of the reduction will be counteracted by a new allocation. The high activity level as concerns exploration

and delineation drilling in 1979 and 1980 must be seen as a result of the extraordinary discovery rate in the 4th licencing round

On the basis of the present situation it will be difficult to defend at the existing level the exploration and delineation drilling as the best for the 1980s.

In connection with the need for new allocation of licences, the Norwegian Petroleum Directorate has evaluated a number of exploration wells which may represent a suitable level from the point of view of i.a.:

- the reserve basis compared to a production level of 90 million t.o.e.
- the wish for longterm surveying of the allocated resources on the Shelf.
- safety considerations, particularly with the view of availability of qualified personnel.

With this basis it has been concluded that the number of wells in the order of magnitude of 30 per year will satisfy the conditions mentioned above.

3.1.1.2. Production drilling

In 1980 27 production wells were drilled. This is a reduction compared to 1979. A further reduction in the number of wells is expected in 1981 and 1982. An increase is expected again in 1983 and 1984. The variation in the number of production wells is applied to the variations in the development activity. The demand for rigs will be different for exploration and production drilling, but there will be a need for the same categories of personnel. From this point of view, exploration and production drilling were looked at in conjunction with each other. Well maintenance was also part of this picture. In general it may be said that production drilling to a greater degree than exploration drilling is predictable within a period of 45 years.

3.1.1.3. Fields under evaluation and planning

As new blocks are allocated and as new fields are discovered in exploration drilling, the extent of field evaluations increases, at the same time as possible development and alternatives for bringing ashore are evaluated. In the blocks allocated in the 4th licencing round a number of interesting discoveries have

been made. In addition to the interesting discoveries in the blocks from earlier rounds, such as Heimdal, Sleipner, 30/4 - 30/7, 15/3, 2/1, 35/3 etc, this has had the effect that the extent of the planning work for last year has been greater than before. The reason for the high planning activity is not only associated with the number of fields but also with the complexity of the fields. A very large investment is necessary for sound field development and means that the licencees have to do very thorough planning before a field development project may be established.

3.1.1.4. Fields under development

After the development of Ekofisk was started at the beginning of 1970 there has been a gradual increase in the development activity on Frigg and Statfjord towards the end of the 1970s. Subsequently this activity has decreased somewhat even if the further development of Statfjord, as well as the Statfjord field still results in a considerable level of activity. The decision to develop Ula, N.E. Frigg and Odin has the effect that one may still expect a certain activity, but not the same as in the last half of the 1970s. Much of the building activity this time has been performed by foreign labour, while domestic competence and capacity has been developed. At this time, most of the devlopment activity is performed by Norwegian labour both for engineering services and shop work.

There is reason to believe that the development activity in the near future will give possibilities for contracts beyond the level at which the Norwegian industry may suitably take care of. The activity will, by necessity, vary from year to year, but it is important that the conditions are facilitated by overall development planning so that too great a fluctuation in the activity level can be avoided.

3.1.1.5. Operational activities

At the end of the 1970s, all fields within the Ekofisk area have been developed and are in operation. The Frigg field was in operation and production from Statfjord A had been started. The operation of production and landing facilities has turned out to require more resources than originally assumed. A considerable number of persons are already directly involved in the operation of production facilities. These are divided into two administrative functions, such as petroleum expert functions for evaluation of production from the individual fields, functions in connection with operation and maintenance of the facilities as well as more service minded functions such as catering and

transport services. The individual field has a life of about 20 years. The number of persons engaged in operational activities must therefore be gradually increased as more fields are developed.

3.1.1.6. Personnel requirements

The comprehensive surveying, evaluation, planning and operational activities have, to a large extent, effected the demand for geologists, geophysicists, engineers in the widest meaning and economists. These are highly qualified personnel whom have undergone a long period of education. It has been necessary to recruit these so far from other activities and this will continue.

If the need for geos are seen in isolation, this will on the condition of a relatively stable activity level with an annual production of 90 million t.o.e., be at about 1,000. This means that the present education capacity must be doubled, but at least 8 or 10 years before the present and future needs are covered. This relates to the needs of the petroleum industry - the other need for geo experts is expected to be stable which seems to be optimistic.

There are reasons to expect that planning and development activity will increase in the years to come.

It is desired to increase Norwegian involvement in the oil activity. This process of Norwegianizing must however be seen in conjunction with the national development and the allocation of the work force.

3.1.2. The reserve basis

Tables XVI, XVII and figure 3.A give a summary of the preliminary reserves on the Norwegian Continental Shelf. In total, 2.4×10^9 t.o.e. have been proven. Of this, there are plans to develop 1.2×10^9 t.o.e.

The reserve estimates for 30/6 and 30/7-6 must be considered as a minimum amount. Drilling in the near future will probably increase the reserves so that the total potential will be over 2.5×10^9 t.o.e. It is too early to publish an estimate for several of the new discoveries 30/3, 35/8, 34/4, 35/3, 2/1-3 and 31/4 because of great uncertainties in the estimates.

The estimates for 31/2 include the parts of the structures which extend into 31/5. The estimates for 31/3 and 6 correspond to about

1.2×10^9 tonnes of oil equivalents (t.o.e.). These reserves may be termed low risk, non-proven reserves.

There are several low risk structures in the licenced blocks, particularly in the 4th licencing round. It is therefore too early to evaluate the effect of the 4th allocating round.

The Norwegian Petroleum Directorate estimated for the 4th licencing allocation round the total potential in the Norwegian part of the North Sea at 4.7×10^9 t.o.e. Even if the 4th round has so far achieved a greater discovery rate than was included in the risk evaluation of the non-proven reserves in these estimates, reserve estimates are too uncertain to draw the conclusion that the estimated expected reserves included in the number are too low. It is thus too early to perform a reevaluation of the estimate of 4.7×10^9 t.o.e.

The reserve basis on the Norwegian Shelf south of 62°N will be as follows:

Proven reserves	2.4×10^9 toe
Low risk reserves	1.2×10^9 toe
Undiscovered reserves	1.1×10^9 toe
	4.7×10^9 toe

Large parts of undiscovered reserves are expected in the already allocated blocks having a joint structure with these.

It is important to emphasize that the indicated reserve figure for undiscovered reserves has been evaluated from the point of view of geological risk.

TABLE XVI

PROBABLE IN PLACE AND RECOVERABLE PETROLEUM QUANTITIES
NOT DECIDED TO BE DEVELOPED AS PER DEC 31st 1980

FIELD	IN PLACE		RECOVERABLE	
	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$
Balder[1]	173	-	50	-
Bream	< 1	< 1	< 1	-
Brisling	< 1	< 1	< 1	-
Eldfisk Jura	-	-	-	-
Flyndre	< 1	< 1	< 1	< 1
S.E. Frigg	-	1	-	1
E. Frigg	-	6	-	5
Heimdal	4	49	2	36
Hod	45	11	9	7
Murphy	-	2	-	2
Sleipner	41	178	11	127
S.E. Tor	21	6	4	3
Valhall[2]	126	31	25	19
1/9 Alpha	26	19	5	11
1/9 Gamma	18	18	4	13
15/3-1	24	84	4	38
25/2-4	23	25	4	12
30/6	8	34	3	27
30/7-30/4	-	70	-	50
31/2	533	805	80	560
33/9 Alpha	37	4	18	2
33/9 Beta	78	3	39	2
34/10 Alpha	17	6	8	4
34/10 Delta	463	21	205	14
TOTAL	1640	1373	471	933

[1]Under evaluation. The estimate does not cover the whole field

[2]That part of the field which is not covered by Valhall A development

[3]Covers estimated extension of structure into 31/5

TABLE XVII

PROBABLE IN PLACE AND RECOVERABLE PETROLEUM RESOURCES IN FIELDS WHICH IT WAS DECIDED TO DEVELOP AS PER 31.12.80

	ORIGINAL IN PLACE PETROLEUM RESOURCES		ORIGINAL RECOVERABLE PETROLEUM RESOURCES		RECOVERED PETROLEUM RESOURCES		REMAINING RECOVERABLE PETROLEUM RESOURCES	
	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$	Oil $10^6 Sm^3$	Gas $10^9 Sm^3$
Albuskjell[1]	31	38	11	21	2	3	9	18
Cod[1]	5	9	2	4	1	2	1	2
Edda[1]	12	3	2	2	1	0.4	1	2
Ekofisk[1]	815	191	165	105	90	18	75	87
Eldfisk[1]	560	141	72	49	8	2	64	47
Frigg[2]	–	158	0.6	127	0.1	24	0.5	103
Murchison[3]	19	1	9	0.3	0.1	–	9	0.3
N.E. Frigg	–	19	–	8	–	–	–	8
Odin	–	30	0.1	22	–	–	0.1	22
Statfjord[4]	682	119	341	40	4	–	337	40
Tor[1]	125	25	20	17	8	3	12	14
Ula	70	8	28	2	–	–	28	2
Valhall A	243	61	41	28	–	–	41	28
W. Ekofisk	54	31	12	24	8	13	4	11
TOTAL	2616	834	704	449	122	64	582	385

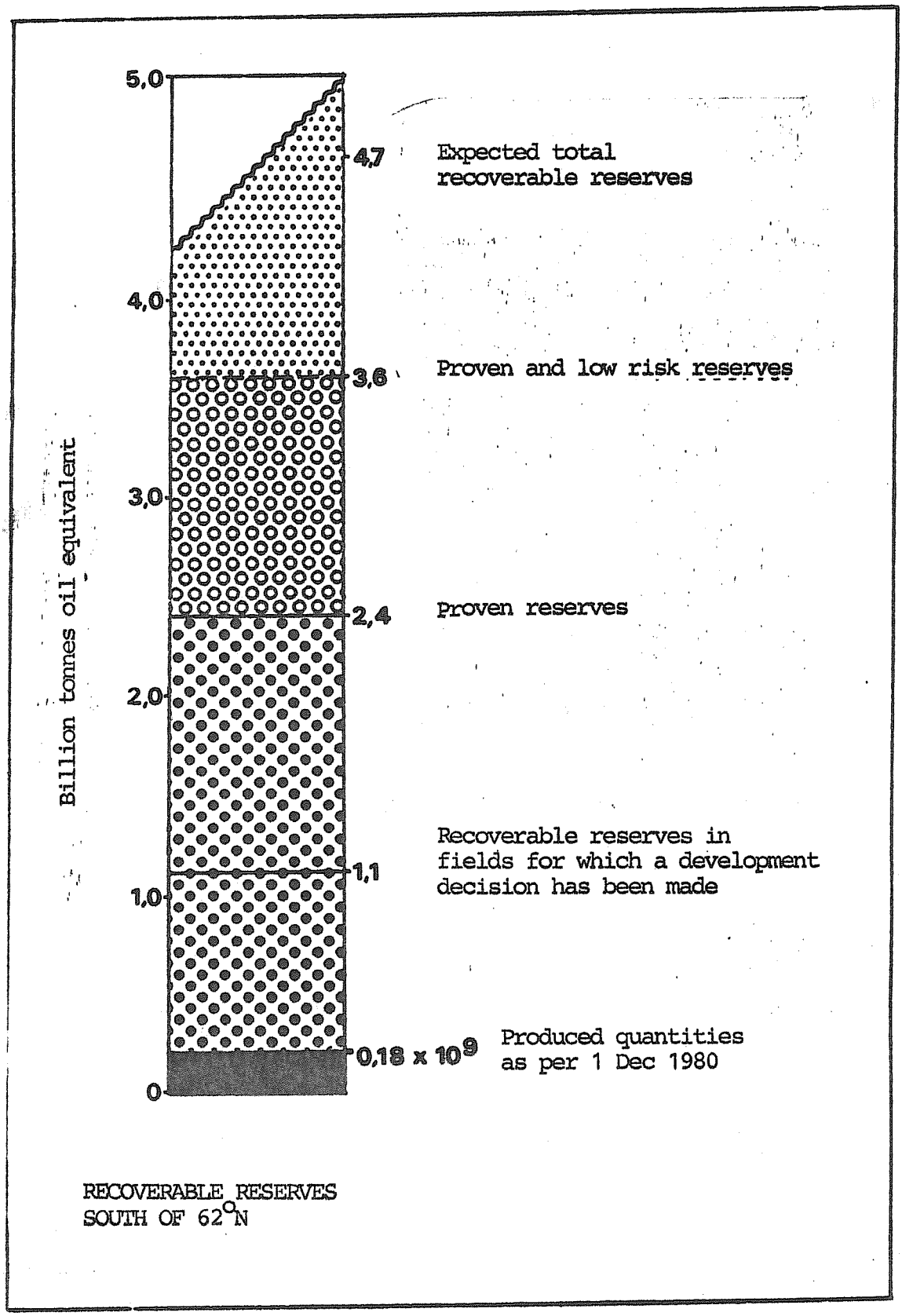
[1] NGL included in the oil

[2] Norwegian share: 60.82%

[3] Norwegian share: 16.25%

[4] Norwegian share: 84.09%

FIGURE 3.A


5,0
4,0
3,0
2,0
1,0
0
Billion tonnes oil equivalent
4,7
Expected total recoverable reserves
3,6
Proven and low risk reserves
2,4
Proven reserves
1,1
Recoverable reserves in fields for which a development decision has been made
0,18 x 10⁹
Produced quantities as per 1 Dec 1980
RECOVERABLE RESERVES SOUTH OF 62°N

3.1.3. Capacity limitations

The many large discoveries which have been made on the Shelf in total confront us with the possibility of carrying on industrial activity of a kind which we have never seen before. How and how fast we adapt to this will depend, amongst other things, on the capacity limitations inherited in the society.

The Norwegian Petroleum Directorate has, in the period covered by the report put increased emphasis on identifying these limitations and on evaluating how strongly it is reasonable to expect that the activity level may be changed from year to year without coming into conflict with the limitations.

An important area where the capacity limitations have been experienced is the absence of some categories of qualified personnel. This may result in reduced quality both in the areas of planning and the execution of field development projects and exploration drilling. The Moe committee has proven the unfortunate consequences which a high pace combined with a lack of experience capacity may have on costs of development projects in the North Sea. Of larger importance in the long term however is the danger for sub-optimal utilization of resources in the North Sea because of erroneous planning and utilization strategy.

3.1.3.1. Dispensation from qualification requirements

It is in particular on the exploration drilling side that there has been a lack of qualified personnel. Because of this the Norwegian Petroleum Directorate has, after a thorough evaluation, granted a larger number of dispensations in 1980. This is important for the safety evaluations and the Norwegian Petroleum Directorate has therefore been particularly concerned with this aspect

The Exploration Act following the 4th and 5th licencing rounds has led to decentralized bases and operations' offices. The Norwegian Petroleum Directorate wil emphasize that such a decentralization poses greater demands on the operator's capacity and necessitates a strengthening of their onshore drilling personnel.

The situation as concerns the supervisory drilling personnel is not very satisfactory at present. However, the educational capacity is presently of such an extent that we will hopefully be able to reach the objective of not giving dispensations after January 1st, 1982. Increased ordering of Norwegian drilling platforms and increased development, however, may lead to a heavy deficit in qualified drilling personnel.

The personnel situation within drilling at present shows great scarcity of both supervising operative personnel and land based engineering personnel. The Norwegian Petroleum Directorate's opinion is that both these personnel categories represent key personnel as concerns the execution of safe drilling operations. The situation at present as concerns available personnel resources indicates that the drilling activities should not be increased beyond the present level.

3.1.3.2. Dispensation from work programs

Each licence is bound by a work program which shall be completed within a further defined time scope, usually 6 years. The work program which the companies are going to undertake is of great importance for the selectional licencees. In practice it is the operation that carries the main responsiblity for the implementation.

Delays in the work program over time influence and impede the authorities' possibility for longterm planning of the development strategy and activity level. For this reason, the time aspect was particularly emphasized when it came to the first drilling in a number of 4th round blocks.

So far, 6 postponements have been made as far as time scopes for the implementation of the word programs are concerned and this must be seen on the basis of the level of activity. These are :

1 in 24/11 - 12	(Statoil operator)
1 in 30/2	(" ")
3 in 30/3	(" ")
1 in 29/6 - 30/4	(BP ")

In addition, a further 3 dispensations have been given, but these were associated with negative geological results and in one case cleared the limits against Great Britain.

3.1.4. Conservation

3.1.4.1. Recovery degree

Table 16 and 17 show presence of recoverable reserves in petroleum discoveries on the Norwegian Shelf. Some fields are produced through joint processing facilities, and distribution of the total production takes place in accordance with the rules agreed between the licencees (e.g. Ekofisk area). In this case, existing reserves are calculated as if each field was isolated, while recoverable reserves are affected by production from other fields. A comparison of the numbers in tables XVI and XVII will therfore not always give a fully correct picture of the degree of recovery for oil and gas. The variations are however small, and the table shows that the average recovery degree for fields for which a development decision has been made is 27% for oil and 56% for gas, a total average of 33.5%. The figures vary however from 14% for oil on Eldfisk to 18% for gas on Frigg. Gas fields normally have a high recovery factor (60% or more). For oil, the recovery factor varies from under 10% to over 60%, with 35% as a rough estimate on a global basis for the type of oil found in the North sea.

The Norwegian Petroleum Directorate has given priority to the work of increasing recovery on the fields which are pre-utilized. The energy quantities which may be gained from improved utilization of petroleum resources are enormous compared to what may be saved by better utilization of energy other places in the country.

In the Ekofisk area the Norwegian Petroleum Directorate has, above all, concentrated on gas injection. Calculations made by the Directorate show that about 1 million tonnnes of oil can be recovered for each 1000 m^3 injected. About 13.5 billion Sm^3 of gas have been injected into Ekofisk since 1975. The injection capacity has thereby been utilized at a rate of 50%, and the oil recovery has been increased by 16 million Sm^3 The experience so far is that when gas injection is used it is a well suited production method for at least Ekofisk , and that it will give a very considerable increase in recoverable reserves had it been used more fully from the beginning. At that time, however, there were no anaylses clarifying this and no experience which could justify this.

This illustrates a main conservation problem. Important decisions on development strategy are made at such an early time that the basis for decisions may be incomplete. Agreements entered into are given economic consideration making it very difficult to change the plans.

The experience in the Ekofisk area illustrates another special feature of field development in the North Sea. The resources are so large that even a low recovery factor gives production rates and recovery reserves which are large in an international context.

Development for optimal utilization resources will often yield a poor economic result. The investment must namely be made at an early stage, whilst the profit will normally not materialise until well into the life of the field.

When the income from development starts coming in, it may be relevant to consider additional investments again. The resources will be frequently more difficult to recover, so the result is poorer than if the investments had been made at the beginning. In accordance with normal economic business practice, the additional investments and the additional production is considered as an isolated project. For this reason, the additional project may be unprofitable whilst primary development together with the additional project will still have given a satisfactory yield.

These examples show some of the problems which the Norwegian Petroleum Directorate has had to face in the provisions of the "temporary regulations for conservation of petroleum resources" (issued by the Minister of Petroleum and Energy on November 17th, 1980), which shall be enforced. Experience has shown that even if the Storting has made decisions on studies for more effective recovery, it may be difficult to motivate the licencees to execute the project.

3.1.4.2. Gas flaring

Utilization of resources also covers sound utilization of the petroleum produced. Oil produced and gas produced from crude gas fields are utilized to the maximum, whilst considerable gas quantities from oil fields have already been flared. As mentioned in chapter 2, a total of 4.17 million Sm^3 of gas has already been flared on the Norwegian Continental Shelf as of December 31st 1980, corresponding to 7.1% of all the gas produced from oil fields. In terms of energy this corresponds to a little under 6 months consumption of petroleum in Norway.

With the exception of the test production on the Ekofisk field in 1971 -1974 all field development plans include many ways to utilize associated gas. When fairly significant quantities are nevertheless flared, this is associated with the fact that it is frequently more attractive from an economic point of view to flare gas and to stop oil production if problems should occur. For operational and safety reasons there will always be a need to flare some gas. The production permits therefore give a maximum limit of how much gas may be flared. The permits are given as a maximum limit over a 15 day period. Therefore the operator's maximum average over any period may unquestionably create problems, but the system has proven effective for limiting the flaring of gas.

It was mentioned in section 2.1.5.3. that approximately 0.6% of gas produced in the Ekofisk area in 1980 was flared. With the equipment present today, it seems questionable that it is possible to reduce the flaring appreciably. Something may still be gained however through development of better flare systems.

The fields developed so far either contain large quantities of gas or are located near transportation systems for gas. For this reason it has not been difficult to require that the gas be utilized. In the future, however, we may be faced with a choice of allowing flaring of gas or risking that development may not be started. If it requires greater resources to utilize the gas than those already gained it goes without saying that it must be possible to permit flaring. In other cases there may be the question of leaving the resources in expectation of new technology or new situations which will make it possible to take better care of the resources.

3.1.4.3. Consumption of energy in connection with processing and bringing ashore

Sound utilization of resources also covers the consumption of gas as fuel in connection with the processing and landing of petroleum. The increasing fuel costs and the general requirement for saving energy has had the effect that much has been done in, for instance, refineries and the petrochemical industry to save on fuel consumption where possible. This is also the same to some degree for production facilities, but a survey of the fuel consumption on some facilities in operation shows that the energy consumption is considerable.

The energy which is used is, practically speaking, all gas from the field. By measuring the consumption per tonne of oil equivalent of petroleum produced, the following account can be made for the individual field developments:

The Ekofisk complex: 19.1 Sm^3/t.o.e. of produced petroleum
Frigg ---------- : 2.6 " " " "
Statfjord -------- : 20.2 " " " "

As it appears from this listing, less energy is used on Frigg, a gas field, than on the other fields which are oil fields with associated gas. The reason for this is that the consumption for compression and bringing ashore has not yet started on Frigg.

The energy-consuming units in the process system are primarily the compressor which is either run directly by a gas turbine or an electric motor. In addition, gas is used as fuel in the hot-oil system at the glycol regeneration plant. In the auxillary system, fuel is used in the form of gas taken from the process flow to generate electricity.

Against this background, it is therefore natural to evaluate whether utilization of the energy developed in the production system may be improved.

A literature survey made by the Directorate shows that, at present, little has been published about work performed to utilize the energy lost on offshore facilities. In this area, one must benefit from the efforts made in the refinery facilities and petrochemical industries to save energy. These are mainly concerned with different recovery methods of wasted in-flue gases from turbines, engines and heaters as well as recovery of energy through turbo-expanders where pressure falls take place in the process.

Energy conservation and better utilization of the energy used for processing and landing of petroleum should be technically possible with the help of:

- heat from exhaust gases
- pressure and temperature faults in the processes
- better isolation
- thermal utilization of process streams
- better design and utilization of pressure release and flare systems

An evaluation made concerning energy conservation on Statfjord A shows that the production process itself provides access to more than three quarters of the total electrical energy requirement. The disadvantage of part of the energy conservation method is that it resulted in a complicated process system with a large degree of internal dependency and there is little flexibility.

3.2. Perspectives

3.2.1. Resource Surveying

The reserve basis in the individual areas on the Shelf are and will continue to be the condition for the activity in the oil industry.

The objective must be to obtain the best possible balance between the future activity level and the factors limiting this (availability of personnel, drilling platforms, the capacity of the companies) and furthermore, a development strategy leading to optimal utilization of resources in the most favourable way possible from a national economic point of view.

A condition for pursuing central objectives such as an even activity level, conservation, etc. is that the most comprehensive resource survey of the Shelf is made. A long term resource survey has the objective of getting a picture of the petroleum potential on a different part of the Shelf in order that the continuity of the oil activity may be maintained in this way on the exploration

side by opening up areas.

Short-term resource surveying will have the objective of exploring the reserve basis in the areas/blocks where drilling is in process or where start-up of drilling is considered. A total evaluation of the resource basis within an area is important for the production of reserves in the individual field and for development within a larger area with a view to keeping a stable activity level harmonising the development of competence, conservation of resources, coordinated development solutions, etc.

Licencing allocations within the block system is the first step in such surveying of resources and development strategy. By making the operator bound by a geologically justified work program, the authorities may further ensure that different prospect times are explored and the reserve basis within an area is surveyed and tested in a sound manner. Because of the long time span from the discovery of a field to the start of operations, it is necessary to have long term planning from the point of view of surveying resources

3.2.2. Future Allocation of Production Licences

In view of the long time span between the discovery of a field and the start of operations, it is necessary to have long term planning based on resource surveying.

New production licences will be governed by the reserves situation, the wish for an even level within the sectors involved in the oil activity, the wish to discover new fields which may support existing development and transportation systems and resource surveying by testing new prospect types and exploration of new areas.

At present we are in the situation where reserves have already been proven to exist in the North Sea in the order of magnitude which is sufficient to reach a production level of 90×10^3 t.o.e. at the end of the 1980s and to maintain this for at least 25 years. There is also reason to expect further discovery in allocated blocks: at the same time there is free transportation capacity in the pipelines from, for instance, the Ekofisk area.

Based on the above, and in view of the fact that it takes a long time for prospects in new areas to mature, it is the view of the Norwegian Petroleum Directorate that allocations in the near future should be aimed at the following objectives:

- to examine blocks in the North Sea where possible discoveries may naturally be tied in with existing or planned transportation systems
- to test "new" prospect types in more well-known areas such as the North Sea
- to create a suitable scope for exploration drilling in new

areas such as Troms, Haltenbanken and Trænabanken, still at a very early phase
- blocks where there is a large probability that very large reserves may be expected can wait at this point.

Frequent but limited allocations are regarded as the best measure, both in the short and the long term.

3.2.3. Coordinated Development Planning

3.2.3.1. The Perspective Analysis

The perspective analysis is a result of the current work done by the Norwegian Petroleum Directorate to clarify the consequences of decisions made and possible decisions on the activity pattern for some time to come.

The good results from drilling in the past year have lead to a considerable change in the reserve basis. In the development on the Shelf so far, there have been no second thoughts about starting production for the fields whose inner development has turned out to be commercial. Today, we are for the first time faced with a real and to some extent difficult choice concerning the type of fields which we want to have developed, how they should be controlled timewise and what kind of infrastructure is necessary to ensure optimal utilization of the fields in isolation and as a whole.

Which choice is to be made will, in the final analysis, be a question of the activity pattern which is desirable from an overall point of view. The political authorities must here exercise their will. The Norwegian Petroleum Directorate's contribution to this project is an objective presentation of the basic data as well as an evaluation of the consequences resulting from alternative lines of action to safety and optimal utilization of resources on the Shelf as well as for other aspects of the activity.

A presentation of this character must by necessity be associated with some uncertainty. The reserves as well as production over time for the individual field are based on estimates so that the development solution and thereby the investment and work requirement for the individual field may deviate from the actual state of affairs.

For a total evaluation covering several fields, however, the uncertainties of the individual fields should balance out.

In the Norwegian Petroleum Directorate's effort to illustrate a coordinated development plan, a basis has been taken in the overall objective for the activity and the level of ambition which has been expressed from central quarters is regarded to be within the range of present and future possibilities. The great question is whether these objectives may be combined in a strategy.

Relevant Development Projects

Today there are a number of development projects which may be envisaged to be started in the near future. These projects may be divided into two main groups. In the first group, the development is dependent upon existing facilities and must therefore be seen as part of an optimal utilization of these facilities. The second group consists of projects where development may take place almost independently, for which reason they may take place at any time in the future.

Dependent (satellite) fields (category 1)

Figure 3.B gives a summary of the projects falling under group 1 and the recoverable gas and oil reserves which can be expected from the individual projects. It is natural to develop the first seven fields and probably 2/1, in connection with the Ekofisk plant. There is quite some uncertainty associated with these projects, particularly Ekofisk water injection, which is dependent on encouraging results from pilot water injection into the Ekofisk field. The fields Ekofisk S, Valhall B and C and South East Tor are the subject of further relevations regarding the possibilities for commerciality. Fields 33/9-Alpha and 33/9-Beta should be regarded in conjunction with the Statfjord and/or Murchison facilities.

It may be said in general about this group of projects that they are mainly oil fields of relatively limited size with the exception of Ekofisk water injection, where the potential is only in the order of magnitude of 100 million Sm^3.

Independent Fields (category 2)

Figure 3.C provides a summary of the fields which are in group 2, meaning fields which may be postponed. The first five fields are the ones which are best defined and the possibilities for rapid development are present. 15/3 and 30/7-30/4 are less known and will require further drilling/appraisal. The lowest three fields are interesting, but are presently uncertain as concerns future development.

With the exception of 30/4-Delta, which is estimated to contain 205 million Sm^3 of oil, all the other positive fields are gas or gas condensate fields. The predominance of gas is strongly emphasised by the reserve magnitude in Sleipner 31/2 and Heimdal. Of these, the development of 31/2 is still uncertain because it remains to be seen if the oil is commercially recoverable or not.

There has been a rapid spurt in the discovery of considerable reserves in the course of the last few years. In the future,

clarification will be expected in the still uncertain fields of 31/2, 31/4, 30/2-30/3, 15/3 and 30/7-30/4. These fields will result in a further increase in potential development projects for gas. Corresponding expectations for increase in oil reserves may at this time only be envisaged in connection with 31/4, possibly in connection with the oil zone in 31/2 on new discoveries in the fourth round of which a complete picture is not available at present.

FIGURE 3.B

RELEVANT DEVELOPMENT PROJECTS

GROUP 1: DEPENDENT (SATELLITE) FIELDS

	PROVEN RECOVERABLE RESERVES	
	GAS $10^9 SM^3$	OIL $10^6 SM^3$
EKOFISK VANNINJEKSJON		80 - 100
HOD	7	9
VALHALL B+C	19	25
1/9 - ALPHA	11	5
1/9 - GAMMA	13	4
S.Ø. TOR	3	4
EKOFISK SØR		
2/1	2	20
33/9 - ALPHA	2	18
33/9 - BETA	2	39

FIGURE 3.C

RELEVANT DEVELOPMENT PROJECTS

GROUP 2: INDEPENDENT FIELDS

	PROVEN RECOVERABLE RESERVES	
	GAS $10^9 SM^3$	OIL $10^6 SM^3$
SLEIPNER	127	11
34/10 - DELTA	14	205
31/2	560	90
HEIMDAL	36	2
30/6	27+	3
BALDER		Under Evaluation
15/3	63	6
30/7 - 30/4	MIN.50-70	
31/4		?
34/2 - 34/4		?
30/2 - 30/3	?	
35/8	Condensate	
35/3		?

Development Alternatives

Figure 3.D shows the production prognosis from existing fields for which a development decision has been made as per January 1st 1981. As it appears from the lowest of the two curves, production will reach a maximum of about 65 million t.o.e. in 1988, and will increase dramatically after this. However, the uppermost curve shows a potential increase which may be obtained by developing the fields covered by category 1 above (dependent fields). This curve shows that it is possible to increase production from 1985 so that the maximum is reached around 1990 of about 75-80 million t.o.e.

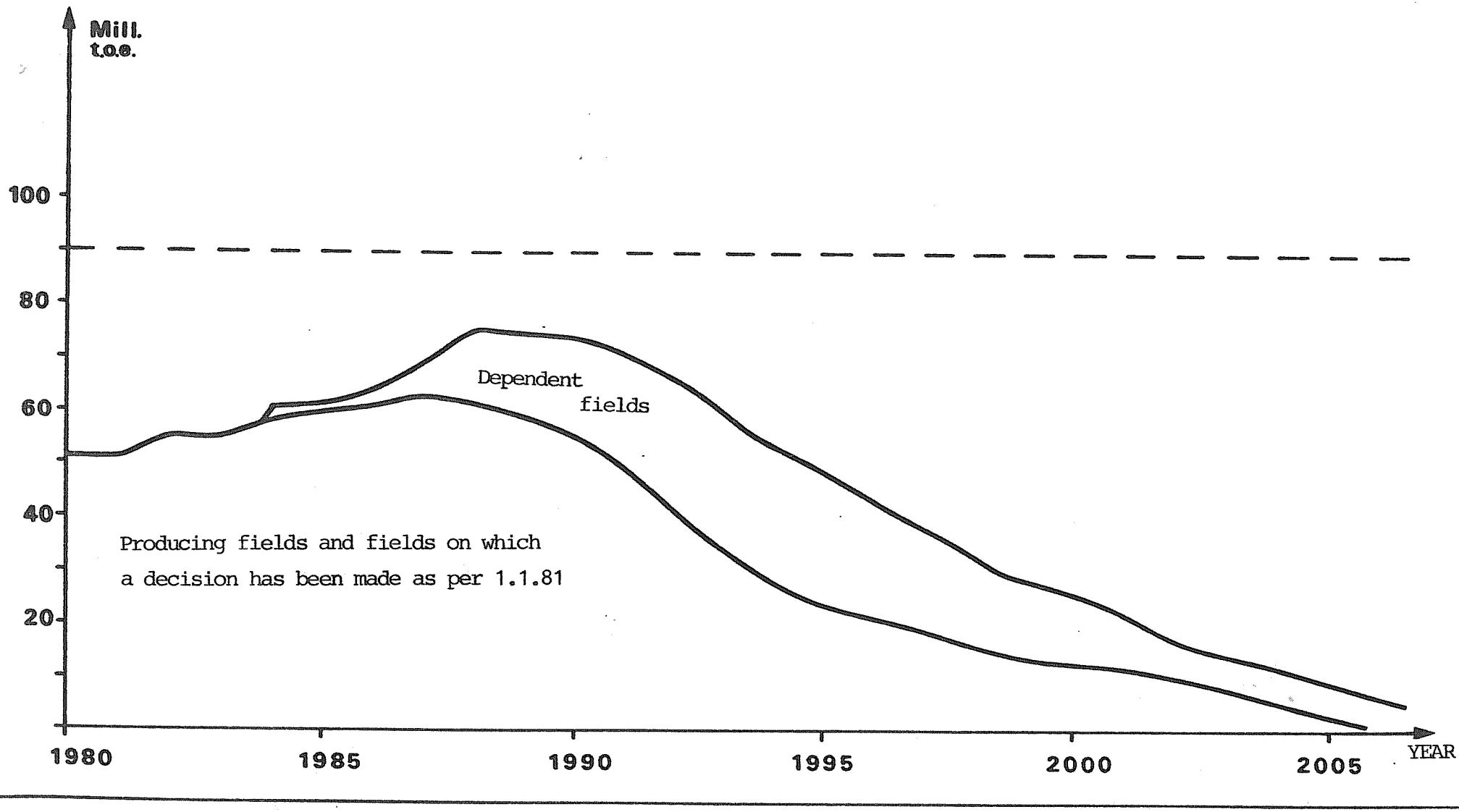
The administration of fields which are in category 2 (independent fields) may lead to different possibilities for increasing production up to 90 million t.o.e. which has been stipulated as the objective for total production on the Norwegian Continental Shelf. To illustrate the consequences of different lines of action, the Norwegian Petroleum Directorate has selected three alternatives:

Alternative 0 presumes that development will take place in accordance with the alternatives used by the companies, without direct influence on the part of the authorities concerning the time of development. Based on experience and the status of work on the individual project, however, some delays in the start-up time for each of the fields under evaluation has been anticipated.

Alternative 1 uses, as a basis, an early development of a coordinated system for gas, with full utilization of the existing gas transportation capacity on the Shelf. It presumes, in other words, that gas fields are developed in step with the increase in the gas transportation capacity and that possible development of oil fields only takes place after satisfactory utilization of the gas system has been reached. The objective as regards the production sealing is that it shall be somewhat lower than 90 million t.o.e. per year in order to have "free capacity" for possible oil production in 31/2 and/or development of possible fields north of 62° N.

FIGURE 3.D

PRODUCTION PROGNOSES



Alternative 2 uses, as a basis, the Statfjord group's landing application for the Statfjord gas with early development of a coordinated system for gas for full utilization of existing transportation capacity, with simultaneous development of the oil field 34/10-Delta.

As it appears from figures 3.E - 3.G, an effort has been made to illustrate the consequences of the three alternatives above by prognosticating four central conditions of importance, namely: expected production, expected investments and operating cost, the man hours and the engineering services required to execute development for each alternative. Figure 3.E (alternative 0) gives an illustration of how the development should not take place - since the production profile reaches a level of 110 million t.o.e. per year around 1990 to fall off to around 95 million tonnes per year towards the turn of the century. Still more serious than the breaking of the production scope are the large fluctuations in investment and operating costs which the plan leads to and the enormous concentration of man hours and engineering services in the middle of the 1980s. This involves both an unrealistic and unmaintainable escalation with corresponding fluctuations in the use of human and economic resources.

Alternative 1 (figure 3.F) illustrates the line of action leading to better management of resources in the time perspective. The production scope is kept at around 80 million t.o.e. per year. The investment and operating costs are kept relatively even with a weak increase which is mainly caused by the increase in operating costs, while the distribution of man hours and engineering services are kept relatively even and within the limits of development of competence which may be obtained in practice by conscious assigning of priority. The latter is a necessary element for safety and effective operation. The plan provides possibilities to "fill" the production profile at around 1990 with other fields, for instance 34/10-Delta.

Alternative 2 (figure 3.G) gives too large a development of activity early in the 1980s and it will be difficult to reach the objective of keeping under 90 million t.o.e. per year in production from fields in the south.

The Need for Gas Transportation

As already mentioned in the discussion of the reserve basis, large quantities of gas have been found in later discoveries but small or uncertain quantities of oil (cf. the oil zone in 31/2). These results have therefore clearly changed the relationship between gas and oil reserves on the Shelf in favour of gas. So far it has been anticipated that the relationship was around 50:50. Today the relationship in the proven fields is 54:46 in favour of gas: on the basis of the present knowledge of the geology on the Shelf there is reason to expect that more gas will be discovered in the time to come so that the final relationship between gas and oil for all probable reserves south of 62°N may be close to 60:40 in the favour of gas.

At present there is free capacity in the Ekofisk system of around 5 billion Sm^3 per year. It is expected that the capacity in the Frigg-system will be fully used until the year 1991. Production from the Frigg fields will taper off quite dramatically from this point in time and will release a capacity of quite some magnitude from and including 1992/93. The combined free capacity from the two systems is presented in fig 3.H. The figure shows that the free capacity from the two facilities reaches 20 billion Sm^3 already from 1992, and as much as 25 billion Sm^3 per year from 1996.

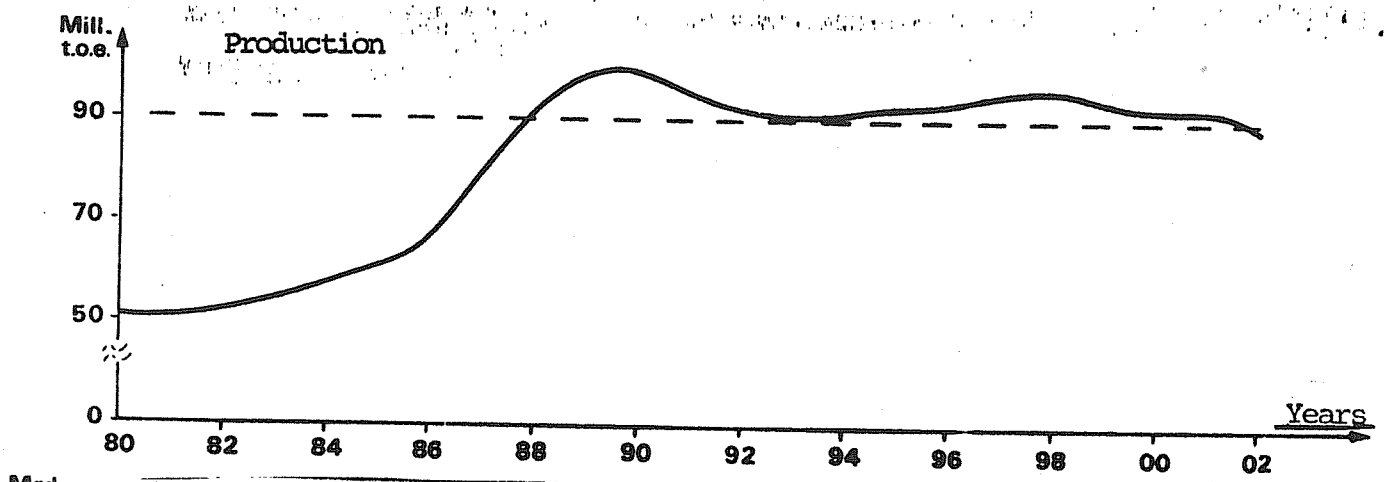
Important elements and decisions

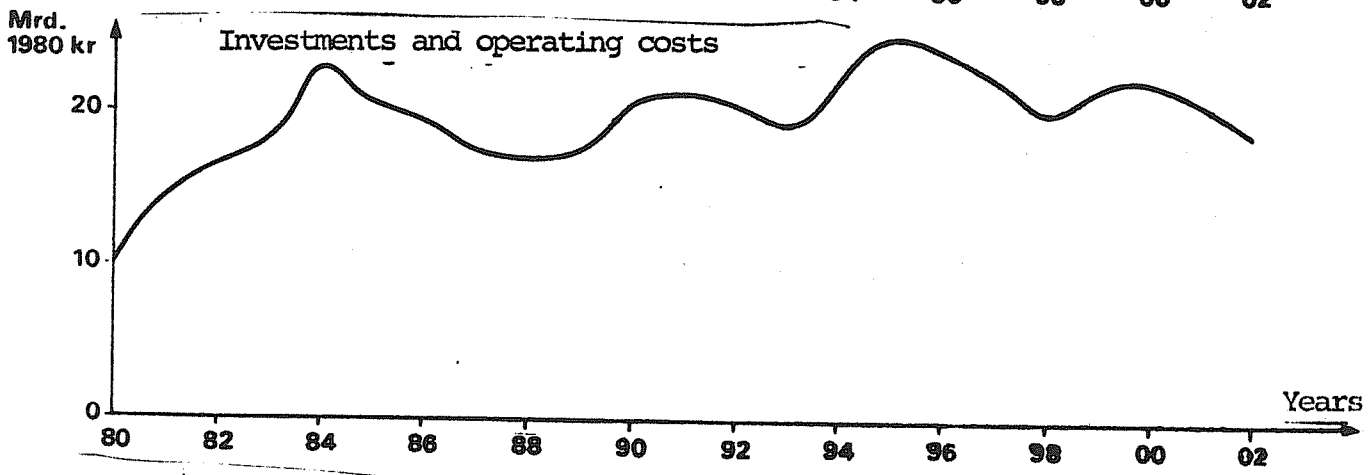
I) Perspective analysis clearly shows a need to look at the development of the individual field in conjunction with the total strategy for the development on the Shelf as a whole. This strategy should ideally also cover plans for possible development north of 62° N when there is sufficient basis to plan such a development. Such a strategy must take into account central objectives such as production ceilings, safety, efficiency, economy and development of competence. From central quarters, signals have been given that production south of 62° should be at a level lower than 90 million t.o.e. per year to give room for development of possible discoveries in the north.

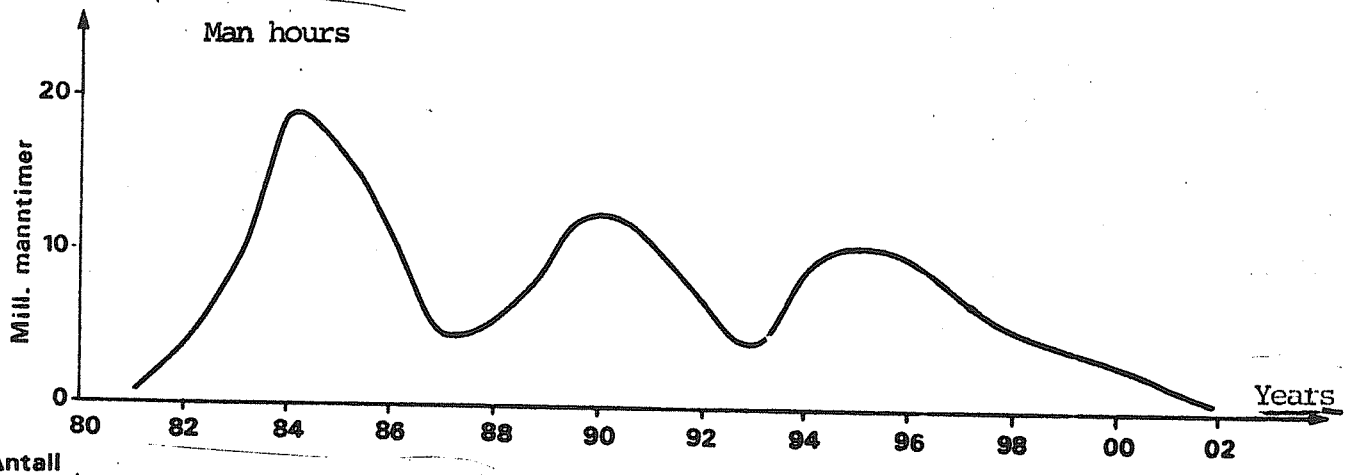
II) Already a strategy for management of gas reserves thrusts itself forward in connection with the bringing ashore of Statfjord-gas. The latest time to make a decision for bringing ashore Statfjord-gas which will make gas sales in 1985/86 possible is the spring of 1981.

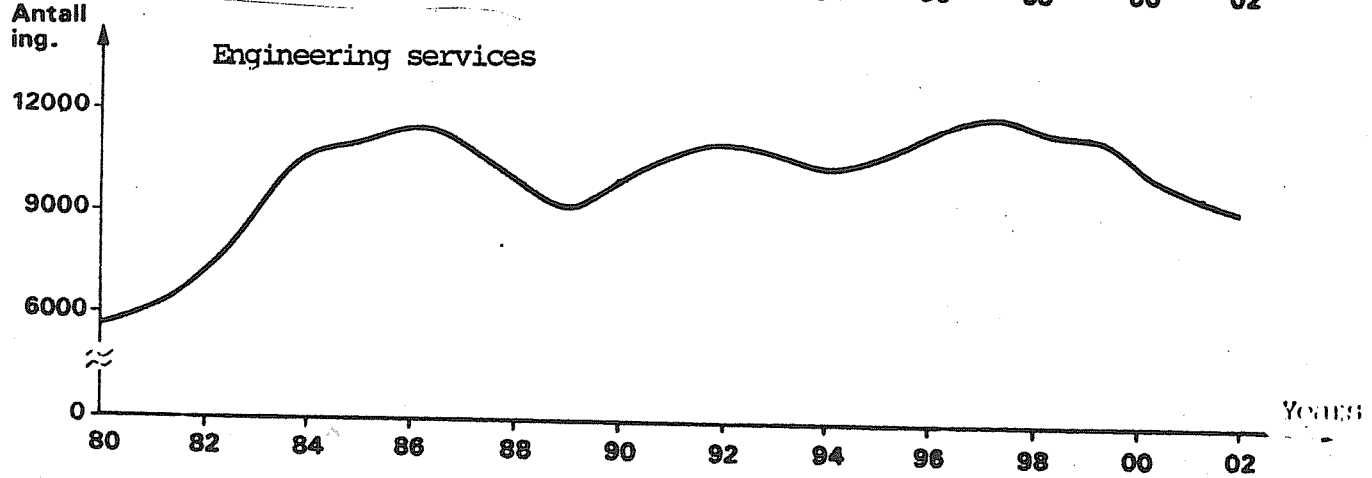
III) An important element in any strategy should be to give a clear priority for utilization of existing facilities on Ekofisk and Frigg. These can transport a total of 32 billion Sm^3 of gas per year. If it is decided to take Statfjord gas ashore to Great Britain, this could give an additional capacity of 4 billion Sm^3 per year in the long term. This may delay, and possibly make more complicated, the planning of increased capacity. On the other hand, it gives time for planning of future strategies. If it is decided to tie the Statfjord gas into a coordinated transportation plan, it will become urgent to clarify the main features of such a plan by the spring of 1981.

ALTERNATIVE 0

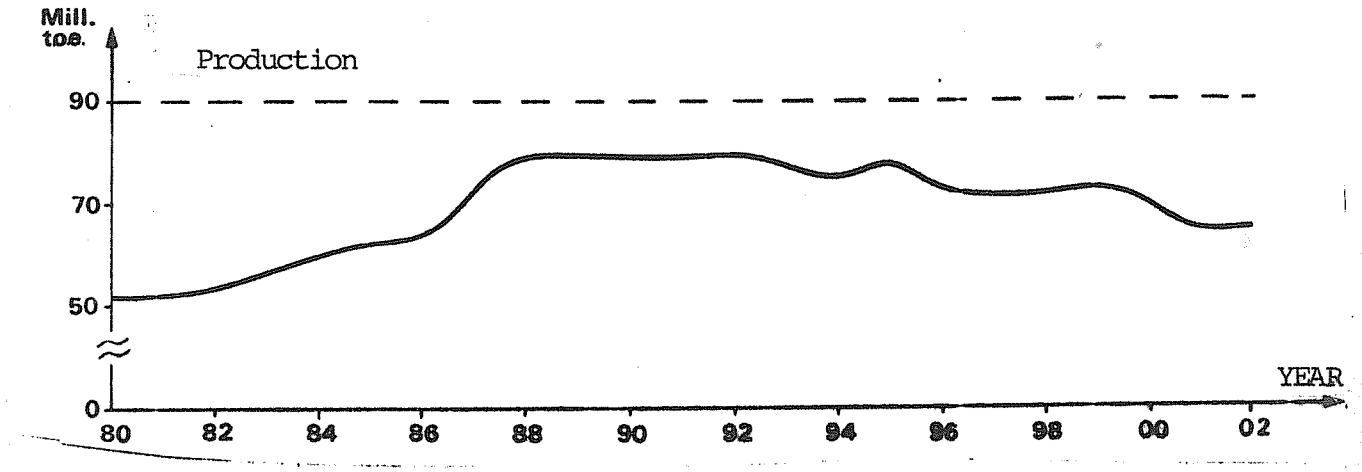


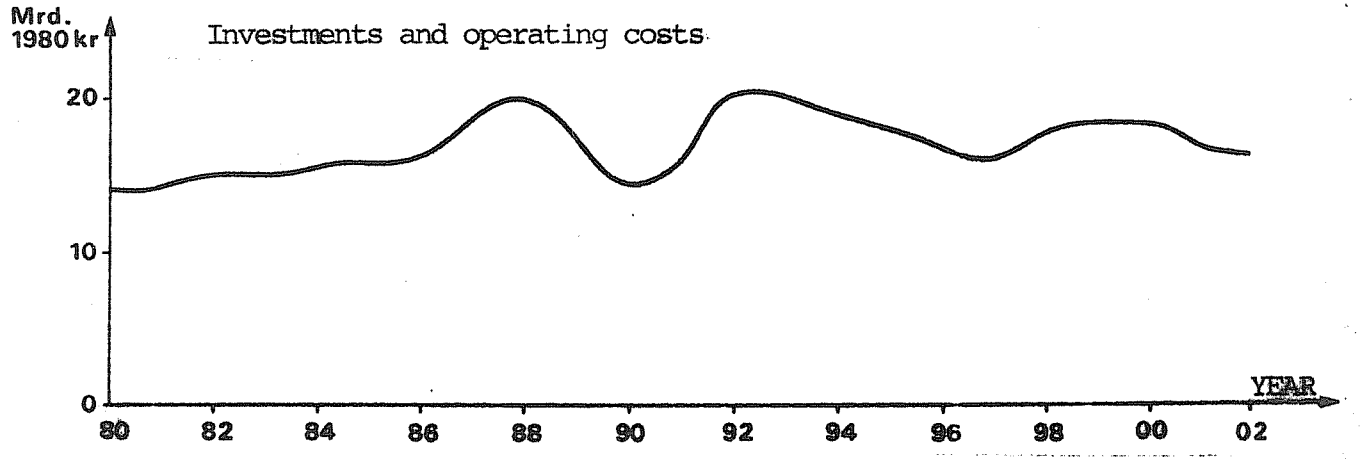


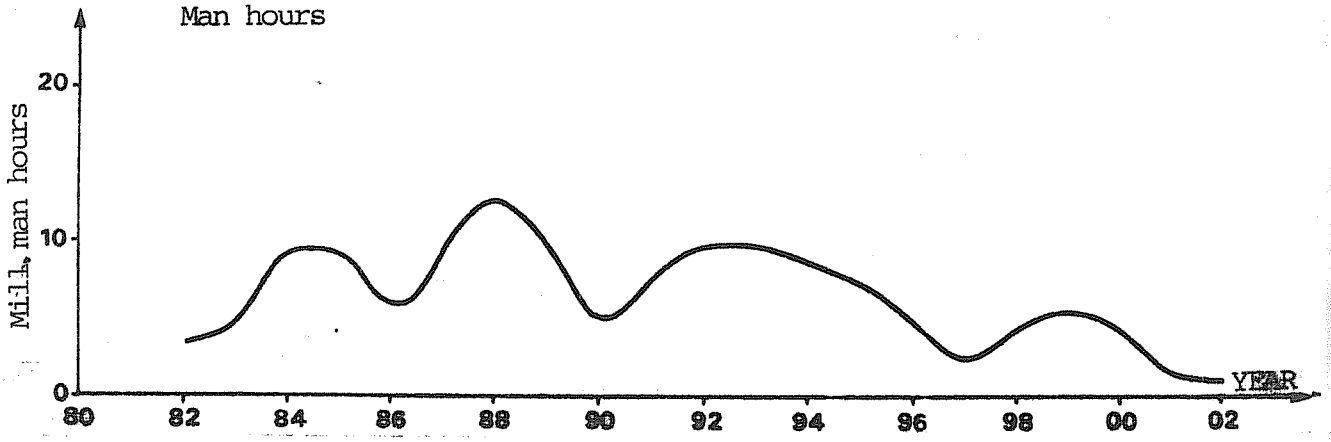


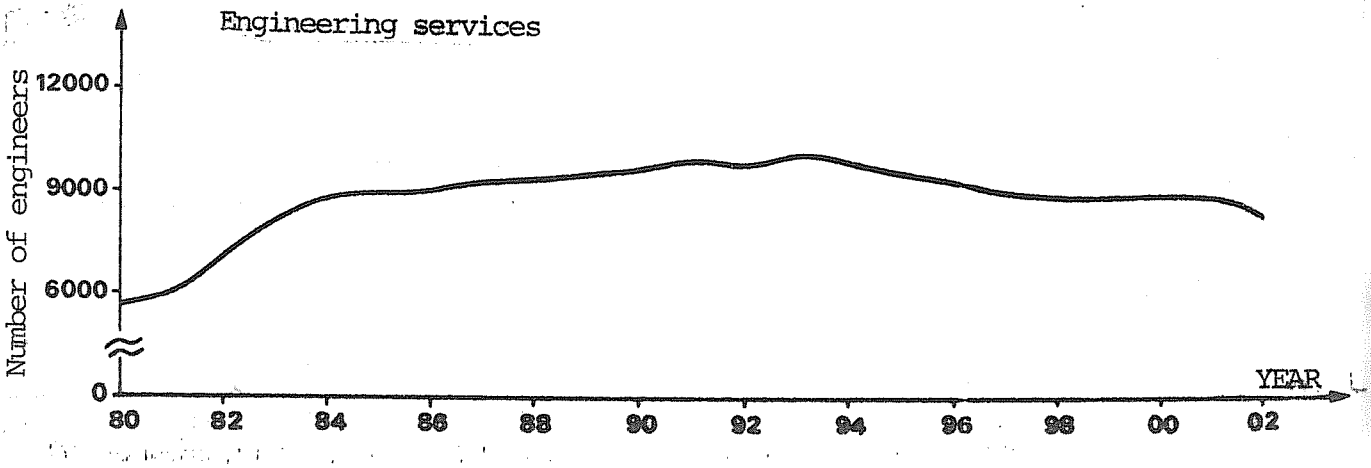


ALTERNATIVE 1

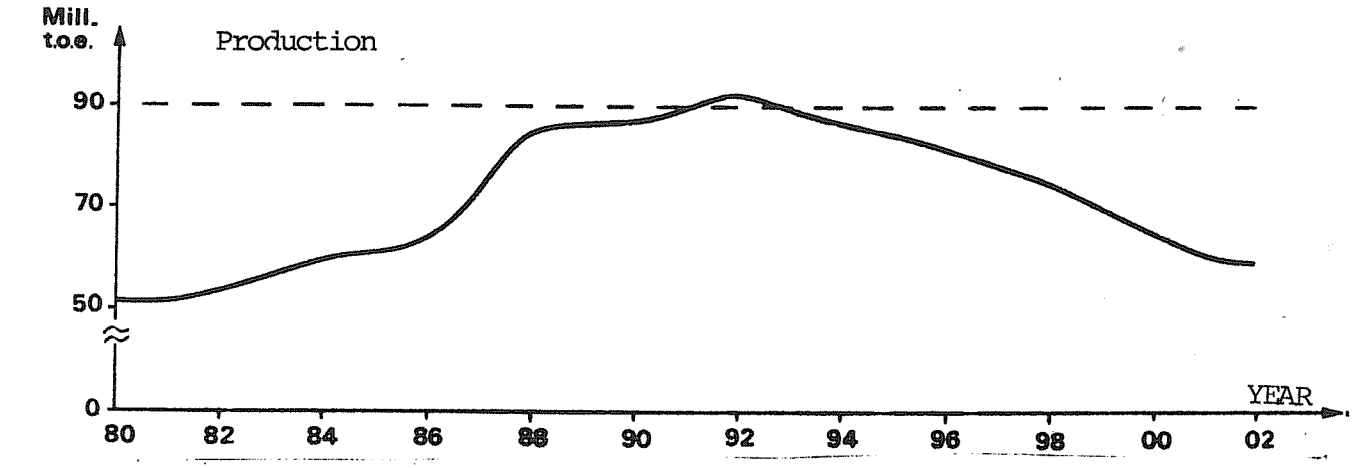


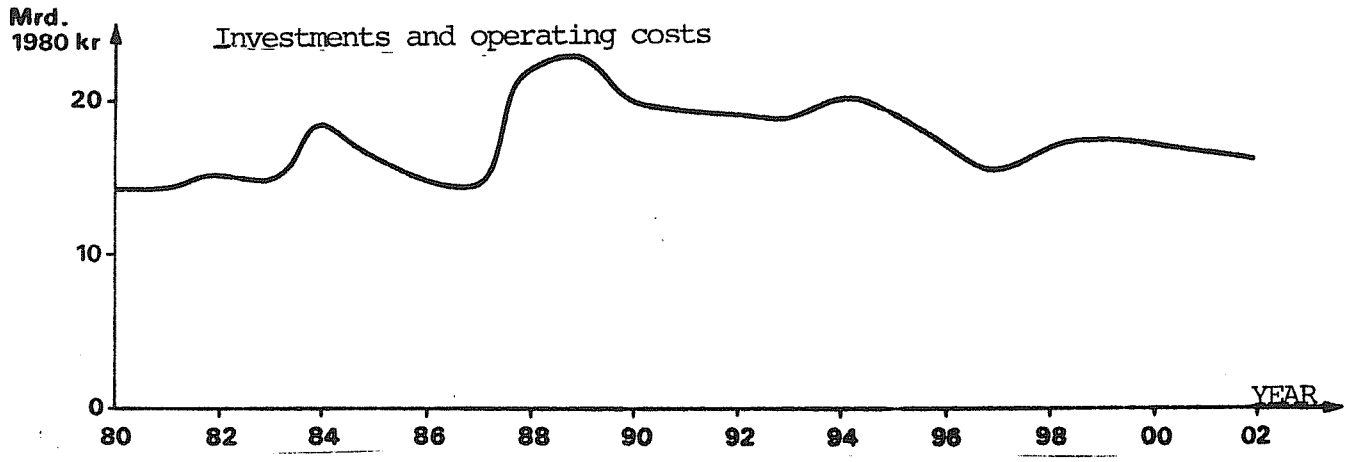


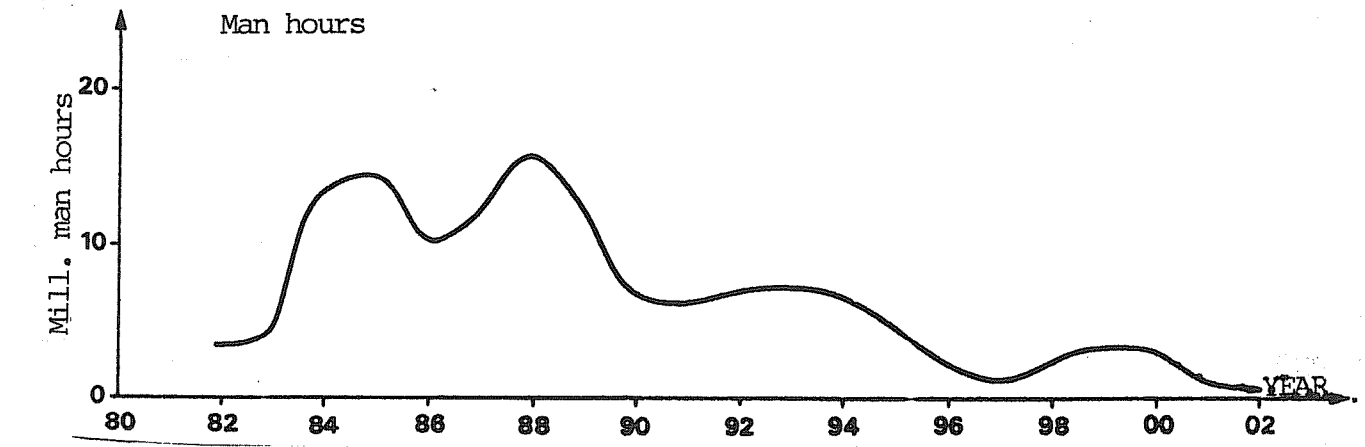




ALTERNATIVE 2







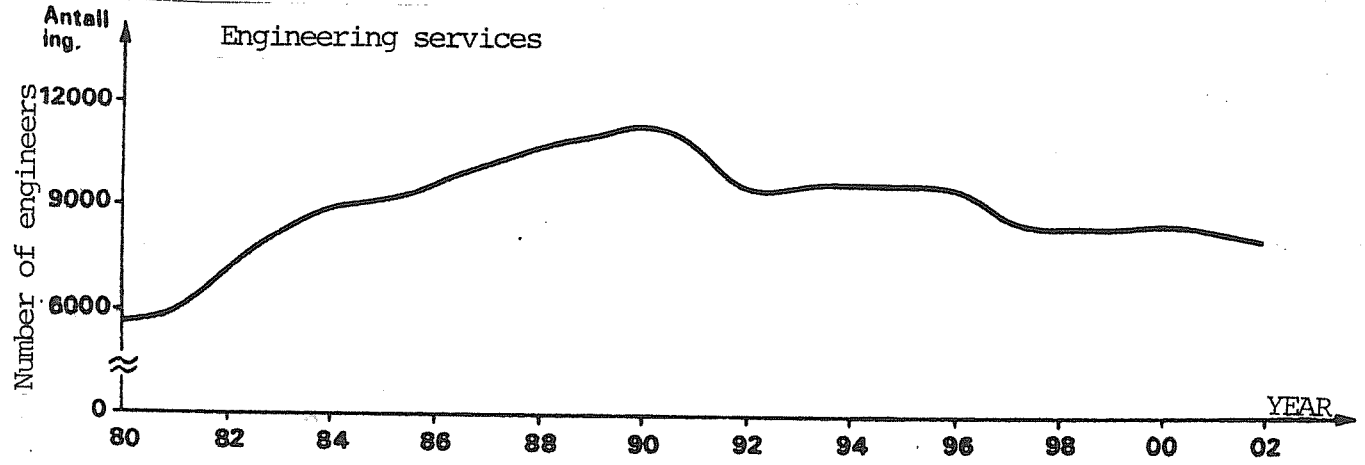
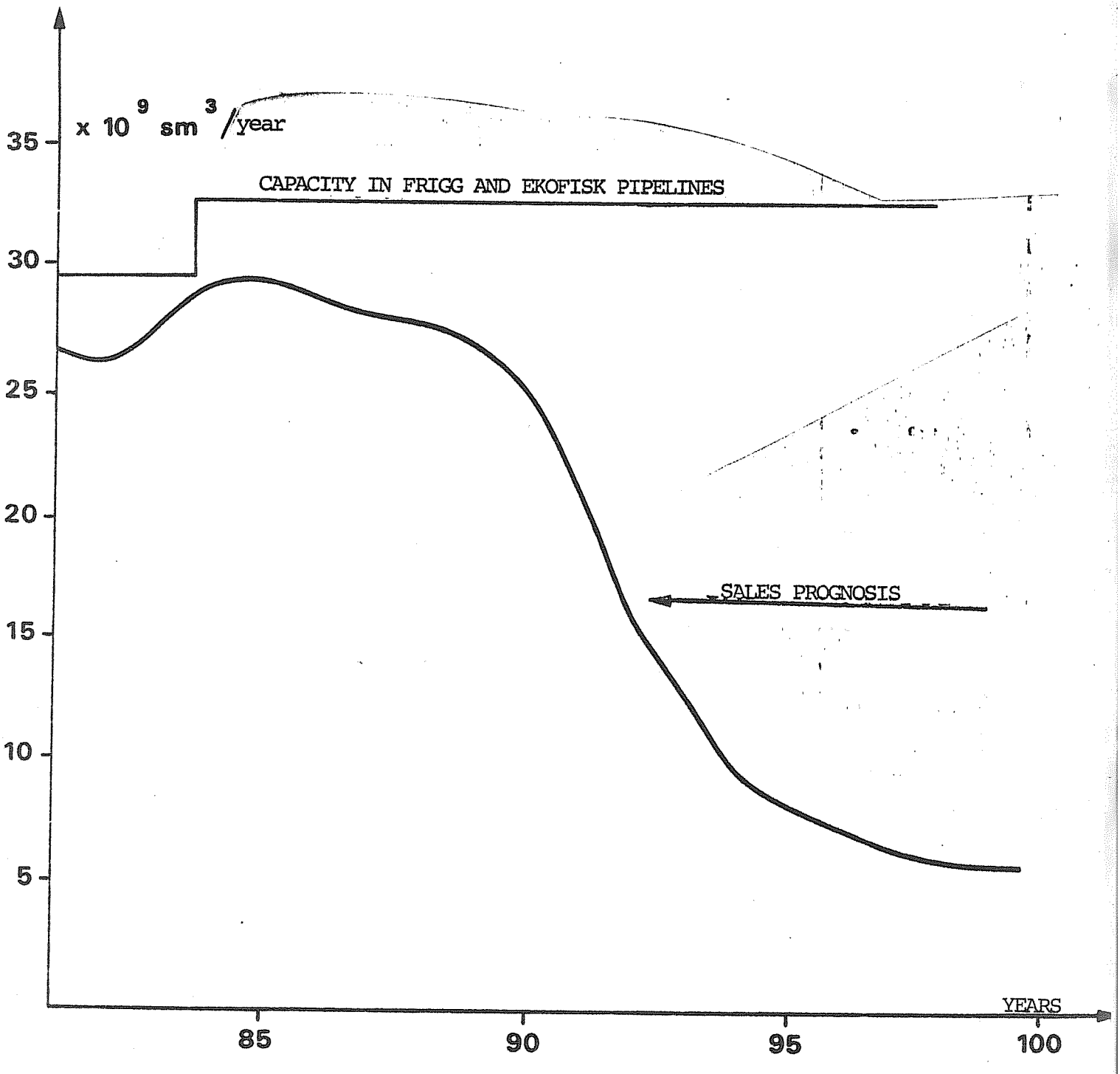


FIGURE 3.H



EXPECTED FREE CAPACITY IN FRIGG AND EKOFISK PIPELINE SYSTEMS

4. RESEARCH AND CONTRACTS WITH OTHER INSTITUTIONS

4.1. North Sea activity in a technical/historical perspective

The offshore petroleum activity is a relatively new development which does not go further back in time than 1945 when the first announcement of the areas in the Gulf of Mexico took place. Earlier, in the 1920's and 1930's, the oil industry had largely kept to land even though a good deal of drilling and production had taken place in shallow waters; mainly in lakes, bogs, and near coastal areas.

After the first movable platform had been introduced in 1949 in the Gulf of Mexico, a period of 20 years with rapid development in offshore petroleum technology followed. Towards the end of this period, at the same time as the North Sea activities began, it was, for the first time, relatively normal to drill in 100 meters of water.

The activity in the North Sea, first on the southern part of the British Shelf and later on the Norwegian part in 1965, still represented a considerable extension of the technology established so far. This was partly caused by a greater water depth, but also the considerably more difficult weather conditions in the North Sea compared to, for instance, the Gulf of Mexico.

The rapid development which has taken place in the North Sea since 1965 has had the effect that it is relatively normal today to produce from a water depth of up to 200 meters, even the technology for 300 meters has been developed. In view of the fact that most of the reserves remaining on the Shelf south of 62° N (including most of the discoveries in the 4th round blocks) are in water depths in excess of 300 meters, it is obvious that large research and development tasks are ahead for Norway within deep water technology. The outlook for future activities north of 62° N also lies in this direction, where more than 75% of the Shelf is covered with at least 300 meters of water. It should be stressed, however, that further development in offshore technology is a much too comprehensive task, demanding too great an extent of resources, for one nation to manage alone. International cooperation must still be the main basis for a satisfactory solution to this task. However, it is right and necessary for the oil and coast nation, Norway, to invest considerable domestic efforts in this field. Solutions adjusted to Norwegian conditions will also help other places of the world where a similar environment exists.

4.2. Public contributions in petroleum related research the Norwegian Petroleum Directorate's research involvement, extent and structure

It is neither right nor possible that the need for research within the oil activity shall always be dependent on public means and initiatives. It is natural that most research tasks dealing with the operating questions in connection with the activity on the Shelf should be solved on the initiative of the oil companies. This tends to suggest that the public contribution should be concentrated on public planning and management of the activity. Its aim should be to initiate studies needed as a basis for the activity, or to develop further on the operative research.

It should be possible to solve many of the tasks through reallocation of competence already developed as a result of the oil activities and its progressive integration into Norwegian industrial life and research. This applies to administration of both the means and of human resources. Personnel may turn out to be a serious limiting factor for the extent of the research efforts, and will require very close coordination and high priorities on the part of central authorities. Otherwise there is quite a danger that the public need for oil related research would be weakened in comparison with operative research tasks.

With the importance gained by petroleum activities in the Norwegian economy and society, time is starting to get short for an increased contribution to research and reports in this area. If they wish for the benefits from the oil activity to materialize for the whole of the Norwegian society, the political consequences of different measures must be evaluated before they are enacted. In this connection there will, among other things, be a need to study the interrelationships between the different parts of the oil operations, between offshore and land related activities, and between the activity and human life in general.

In connection with the research need for central planning purposes, there are a number of research tasks within the traditional petroleum subjects which should be given high priority. On the basis of the tasks assigned to the Norwegian Petroleum Directorate, these research assignments may be grouped into two main categories, those related to safety, and those related to administration of resources on the Shelf.

When the SPO, SSB, and SPS programs are completed in 1981 and 1982 respectfully, the project will probably continue covering the whole safety field. The project will also be of a different nature.

In the future the Norwegian Petroleum Directorate will actively support research so that the attention/stimulus given to safety research will not be weakened.

Based on the experience now gained from the programs going on, it is obvious that the basic research and research/project development should be left to the Norwegian Research Council for Technology and Natural Science (NTNF). It is important, however, that the Norwegian

Petroleum Directorate takes an active part in the relevant management committees etc. for these type of NTNF projects.

The Norwegian Petroleum Directorate's research/study should concentrate on the relationships which have a direct effect on the bases for evalutions, regulations, and guidelines which the Directorate has given today and which will be developed further.

As concerns research tasks related to resource administration, major benefits may reasonably be expected with relatively modest means. This may involve either improved knowledge on surveying or recovery or an improvement in the way in which they are used. An improved survey of the resources will mean an increase in the riches which Norway may dispose of, while an increase in the recovery factor will increase the quantity of oil and gas which may be recovered on the surface from deposits underground. As an illustration of the potential values which may be achieved, an increase in the recovery factor of one percent from an expected average of 35% to 36% will represent an increase in the quantity of recoverable petroleum expected south of 62°N of 150 million t.o.e. or about NOK (1980) 200 billion at the present oil price. Similar gains are associated with proven reserves south of 62°N, presently in the order of magnitude of 2,300 million t.o.e., which would measure up to 70 million t.o.e. or NOK (1980) 85 billion at the present oil price. These gains may reasonably be expected through efforts in geological, geophysical, and reservoir research measured in 2 digit or possibly 3 digit figures in Norwegian kroner.

As an illustration of the research groups directed with better resource surveying, these naturally fall into three categories:

- Basic research directed at increased understanding of the fundamental processes which cause the forming and migration of hydrocarbons in sedimentary basins. Furthermore, the changes in the reservoir rocks which are important for accumulation of oil and gas, such as the forming of porosity and permeability.

- Improvement in the methods used in the exploration and delineation phase, and, above all, in the gathering of geophysical data, processing, and methods of interpretation. Furthermore, the method used to predict reservoir quality within an area on the basis of well data. Central in this instance are paleontological, palynological, sedimentological, and petrophysical methods.

- Progress in drilling technology which will make it possible to drill deeper and more problematic prospect types than are routine at present.

As concerns the tasks directed towards greater production, the main emphasis at present should be on the systematic and coordinated development of expertise in reservoir technology. With the very scarce human resources available, a priority must be given so that expertise is duplicated to the least possible extent in several institutions. Both public and private means must be channeled so that the instituions already established develop expertise within the different professional areas. Above all there is a need for

comprehensive coverage of the varying needs within laboratory services, computer expertise for development and maintenance of mathematical simulation models, increased utilization of the geo subjects in reports on reservoir technology, increased capacity to study the relationship between the reservoir rocks and the liquids used for injection etc. In addition there is a need to look at the improvement in the present possiblities in different patterns for the allocation, better completion methods, production control, better and more efficient methods for reservoir monitoring, better methods for reservoir stimulation with a view of increasing the productivity from wells etc.

It should not be an unreasonable objective for Norway to make efforts as soon as possible to contribute to international research in new methods for increased recovery, such as through the use of special liquids or gas.

Another main field for increased research and studies is that aiming at increased efficiency and development in the development and operating phase. The report from the Moe committee has pointed out a number of areas where it is possible to reduce the cost per produced unit of petroleum. This mainly relates to better technical solutions, better steering in the planning and development phase, clearer coordination between the authorities involved in the decision process etc. In addition to these and other possibilities of obtaining better operations, there is considerable excitement in increasing the utilization of the facilities so that more resources are tied in with existing or planned facilities to a degree technically possible and economically desireable. Examples of valuable subjects for study in this connection are wells, stream transfer, one phase high pressure transfer, joint utilizaton of treatment facilities for crude oil and gas, joint storage and transportation, joint use of channels, increased efficiency e.g. through improved energy consumption, increased operation regularity etc.

4.3. Safety and research preparedness

4.3.1. Background and objectives

As concerns the background and objectives for the research projects within preventive safety and preparedness, reference is made to the Norwegian Petroleum Directorate's Annual Report for 1979.

4.3.2. Development and Status

The year 1980 was the third year of the SSB and SPO programs, and the two programs are starting their completion phase. The initiation phase was characterized by a large number of study projects which were started within narrow economic frames and time schedules. The intermediate phase was characterized by extending the economic limits for some projects, new projects were added, and the short-term projects were completed. The final phase will be characterized by the remaining existence of a small number of projects within professionally important areas. This concentration makes it possible to increase the economic framework for these projects.

The financing of the research programs consists of an annual allocation from the budget of the Ministry of Local Government and Labor of about NOK 8 million. For 1981, the allocation is of the same order of magnitude.

In addition to the public contributions as controlled by the Norwegian Petroleum Directorate, the operator companys have contributed in 1980:

	NOK 4 000 000	to SSB-project 2.2
	NOK 666 667	to SSB-project 3
	NOK 936 000	to SPO-project 1.2
	NOK 1 466 667	to SPO-project 6
SUM	NOK 7 069 334	

In addition, Statoil has taken upon itself the task of carrying on important parts of SSB-project 4.3.

For 1981, the operator companies have been asked to contribute NOK 10 101 000 to the research programs as direct financial support. In addition, some operators have been asked to assume the follow up of special projects.

4.3.3. Planning of the completion

In order to secure a sound completion of the two programs directed by the Norwegian Petroleum Directorate, cooperation with the central organization of the Norwegian Research Council for Technology and Natural Sciences (NTNF) and other authorities has been escalated. As part of this cooperation, the project manager for the SSP program was partly engaged by NTNF in 1980. In the last part of 1980, the Norwegian Petroleum Directorate, other authorities involved, and NTNF prepared proposals for principal guidelines concerning the follow-up of the programs.

As concerns the SSB- and SPO-programs, it is planned that these will be finalized in 1981. The Norwegian Petroleum Directorate plans to follow up some activities with a special research budget.

It is planned, however, that the research and development activity shall mainly be taken care of by NTNF.

4.3.4. Project Summary

SSB-program

Up to now, the Ministry of local government and labor has contributed about NOK 9.6 million to the SSB-program. In addition, the industry has contributed NOK 4.6 million. The means have been distributed amongst the following projects:

1.	THE EMERGENCY PREPAREDNESS SYSTEM	
1.1	The emergency preparedness system	Not started
1.2	Supreme - emergency preparedness - cooperation (the OBS project)	The project is being carried out by the Norwegian Institute for Ship Research. Possible follow-up is being considered.
1.2.1	Emergency preparedness plan for movable drilling rigs	The project is being carried out by the Norwegian Institute for Ship Research. Possible follow-up is being considered.
1.2.2	EDP-based information system for the preparedness and rescue service	The project is being carried out by the Norwegian Institute for Ship Research.
1.2.3	Training program for auxiliary vessels	The project is being carried out by the Norwegian Institute for Ship Research. Possible follow-up is being considered.
1.2.4	Emeregency training in introduction courses	The project is being carried out by the Norwegian Institute for Ship Research. Possible follow-up is being considered.
1.2.5	Working conference concerning the auxiliary vessel	The conference was arranged by the Norwegian Institute for Ship Research in co-operation with the Norwegian Petroleum Directorate. The results from the project will be carried on in 1981 under SSB project 2.2

1.3	Decision basis	Ref. SSB projects 2.1, 3.1, 4.1, 4.6 and 4.10.
1.3.1	Large accidents in Norway	The project will be started in 1981 and will be carried out by Det Norske Veritas.
1.4	Tasks related to the emergency preparedness system.	
1.4.1	Simulation - Disaster - Shelf (SIKAS project)	The project will be carried out by the Norwegian Institute for Ship Research. In 1979, the project was carried on under the direction of the State Pollution Control Authority.
1.4.2	Design of a Main Rescue Centre	The project will be carried out by the Norwegian Institute for Ship Research. Possible follow-up is being considered.
1.5.	Authoritative and responsible relationships	The project was carried out by the Norske Veritas, and has remained in assistance of the authorities' own work.
2.	HUMAN LIFE AND HEALTH	
2.1	Human life and health. Analyses - criteria	Start-up of the project in 1981 by Det norske Veritas is evaluated.
2.1.1	Evacuation of offshore installations	The pilot project was carried out by Det Norske Veritas. The financing of continuation is being considered.
2.2	Evacuation by sea	The project is carried on by Det norske Veritas. In 1980, the project was financed by the Norwegian Industry Association for Operating Companies (NIFO). NIFO has also been asked to finance the project in 1981.
2.2.1	Evacuation aspects concerning "Offshore system for personnel transport and evacuation".	The project was performed by Kongsberg Engineering A/S Maritime Project Group.
2.2.2	Free-fall rescue system for the offshore oil activity.	The project was carried on by the Norwegian Institute for Ship Research. From

		1980, it was continued under SSB project 2.2.
2.2.3	Personnel and goods transfer system between offshore structures.	The project was performed by Jarle Wanvik. The project was carried on from 1980 under SSB project 2.2.
2.3	Evacuation by helicopter.	The project was carried out by the Norwegian Institute for Ship Research. The preliminary project was postponed in 1978, but was started again in the spring of 1980.
2.4	Rescue suits/helicopter transportation	The project was carried out by the Norwegian Institute for Ship Research.
2.5	Medical information system	The project is being performed by the State Institute for National Health. The financing of continuation is being considered.
3.	DIVING PREPAREDNESS	
3.1	Risk analysis	The projects are performed by thethe Norwegian Underwater Institute in cooperation with Det norske Veritas. In 1980 the projects were partly financed by the Norwegian Industry Association for Operating Companies (NIFO). NIFO has been asked to finance the projects in 1981 also.
3.2	Manned test of rescue chambers/diving bell connection to the surface uninterrupted.	
3.3	Energy systems/energy package for rescue chambers.	
3.4	Testing of existing gas-preheaters, and, where nec-, cessary improving these.	
3.5	Emergency preparedness/ actions/operational guide-lines. Technical evaluation equipment.	
3.6	Connecting of life support to sunken/lost manned submarine vessel.	
3.7	Medical furnishing of location where injured	

	diving personnel are received.	
3.8	Reheating of diver having suffered hypothermia.	
4.	FIGHTING THE SOURCE	
4.1	Fighting the source. Analyses - criteria	Not started.
4.2	Emergency preparedness upon indications that a well is not under full control	The pilot project was performed by SINTEF in 1979. In 1980 the project was carried on by Statoil in co-operation with Rogaland Research and Scandpower. The follow-up of the project in 1981 is being considered.
4.3	Well control in case of offshore blow-outs	The pilot project was carried on in 1978 by SINTEF in cooperation with the Norwegian Institute for Ship Research and the Central Institute for Industrial Research. In 1979, the project was carried on by SINTEF. Statoil and the PFO program assumed the follow-up of important parts of the project in 1980 upon request from the Norwegian Petroleum Directorate. The secretarial function for the Norwegian Petroleum Directorate's follow-up group as well as total reporting of the project is is taken care of by the Norwegian Institute for Ship Research, Trondheim.
4.4	Drilling of relief wells in case of uncontrolled blow-outs	The project was carried out by Rogaland Research in co-operation with PETCON.
4.4.1	Accurateness when surveying drilling holes	The project is being carried out by SINTEF. The Financing of continuation is being considered.
4.4.2	Instrument development for localization of drilling holes	The project is being carried out by SINTEF. The financing of continuation is being considered.
4.4.3	Flow detector	The project is being carried out by Chr. Michelsen's Institute. The financing of

		continutation is being considered.
4.6	Fire and explosion danger in connection with gas spreading during uncontrolled release of hydrocarbons.	The project is carried out by OTTER in cooperation with SINTEF, the Norwegian Institute for Air Research and the Waterways and Harbour Laboratory. The financing ofcontinuation is being considered.
4.7	Fire Preparedness	
4.7.1	Fire Preparedness on platforms	The project is being performed by Det norske Veritas Completion is planned for early 1981.
4.7.2	External Fire Preparedness system.	The project is being carried out by Det norske Veritas. The financing of continuation is being considered.
4.8	The properties of the vessel	
4.8.1	Evaluation of requirements concerning dynamically positioned ships and platforms	The project was carried out by the Chr. Michelsen´s Institute.
4.8.2	Ship in Heavy Seas (The SIS-project)	The project was carried out by the Norwegian Institute for Ship Research.
4.8.3	Tension surveys for new types of mooring arrangements	The project is being carried out by the Maritime Directorate. The financing of continuation is being considered.
4.9	Preparedness when in danger of collision	Norpipe is working on the project at their own cost.
4.10	Criteria for decisions when constructions have been damaged.	Det Norske Veritas is working on the project at their own cost.
	Financial assistance for preparatory work for research programs proposed by the Maritime Directorate, concerning the safety on moveable drilling platforms.	

THE SPO PROGRAM

In the period 1978-1980, the SPO program has been allocated approx. NOK 10.8 million by the Ministry of Local Government and Labour. In addition, the industry has contributed about NOK 2.4 million. The means have been distributed to the following projects:

1.	DRILLING	
1.1	Safety optimalization in connection with drilling.	The project was carried out by SINTEF.
1.2	Simulator for well control	The project was carried out by SINTEF. The simulator will be produced by A/S Seagull in Horten. In 1980 the project was financed by the Norwegian Industry Association for Operating Companies (NIFO).
1.3	Completion and maintenance of production wells	The project was carried out by Rike Services, New Orleans, in cooperation with the Norwegian Petroleum Directorate.
1.4	Subsea systems for oil and gas production	The project was carried out by Kongsberg Våpenfabrikk.
1.5	Inspection routines for drilling equipment	The project was carried out by the Norwegian Institute for Ship Research.
1.6	Casing design	The project was carried out by SINTEF.
1.7	Cementing in wells (pilot project)	The project was carried out by SINTEF.
1.7	Cementing in wells (main project)	Not started
1.8	Damage in connection with the handling of pipe on the drilling deck	The project was carried out by Rogaland Research.
2.	CONSTRUCTION	
2.1	Control of the state of pipelines	Performed by the Petroleum Directorate. Financing of continuation is under review
2.2	Internal corrosion in offshore pipelines	Executed by Det norske Veritas. Financing of continuation is under review

2.3	Guidelines for evaluation of platform concepts from a safety point of view	Executed by Det norske Veritas in cooperation with the Petroleum Directorate.
2.4	Procedures for sub-marine pipelines	Executed by the Petroleum Directorate.
2.5.1	Inspection of the state of the structures	The project was carried out by Hollobone Hibbert, England.
2.5.1	Inspection of the state of structures II	The project was carried out by Hollobone Hibbert, England.
2.6	Mounting of a corrosion probe in cement in the shaft wall on Statfjord B	The project was assigned to the Research Central for Cement and Concrete - NTH, but has been postponed.
2.7	Exhaustion of offshore steel constructions	The project is being carried out by SINTEF/Det norske Veritas. The project is part of a large European project. Financing of continuation is being considered.
2.8	Copper penetration in anode fixtures on risers	The project was carried out by Det norske Veritas.
2.9	Selection of corrosion coating for offshore pipelines	The project is being carried out by Battelle, Switzerland with 16 contributors from several countries. The project is expected to be concluded in 1981.
3.	SAFETY	
3.1	Work conference - protection and environmental work	The conference was arranged by the Norwegian Institute for Ship Research at Jæren Hotel, Bryne, 19 - 23 June 1978.
3.1.1	Work conference - protection and environmental work	The conference was arranged by the Norwegian Institute for Ship Research at Jæren Hotel, Bryne, 28 Jan. - 1 Feb. 1979.
3.1.2	Work conference - protection and environmental work	Two conferences were arranged. The first was held in Haugesund, 21 - 24 April 1980, and was carried through by the Norwegian Petroleum

		Directorate in cooperation with the Norwegian Institute for Ship Research. The second conference was carried through by the Norwegian Petroleum Directorate at Jæren Hotel, Bryne, 20 - 23 Oct. 1980.
4.	PRODUCTION	
4.1	Collection of data and processing (Pilot project, part I)	The project was carried out by PA Management Consultants England.
4.1.1	Collection of data and processing (Pilot project, part II)	The project was carried out by T R Moss, England.
4.2	Safety valve arrangement	The project is being carried out by SINTEF
4.3	Fire classification for mechanical equipment	The project was carried out by the Research Program Systems for Safe Shipping.
4.4	Detection systems for gas/fire	The project was carried out by Det norske Veritas.
4.5	The minimum criteria for inspection of processing equipment	The project was carried out by Atkins Planning, England.
4.6	IFAC/IPPI Automation for safety - conference	Arrangement of conference held in Trondheim 16 - 18 August 1980. SINTEF was responsible for arranging the conference.
4.7	Supervision of the state of processing equipment	The project was carried out by Det norske Veritas in co-operation with Cranfield Institute of Technology, England.
4.7.1	Emergency shut down systems	The project is being carried out by Det norske Veritas in cooperation with Cranfield Institute of Tecnology, England. Financing of continuation is being considered.
4.8	Detection of leakage by acoustic emission	A preliminary study performed by SINTEF in cooperation with Unit Inspection, Wales. Possible follow-up is being considered.
4.9	Protection of platforms	The project is being carried

	against damage by lightning	out by the Electrical Supply Research Institute. Financing of continuation is being considered.
4.10	Recording of lightning discharges	The project is being carried out by the Electrical Supply Research Institute. Financing of continuation is being considered.
4.11	Fire in electrical cable installations	The project was carried out by the Electrical Supply Research Institute.
4.12	Maintenance of offshore processing installations	The project is being carried out by the Norwegian Institute for Ship Research in cooperation with Atkins Planning, England. Financing of continuation is being considered.
5.	INFORMATION SYSTEMS	
5.1	Basic inspection strategy	Arrangement of "brain-storming" meeting at Hovda Gård 4 - 6 Sept. 1978. The Norwegian Petroleum Directorate was responsible for the arrangement.
5.2	Collection, processing and use of data - Databank (Main Project)	The project is being carried out by Rogaland Research. Financing of continuation is being considered.
5.3	Information system concerning offshore related and petrochemical research and development projects - INFOIL II	The project is being carried out by the Norwegian Petroleum Directorate in co-operation with the Norwegian Centre for Informatics. Financing of continuation is being considered.
5.4	Preparation of reliable data manuals.	The project is being carried out by Rogaland Research in cooperation with Det Norske Veritas. Financing of continuation is being considered.
6.	DIVING	
6.1	Detection of decompression bubbles	

6.2	Personal diving equipment	
6.3	Diver communication	The projects will be carried out at NUI. Some of the projects took place in 1980 financed through the Norwegian Industry Association for Operating Companies (NIFO). NIFO has also been requested to give financial support in 1981.
6.4	Work effort limitations	
6.5	Physiological supervision	
6.6	Communication and supervision techniques	
6.7	Decompression	
6.8	Prolonged effects from diving	
6.9	Oxygen limitation for diving	
6.10	Preparation of regulations for dynamic positioning and diving	The projects was carried out by Hollobone Hibbert, England, on assignment from the Department of Energy, England, and the Norwegian Petroleum Directorate.

4.4. Assignments to scientific institutions

Partly on the initiative of the research institutions and partly from the Norwegian Petroleum Directorate, geological and geophysical surveys have been performed with financial contribution from the Norwegian Petroleum Directorate:

These surveys are clearly connected with the Norwegian Petroleum Directorate's tasks and are an integrated part of the petroleum related research on the Continental Shelf.

In 1980, NKr. 1.5 million was allocated (NKr. 1,552,550) to 16 projects:

PROJECT	RESEARCH INSTITUTION
Processing of seismic data from the Antarctic	The Earthquake Station, University of Bergen
Obtaining a seismic refraction profile between Scotland and Southern Norway	The Earthquake Station, University of Bergen
Continental Ridge Project	The Earthquake Station, University of Bergen
Continental Shelf Surveys 1980	The Earthquake Station, University of Bergen
Sandstone Diagenese	Geological Institute, Dept. A University of Bergen
Petroleum related study of sedimentary rocks along the Hornsund-Sørkapphøyden, Svalbard and the areas to the north	Geological Institute, Dept. A University of Bergen
Permian-Triassic project	Geological Institute, Dept. A University of Bergen
Sedimentological studies of Mezozoic from the Norwegian-Danish basin, North Sea	Institute for Geology, University of Oslo
Paleontological and sedementological studies in the Jurassic layers, central North Sea and Yorkshire	Institute for Geology, University of Oslo
Tertiary (eocene-pliocene) sediments' textural, mineralogical and geochemical composition	Institute for Geology, University of Oslo
Paleonological surveys	Institute for Geology, University of Oslo
Faults and breach techtonics in the Barent Sea region	Institute for Geology, University of Oslo
The North Sea and the Norwegian Continental margins' tertiary deposits	Institute for Geology, University of Oslo
Marine geological research	Institute for Geology, University of Oslo
Organic geological chemistry, Svalbard	Institute for Continental Shelf Research
Migration Studies	Institute for Continental Shelf Research

4.5. Scientific Surveys and Release of Data

4.5.1. Scientific Surveys

As of December 31st, 1980, a total of 127 licences for scientific research on the Norwegian Continental Shelf have been granted. As appears on table XVIII, 11 such permits have been granted for 1980.

This mainly relates to geophysical and geological surveys and some biological surveys.

From a geographical point of view the surveys are distributed over the whole Norwegian Shelf.

TABLE XVIII

LICENCES FOR SCIENTIFIC RESEARCH FOR NATURAL RESOURCES

Licence	Name	Field			Area
		Geophysics	Geology	Biology	
117	Institut für Meereskunde University of Kiel	X	X		Skagerak
118	Natural Environment Research Council Research Vessel Services South Wales	X			Touching the Norwegian Shelf in Field 1 and 2 when turning equipment around
119	The Norwegian Geological Surveys		X		The Fjord area west of Ålesund
120	DAFS Marine Laboratory Scotland		X	X	Off the west coast of Norway
121	The University of Tromsø The Institute for Biology and Geology		X		In the fjords Malangen and Lyngen
122	Natural Environment Research Council Research Vessel Services South Wales	X			A line between Edinburgh and Kristiansand
123	The Royal Swedish Science Academy, The Royal Naval Society and the Society for anthropology and geography	X	X	X	Areas around Svalbard
124	Norsar	X			South of Lista
125	The Norwegian Polar Institute	X	X	X	Areas between Norway and Svalbard
126	The University of Bergen The Earth Quake Station	X			The Faroe-Shetland slope
127	DAFS Marine Laboratory		X	X	Areas on the border towards the English shelf

4.5.2. Release of Data

The Norwegian Petroleum Directorate may release geological material and interpret the data from the Continental Shelf when this is more than 5 years old.

The Directorate has not released the interpretation of the oil companies. Each year, a summary of the wells completed five years previously is published. This publication, "Well Data Summary Sheets" gives information about each well in the form of a rough geological summary, tables showing where casing has been set, what logs have been run, whether core samples have been taken and possible test results.

The purpose of this series is to show what wells are in the process of being released and what core and log material is available from the different wells.

Uninterpreted logs have been released for sale when the well has been presented in the "Well Data Summary Sheets".

All wells completed before 1976, a total of 139, have up to now been presented in 6 volumes of the series. Volume 6, published in 1980, describes the following 21 wells which were drilled in 1975:

2/4-12	25/1-5	30/11-1
2/7-11	25/2-4	30/11-2
2/8-6	25/4-4	33/9-4
2/8-7	25/8-2	33/12-3
8/11-1	30/7-1	33/12-4
15/3-1	30/7-2	36/1-1
15/12-1	30/10-5	36/1-2

A more comprehensive geological description of the individual wells is presented in the series "NPD Papers" which shows a detailed literographical/stratigraphical log, geological interpretation and a summary of the geological material which is available.

In the course of 1980, 4 folders with a total of 15 wells have been published. At the end of 1980, 48 wells have been published in 28 folders.

In the table below, a summary is given of the folders published and the wells included in the individual folders.

Folder No.	Well	Folder No.	Well	Folder No.	Well
No 1	8/ 3-1	11	16/ 9-1	21	17/10-1
2	25/11-1	12	17/11-1	22	8/10-1
3	16/ 2-1	13	2/ 8-2	23	11/10-1
4	16/11-1	14	17/ 4-1	24	9/ 4-1,2,3
5	9/ 8-1	15	1/ 3-1,2	25	2/ 4-1,2,3,4,
6	16/ 1-1	16	7/12-1	26	10/ 8-1
7	2/11-1,2/8-1	17	2/ 3-1,2,3,	27	9/12-1

8	16/ 1-1	18	7/ 8-1	28	25/11-2,3,4,
9	16/ 6-1	19	2/6-1		25/10-1,2,3,
10	7/11-1,2,3,4	20	7/3-1		25/ 8-1

As the table shows, the wells have to a large degree been presented individually in each folder.

With this method of publication, it has turned out to be difficult to keep pace with the wells which have filled the requirements for being released. From and including 1980, the publication has been changed so that each folder contains several wells. The wells are selected on the basis of relevant fields and from regional priorities.

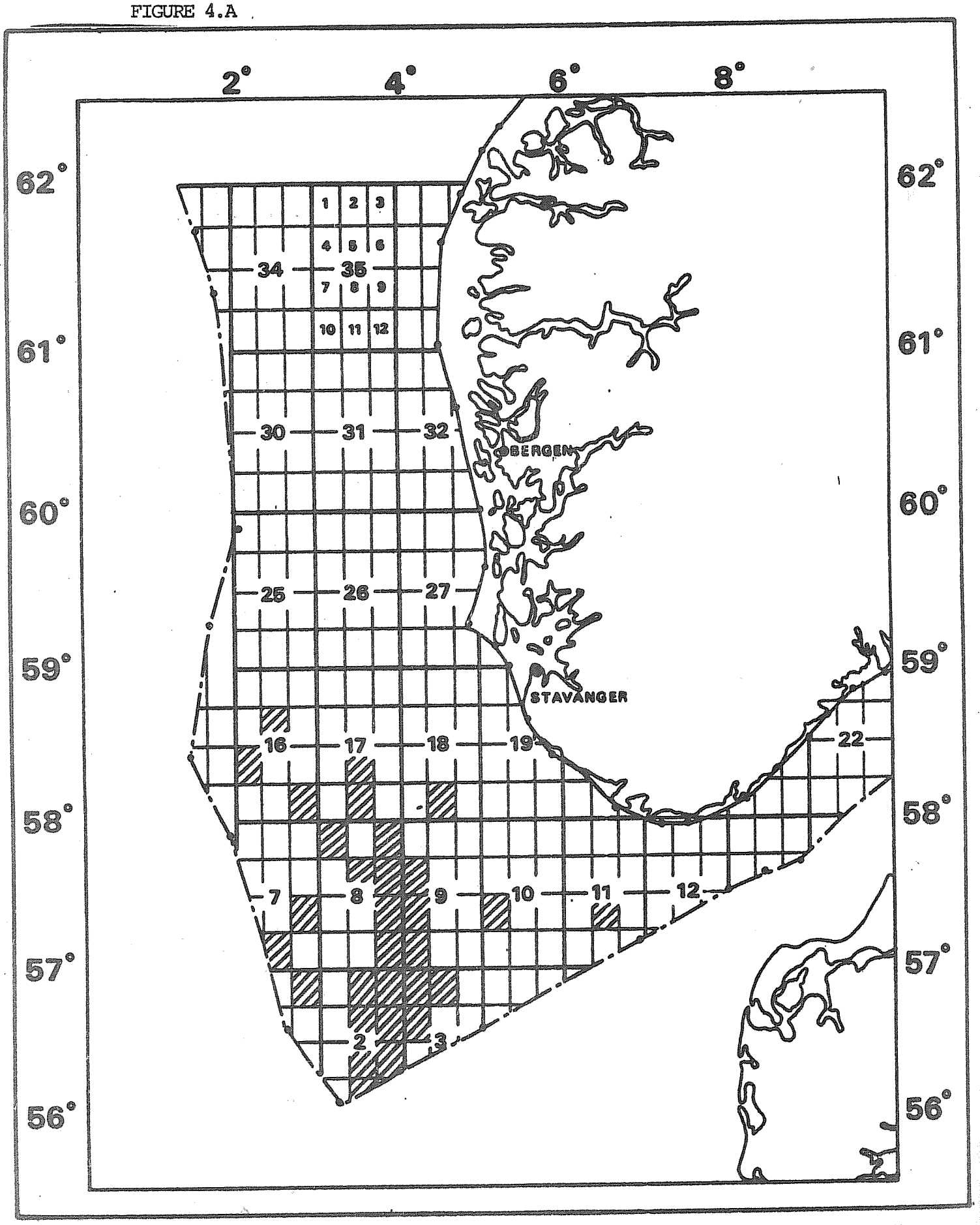
Geological material from wells that may be released will only be made available when the wells have been presented in "NPD Papers".

Seismic data has previously been released and sold in the form of single seismic lines. In 1979, the Norwegian Petroleum Directorate started to make larger packages within relinquished blocks. This work has continued in 1980. At present, about 14,000 kilometers of seismic lines are available from 32 relinquished blocks or parts of blocks. The price is the copying cost plus a reasonable mark-up for administration and postage.

Figure 4.A shows mapped indication of blocks where seismics have been released. The individual blocks are as follows:

1/3, 2/2, 2/3, 2/5, 2/6, 2/8, 2/9, 2/11, 3/1, 3/2, 3/4, 7/9, 7/11, 8/1, 8/3, 8/5, 8/6, 8/12, 9/4, 9/10, 10/7, 11/8, 16/5, 16/7, 16/12, 17/8, 17/11 and 18/11.

FIGURE 4.A



BLOCKS WHERE SEISMIC DATA IS RELEASED

5. CONTRIBUTION TO FOREIGN STATES

The Norwegian Petroleum Directorate's contributions to central authorities in connection with cooperation with other countries within the petroleum sector has continued to more or less the same extent as in previous years. On April 30th 1980, however, an agreement was signed with NORAD further regulating the cooperation between the two institutions in this sector. In accordance with this agreement, the Norwegian Petroleum Directorate will assist other countries through NORAD in the extent to which this may be incorporated in each individual case into the Norwegian Petroleum Directorate's other tasks. To cover the load which this work represents for the Norwegian Petroleum Directorate, NORAD is making available means corresponding to two man years.

A number of the Norwegian Petroleum Directorate's experts have participated in petroleum related projects, mainly in five cooperating countries, namely Tanzania, Portugal, Pakistan, Kenya and Mozambique. As regards the first three countries, this year's work represents a continuation of earlier cooperation, while the tasks were initiated in the course of the year in the case of the two latter countries.

In addition to projects supported by NORAD, the Norwegian Petroleum Directorate has also participated in discussions on cooperation with other countries, such as India and China, by participation in official delegations to these countries.

6. INTERNATIONAL HARMONISATION OF SAFETY REGULATIONS - INTERNATIONAL COOPERATION

The second north-west European conference on "Safety and pollution safeguards in the development of North-West European mineral resources" was arranged in Haag in the period 13th - 17th November 1978. The countries participating in the international harmonisation work are as follows: Belgium, Denmark, Ireland, France, the Netherlands, Norway, Great Britain, Sweden and the Federal Republic of Germany. The Haag conference prepared new terms of reference for Working Group III directed by Norway and Working Group III directed by the Netherlands.

Working Group II had its final meeting on 11th and 12th December 1979 and the final report is dated May 1980.

In accordance with the terms of reference, the Working Group has prepared a proposed certification system with a view to simplifying control procedures when mobile drilling vessels are moved from the Continental Shelf of one country to another.

Working Group III had its final meeting on 15th and 16th January 1980 in Haag. The terms of reference of the Working Group cover in particular subjects concerning safety, health and welfare of personnel. The final report was submitted to the participating countries by the committee chairman in a letter of July 2nd 1980. The part of the Working Group's terms of reference covering among other things injury statistics is taken care of by a Working Group under the direction of the EEC, where Norway is present as an observer.

As regards Working Group I, Great Britain is the leader of a group of experts who presented a final report on June 26th 1980. The report deals with data concerning the physical environment in the North Sea.

The Haag conference decided that a new conference should be held in the last quarter of 1980. The host country for this conference was not appointed. It seems to be clear, however, that Norway will be the host country for the next conference.

In connection with the work in the International Naritime Organisation IMCO, the Norwegian Petroleum Directorate was represented in 1980 by two representatives appointed as members of the Norwegian delegation to IMCO's sub-committee on standards of training and watchkeeping, 13th session.

The said sub-committee deals among other things with questions concerning manning and qualifications for personnel on mobile drilling vessels.

The Norwegian Petroleum Directorate has also been represented in the Norwegian delegation to IMCO's sub-committee on Ship Design and Equipment in connection with questions associated with legislation and supervision of diving systems on ships, etc.

INTERNATIONAL LABOUR ORGANISATION - ILO

In October 1977, a meeting of experts was arranged in Geneva to discuss safety questions related to the design and operation of offshore drilling installations within the oil industry. One of the conclusions of the meeting was that it was necessary to accept the standards of taking care of health and safety questions in the design of fixed offshore installations. The said guidelines cover production facilities, etc., not only drilling installations. This was on the basis of the discussions taking place, during which it was found, however, that the title of the working document distributed could not be changed. It was agreed, however, that both drilling and production installations should be discussed.

A wish was expressed from the representatives that guidelines should be prepared under the supervision of ILO. Furthermore it was an assumption that existing relevant standards for design activities should be taken into account, and that existing ILO recommendations concerning health and safety within the construction and shipbuilding industries should be incorporated in the guidelines. Furthermore it was widely agreed that one should also try to harmonise the guidelines with IMCO's rules.

On the basis of the said recommendation and in accordance with decisions made by ILO's superior body (Governing Body) in November

1979, an expert meeting was arranged in Geneva for the period 1st-10th December 1980 to prepare such guidelines. As a basis for the meeting, comprehensive draft guidelines were available as well as comments received from a draft that had been distributed earlier - sent to all ILO's member countries.

The expert meeting, which was composed of independent experts proposed by involved unions, employers' considerations and authorities as well as ILO's professional bodies, was able to complete its tasks.

It is now up to ILO's superior body (Governing Body) possibly already included in the next meeting in 1981, to approve the proposed guidelines for safety and health questions in construction of fixed offshore installations within the petroleum industry.

7. SUBJECT ARTICLES

7.1. Working environment problems over the use of mercury offshore

Introduction

For well testing of hydrocarbon saturated rocks, it is normal to use mercury by

- transfer of bottom hole samples (formation liquid) from submersible sample takers to transportable steel containers.
- transfer of oil/condensate extracted from the separator to the transportable steel containers.

When transfering bottom hole tests to transportable containers, this takes place by a manually operated mercury pump. The transfer system itself consists of a sample taker, a mercury pump and a transportation container with hook-up lines, and in mounted position this amounts to a closed system.

The transfer itself takes about 2 hours per test, whilst unhooking time will be about 10-15 minutes. The number of transfers per well may vary with the quality of the formation liquid, and it is not unusual to have three or four transfers per well.

By transferring oil from the test separator to the steel container, the separator pressure will force the oil extracted over into a permanently mounted steel bottle which is filled with mercury beforehand. As oil fills the bottle, the mercury will be displaced and collected in a measurement cylinder of gas. The transfer time for separator tests is about 30-45 minutes, and it is usual practice to take two such samples from each oil producing "drill stem" test.

Health Risk

Mercury vapour is very toxic and is inhaled into the lungs by respiration. As regards swallowing, however, mercury metal does not seem to be toxic.

Mercury and its combinations may be irritating locally and acidising towards the skin and mucous membranes.

Mercury may be easily absorbed through the skin, particularly in a finely dispersed form. The toxicity varies depending on the disassociation, but the joint mechanism is that the quicksilver ions are combined with the tiol groups of enzymes and block their activity. In addition, the albumen molecules are denatured.

The most usual symptom of quicksilver poisoning is, besides damage to organs, psychic disturbances.

The early stages of the pollution appear when the poisoned person becomes nervous, easily irritated, a volatile temperament and sudden bursts of anger. There is a great risk that these symptoms may not be associated with mercury exposure at first.

One of the sickness symptoms is shivering hands, which at a later stage may spread to other parts of the body such as eyelids, lips, tongue and legs. Inhalation of large concentrations over a long period may lead to serious damage of the nervous system and the kidneys.

The time taken for mercury absorption to halve for exposed persons has shown great individual variations. Newer research also shows that elimination curves for the body's total separation capacity may best be described as a multiphase curve. A halving time of 42 days has been proven for 80% of absorbed quicksilver by oral doses. Other experiments have shown a halving time of 1.5 years for mercury stored in the central nervous system.

Exposure

The inspection of exposed personnel (urine tests) who are involved in offshore well testing, has shown that the mercury exposure far exceeds the level which may be accepted on the basis of governing safety and occupational hygiene norms. In some cases, the mercury separation in urine has been up in 1,5000 nM.

It is difficult to quantify to what degree the sample taking crews may be exposed to mercury by transfer of bottom hole tests. During pressure testing of the equipment, the operator must bleed mercury through several valves, with the risk of mercury exposure. The danger from exposure will also be present in loading the pump cylinder and disconnecting the transportation container unless care is taken in the work. By taking samples from the test separator, the risk from mercury exposure will be largest in case of mercury spills by transfer from measuring glasses to bottles as well as by filling up with mercury from steel bottles.

Monitoring of Work Operations

Well testing of hydrocarbon-containing rock formations in the North Sea is performed by contractor companies with sample taking as a special field. Normally, two people from the contract company are involved in this type of work where the risk from mercury exposure is present.

It is the operator company's production foremen who are work supervisors when samples are taken. Because of the hectic activity that may occur during well testing, the contractor's sample operators will frequently be exposed to heavy work pressure.

The Norwegian Petroleum Directorate has pointed out the importance of personnel involved in sample taking being given sufficient time to mount and demount and clean equipment as well as time for personal hygiene before they continue other work.

To ensure that these requirements are fulfilled, the operator companies have been ordered to appoint a representative who is responsible for all work with mercury being performed in a sound manner from a health point view. The relevant person shall have sufficient competence in occupational hygiene to evaluate whether the work is performed in accordance with accepted guidelines for industrial handling of mercury.

The operator's responsible person shall in particular be aware of the following circumstances:

1) Work with mercury requires good ventilation, preferably with suction point. Where there is danger from quicksilver vapour, a safety mask with a filter (brown-red) or fresh air apparatus shall be used.

2) In the case of work processes where there is a danger of skin and eye contact, tight safety goggles or a face mask, safety gloves, apron and work clothing of smooth material without pockets and folds should be used.

3) When the work is finished, fingers and nails should be well brushed with soap and water. The nails should be cleaned and thoroughly inspected. Anyone who has helped to collect mercury must also brush the fingers and nails in case of sprays or leaks.

4) Shoes and stockings should always be checked for mercury at the end of the work, even if no sprays or other spills of mercury have occurred.

5) Never use aluminium objects in connection with mercury, since aluminium will be quickly and totally destroyed.

6) Objects of silver and gold form amalgams with mercury. Apart from the fact that the objects will lose their lustre and therefore will be spoiled, such amalgamed objects (for instance rings, watches, etc.) will be a steady source of mercury contact with the skin.

7) It is prohibited to smoke or eat when working with mercury. Before smoking or eating, the hands should be thoroughly washed with soap and water. Work clothing should be kept separate from day-to-day clothing, preferably in a separate wardrobe.

8) When filling sample bottles with mercury and mounting on a test bench, this work shall be performed over a steel or plastic plate which effectively limits possible spills of mercury. When collecting mercury, one must avoid breaking up larger drops into smaller ones because of the increased surface area and thereby increased vapourisation.

9) Storage containers for mercury shall be sealed with tape and stored in sealed plastic containers.

10) Equipment which has come into contact with mercury (transfer benches, sample equipment, pumps, pistons, etc.) must be thoroughly cleaned after work.

For monitoring offshore mercury exposure, the test operator is ordered to give urine samples before and after well testing. Furthermore, the Norwegian Petroleum Directorate shall receive a report with a description of the sample taking as soon as possible after the taking of samples has ended, as well as time for transfer and name and birthdate of involved personnel.

The operation's personnel responsible for the sample taking is responsible for preparation of this report.

Evaluation

By evaluation of the analysis results from mercury separation in the urine, the Norwegian Petroleum Directorate will (upon recommendation from the Institute for Occupational Hygiene and the Labour Inspectorate) comment on the figure values as follows.

Less than 100 nM U-Hg: no occupational exposure to mercury. Equipment and work procedures shall be laid out in such a way that the test operators will satisfy this norm.

100-200 nM U-Hg: occupational exposure to mercury. The exposure is controlled quarterly with urine samples. Damage to health is not known at this level.

200-500 nM U-Hg: the work site should be inspected. Measures should be implemented to reduce/eliminate exposure. The result of the improvement on the work site is controlled by monthly urine samples of exposed persons.

Over 500 nM U-Hg: occupationally unacceptably high exposure. Employees with mercury exposure in this area shall immediately be removed from mercury exposed work. The working conditions shall be improved and the exposure shall be brought under control. A return to work shall not take place until after a medical evaluation and the results of the urine test are received.

It has turned out that the exposure giving U-Hg values over 1000 nM may have injurious effects on the central nervous system, in the worst cases with irreparable damage.

Preventive Measures

The demand for suspension of mercury exposed personnel with urine mercury values higher than 500 nM is above all a preventive medical measure. In connection with the ventilation, the relevant work site must be surveyed and improved so that further mercury exposure may be reduced/eliminated.

In the view of the Norwegian Petroleum Directorate, the existing test bench for bottom hole tests does not satisfy the requirements which must be stipulated for sound handling of mercury from an occupational hygiene point of view.

Against this background, the Norwegian Petroleum Directorate has presented demands for the introduction of improved

equipment/techniques on January 1st, 1981 for this type of work. In particular, the order comprises an evaluation of the introduction of equipment where transfer of formation liquid may take place without the use of mercury.

7.2. Petroleum documentation

Our petroleum industry is an expansive and modern activity presenting extensive demands to the different information channels. Knowledge of what takes place in the research and development work, public decisions, applicable laws and regulations, statements on topical matters both from professional quarters, political quarters and the society is very important. The information must be obtained as soon as it is present, whether it is in the form of news reports, press briefs, professional articles, speeches, legal text, research reports or similar.

A well organised library and documentation service is the cornerstone in the gathering of such information.

With the help of modern technics as represented in particular by computer technology, libraries, professional information and documentation (the bid sector) are made more effective than before. Traditional manual literature search, which is very time consuming and the result of which is frequently less than satisfactory, is for example to a large degree replaced with some few minutes of active work at the data terminal which is directly connected with so-called literature data bases.

Literature Data Bases

A literature data base consists of large quantities of information stored in computers for on-line accessibility. The user of the system is then in direct communication with the relevant data base, and may in a dialogue with the computer influence give directions in all phases of the information search. This requires that the user has the type of data terminal which through the telephone network and satellite system may reach the computer where the desired data base is stored (fig. 1), and that he can use the search language required by the data base.

The information contained in general by literature bases is biographical information about the document, that is to say reference to the author(s), title, the name of the document, the publisher, the page number etc for journals, articles, research reports, books, standards and patterns, regulations, public volumes, speeches and possible other public types. Quite frequently a summary of the content of the publication is also given in the form of a brief or an alphabetical listing for describing subject words.

There are special data bases for most of the subject areas or disciplines. The bases are made available to users all over the world by special data base suppliers. In California, USA there are

the Lockhead Information Systems and the Systems Development Corporation (SDC), and in Europe, the European Space Agency (ESA) which is situated in Italy.

Foreign petroleum data bases

With particular emphasis on petroleum related activity, there are several literature data bases of very high quality, those most used are:

TULSA

which is the data based version of the reference journal Petroleum Abstracts from the University of Tulsa. This data base presently consists of more than 200,000 literature references concerning petroleum exploration, extraction and production, including professional areas such as geology, geophysics and geochemistry, drilling, logging, reservoir technology, production technology, transportation and storage of oil and gas, ecology, pollution and alternative energy forces. The base covers the literature from all over the world back until 1965.

The data base is through a corporation with the interested parties (INFOIL) made available for Norwegian users.

API

The American Petroleum Institute (API) has several relevant and recognisable data based services for the petroleum industry:

APILIT which contains references to literature on refining and the petrochemical industry.

APIPAT which makes reference to patterns within the same subject areas.

P/E NEWS or Petroleum Energy News which has information about petroleum and energy economics from five recognised journals on petroleum economy.

For Norwegian users, only P/E News is generally available among API's literature services. Access to the other bases may only be obtained on special conditions which Norway has still not fulfilled. Most of the foreign oil companies working on the Norwegian Continental Shelf, however, have access to the valuable information contained by these data bases through their mother companies.

Both Tulsa and the API Services were originally started upon the initiative of the American oil industry with the task of making topical and relevant information available for all "subscribing" oil companies. Through this the individual companies could dispand their internal overlapping services of this type.

GEOREF

Geological Reference File (Georef) is issued by the American Geological Institute and covers all disciplines within geology as well as closely associated subjects. References are made to both

journals and literature from all over the world. The data base consists at present of more than 500,000 references and goes back to 1961.

GEO-ARCHIVE

is the name of a similar data base issued by Geosystems in London. The base covers the same professional subject areas as Georef, but is concerned with the coverage of European and Asiatic publications. Geo-archive is a relatively new service. the coverage goes back until 1969 with a total of approx. 400,000 references.

Other literature data bases

It is recognised that the petroleum activity is not an exact, closely defined subject area. Most technical and theoretical subjects are in one way or another involved in the activity. This means that the term "petroleum documentation" must involve all the special literature data bases which are available from the different data base suppliers. Examples of such data bases may be: CHEMCO "Chemistry and Chemical Technology", COMPENDEX "Technology", ENERGYLINE "Energy", ENVIRONLINE "Working Environment and Polution", INSPEC "Electrical Technology", METADEX "Metallurgy" etc.

Norwegian Petroleum Data Base

Corresponding to the foreign literature data bases, we have data bases installed on the national information or telephone network. In Norway, a joint Nordic telecommunication network, operated by the Nordic telecommunication administration is used. This network has nodes or pickup switchboards located in the Scandinavian capials, and each such node has the data base of its country available for all uses, regardless of nationality.

Examples of the Norwegian data base of interest to the petroleum industry, installed at the Norwegian Centre for Information (NSI) in Oslo are:

Oil indexes — have a special data base for petroleum subjects (discussed below)

Article indexes — on Norwegian or foreign professional literature with an expected interest in Norwegian industry.

Ship abstracts — for shipping and marine technology professional literature.

Export Index — with export information.

The principle for establishing contact with the data base and search in them are identical to similar procedures for international literature data base.

Oil Index

Oil which is the name of the data base, is one of the Norwegian (and Nordic) data bases directly aimed at the petroleum trade in the Nordic countries. Oil Index is presently owned by the Norwegian Petroleum Directorate but was originally started by the Norwegian Centre for Information (NSI) as led in the NTNF-project INFOIL in 1974. In 1975, co-operation was started between NSI and the Norwegian Petroleum Directorate on the publication of an index to quote all the indexes. This co-operation led to a higher quality in the index and the data bases. Indexing and cataloguing, means that preparation under cover of the relevant literature was systematized and expanded. As a result of this, the number of subscribers and the use of the data base has increased considerably. In 1979, the index was fully taken over by the Norwegian Petroleum Directorate and is now published as part of the Directorate's general information activity on petroleum activities towards Norwegian institutions and companies. The index is available in both a Norwegian and English edition as from 1980.

The oil index covers the following subjects within the petroleum activity: petroleum geology, oil exploration, extraction and projection, offshore constructions, landing, transportation and storage of oil and gas, petrochemical industry, oil policy, changes in society because of the petroleum activity, environmental protection and employment in connection with the activity.

All literature referred to in the index is immediately available either from the oil index reference at NSI or from the Directorate's library. The data base service therefore units in important requirements for an effective information retrieval, namely information about:

- what information is found on the subject in question.
- where the required information or required document can be obtained at once.

The search language for the oil index is POLYDOC, a Norwegian developed computer base documentation system and retrieval language.

The Norwegian Petroleum Directorate's Data Base, Odin

As you can see the technical documents work with petroleum literature in the Directorate has gone one step further than illustrated above: from the use of an international petroleum data base, through current publications of national literature data base, Oil, to a literature data base, Odin, which is in the Institution, based on exactly the same principles as the oil index. The basis for all this, Odin, wished to have a picture of the Directorate's total information quantity in the form of a printed publication. The library's literature collection has been available for direct reference from data terminals in the library, and in principal also from terminals located in the Directorate's other buildings. The

catalogues are also available for manual reference. Odin also makes possible print-outs of regular newslists of newly acquired literature as well as other forms of listing.

INFOIL

INFOIL is a group of Norwegian companies and institutions which coordinate petrtoleum documentation. The work was started as an NTNF project in 1975 and the oil index was one of the tasks of this project. Since 1978, INFOIL has had a separate secretariat administered by the Norwegian Petroleum Directorate.

For practical results, the group may make reference to:

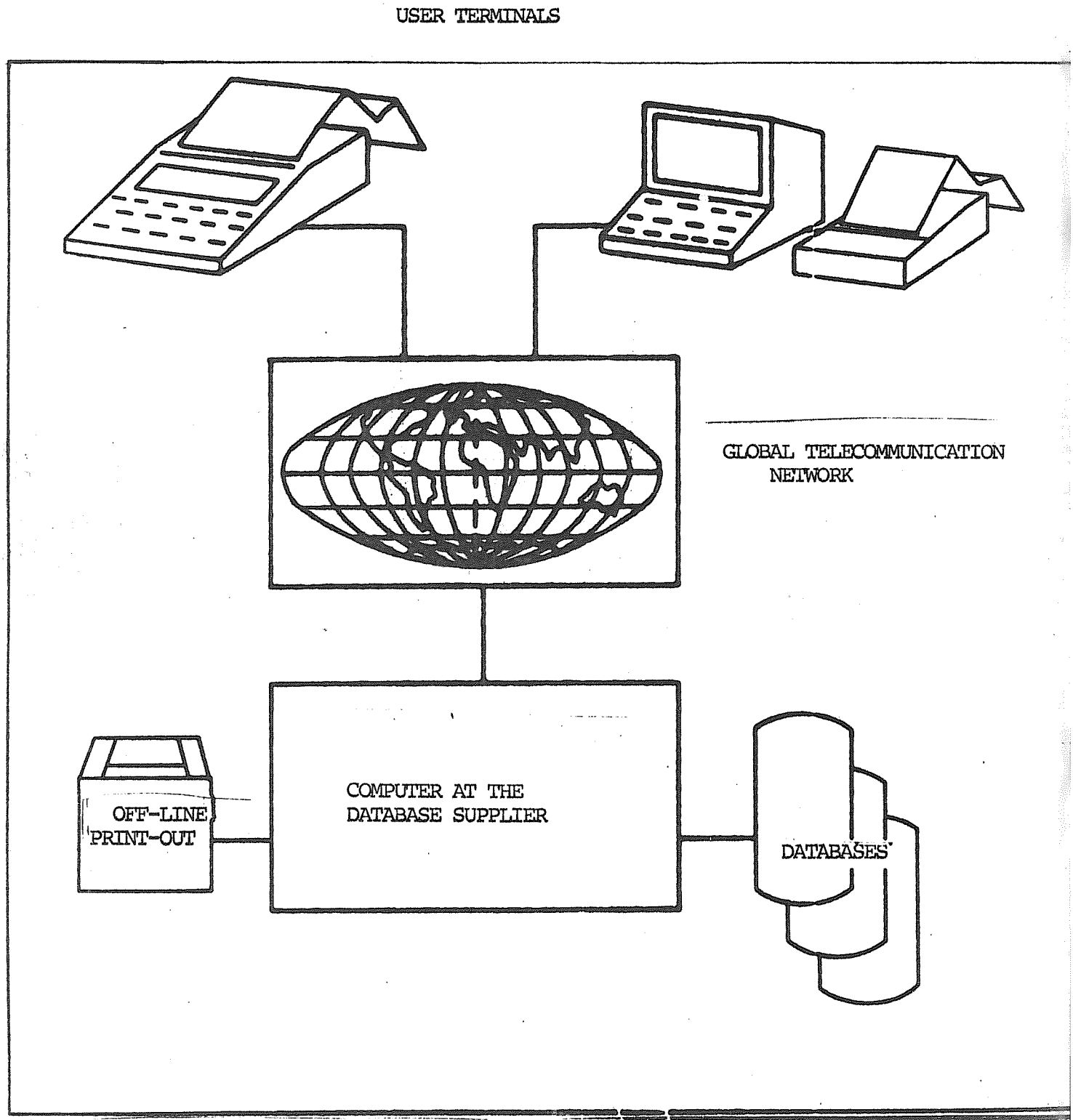
- favourable agreement for access to the Tulsa data base for Norwegian users
- test operation of the TULSYAV data base for 1977-1978
- annual seminar on petroleum documentation

The INFOIL secretariat still has the editorial responsibility for the "oil index", and is otherwise working on increased utilisation of international petroleum data bases, access for Norwegian users to the API services, etc.

As an advancement of the technical documentation work with petroleum information in the Directorate, the INFOIL secretariat started a new project on October 1st called INFOIL II. The purpose of this is to develop a data base of information on projects started in offshore related and petroleum chemical research in Norway. The purpose is to make this information easily available. The data base is designed on the same principles as for the oil index, using among other things the same computer program for both bases and the same means, that is to say that the petroleum thesaurus, the Norwegian-English vocabulary, etc., is used as a basis for both projects.

The financing of INFOIL II is still taking place through the research group in the Directorate with the Norwegian centre for informatics as executive consultant. The project is performed in cooperation with the Continental Shelf Committee in the Norwegian Research Council for Technology and Natural Science and the Department of Energy in London. Both of these institutions will participate actively in the development and operation of the data base.

FIGURE 7.A



INFORMATION RETRIEVAL

SOURCE: SOMETHING ABOUT ON-LINE INFORMATION RETRIEVAL SYSTEMS DTB 1978

8. STATISTICS AND SUMMARIES

8.1. Exploration and delineation drilling in the Norwegian sector of the North Sea

Since the exploration activity for petroleum started in 1966 in the Norwegian parts of the North Sea, a total of 272 exploration and delineation wells have been started as of December 31st 1980. Of these, 260 had been completed as of the same date.

The information from these wells has been presented statistically to throw light on some aspects of the activity.

In total, 840,671 metres have been drilled in the wells included, whereof 136,683 metres were drilled in 1980. The average depth of the 35 wells completed in 1980 is 3,115 metres. The average cost of the 36 wells started in 1980 is estimated at NOK 55.6 million.

The deepest well in the Norwegian part of the North Sea is 30/4-1 with British Petroleum as operator. Drilling was started in November 1978 and completed in March 1979 at 5,430 metres depth.

The greatest water depth at which drilling has taken place so far is 389 metres. The well was Amoco's 34/2-1 which was started in December 1979 and completed in February 1980.

For drilling of the wells covered by the statistics, 46 different drilling platforms have been used. Of these, 34 are of the semi-submersible type, 9 jack-ups and 3 drill ships.

Table XIX shows the drilling platform months per quarter up to and including 1980.

Table XX shows the seasonal variations in well activities from 1963 up to and including 1980.

Table XXI shows the average water depth and drilling depth.

Table XXII shows which drilling platforms have been in operation on the Norwegian Continental Shelf.

Table XIX

DRILLING PLATFORM MONTHS PER QUARTER 1966-1980

Year	1 Quarter	2 Quarter	3 Quarter	4 Quarter	Sum Pr.Yr.
1966			2	3	5
1967	3	3	5	6	17
1968	5	11	9	8	33
1969	6	7	9	6	28
1970	5	8	16	15	44
1971	12	12	14	9	47
1972	9	13	18	13	53
1973	5	7	10	17	39
1974	19	15	8	12	54
1975	9	16	17	13	55
1976	17	8	13	8	46
1977	5	10	17	18	52
1978	10	14	14	11	49
1979	15	14	20	25	75
1980	32	29	34	35	130
Sum pr. quarter	154	167	206	199	

Table XX

SEASONAL VARIATIONS IN ACTIVITY 1966-1980

Month	No. of wells Started
January	13
February	15
March	13
April	23
May	20
June	27
July	35
August	33
September	25
October	24
November	20
December	25

Table XXI

AVERAGE WATER AND DRILLING DEPTHS

Year	Average Water Depth (m)	Average Total Depth (m)
1966	110	2737
1967	93	2599
1968	75	3495
1969	70	3143
1970	89	2983
1971	82	3101
1972	79	3313
1973	86	3089
1974	109	3078
1975	109	2954
1976	124	2949
1977	94	2719
1978	109	3502
1979	153	3375
1980	176	3115

Table XXII

DRILLING PLATFORMS WHICH HAVE BEEN OPERATING ON THE NORWEGIAN CONTINENTAL SHELF

Drilling platform	No. of wells	Rig type
Ocean Viking	29	Semi submersible
Neptune 7	13	Semi submersible
Zapata Explorer	13	Jack-up
Norskald (Glomar Semi II)	27	Semi submersible
Glomar Grand Isle	11	Drilling ship
Ross Rig	26	Semi submersible
Ocean Traveller	9	Semi submersible
Deepsea Driller	8	Semi submersible
Orion	7	Jack-up
Poliglomar Driller	11	Semi submersible
Zapata Nordic	5	Jack-up
Ocean Tide	5	Jack-up
Naersk Explorer	5	Jack-up
Deepsea Saga	12	Semi submersible
Drillmaster	5	Semi submersible
Sedneth 1	3	Semi submersible
Gulftide	3	Jack-up
Dyvi Alpha	10	Semi submersible
Sedco 135 F	2	Semi submersible
Endeavour	2	Jack-up
Transworld Rig 61	2	Semi submersible
Ocean Voyager	2	Semi submersible
Ocean Victory	1	Semi submersible
Chris Chenery	1	Semi submersible
Drillship	1	Drilling ship
Waage Drill	1	Semi submersible
Sedco 135 G	1	Semi submersible
Norjarl	2	Semi submersible
Odin Drill	3	Semi submersible
Saipem II	1	Drilling ship
Borgny Dolphin	6	Semi submersible
Treasure Seeker	9	Semi submersible
Dyvi Beta	6	Jack-up
Dyvi Gamma	1	Jack-up
Sedco H	2	Semi submersible
Sedco 707	3	Semi submersible
Haakon Magnus	3	Semi submersible
Byford Dolphin	6	Semi submersible
Pentagone 84	2	Semi submersible
Fernstar	3	Semi submersible
Nortrym	4	Semi submersible
West Venture	3	Semi submersible
Nordraug	2	Semi submersible
Sedco 704	1	Semi submersible
Sedco 703	1	Semi submersible
Borgsten Dolphin	3	Semi submersible

8.2. Units of measurement

In line with general Norwegian practice for units of measurement, the Norwegian Petroleum Directorate will normally use units from the SI system. This system is also recommended for use by the oil companies operating on the Shelf.

It is a fact, however, that other units than those permissible within the SI system have a very strong position within the petroleum industry because of traditional and practical circumstances.

In the table (on the cover) some physical quantities have been tabulated together with the units from the SI system which are most frequently used for these. In addition, formulae have been tabulated for use in converting from other units to the corresponding unit in the SI system.

In addition, there are some terms, expressions and abbreviations which are frequently used in connection with production data for oil and gas and which are associated with the measurement units. Some of these are mentioned briefly below.

Quantitites - oil

An accurate indication of an oil quantity in volume (barrels or M^3) must refer to a further defined condition characterised by pressure and temperature. This is necessary since the volume of a quantity of oil is affected both by pressure and temperature. Pressure and temperature to which oil volume refers is normally mentioned as the volume "under standard conditions" or "under reference conditions". The two most usual reference conditions are a) (60^oF, 0 psig) and b) (15^oC, 1.01325 bar).

Other pressure and temperature references than these may also occur. It should be noted that such expressions as "standard conditions", "barrels at standard conditions" etc. are not ambiguous unless pressure and temperature references have not been defined.

The use of reference condition (b) is recommended by the International Standardisation Organisation. In addition, this reference condition was introduced as a Norwegian standard in 1979. The Norwegian Petroleum Directorate is working for the incorporation of this reference condition both for internal use and for reports from the oil companies.

Accurate recalculation of an oil volume from one condition to another involves the use of special tables. For estimates, however, one may assume that a volume at 60^oF, 0 psig corresponds approximately to the volume at 15^oC, 1.01325 bar.

Usual units/abbreviations:

Sm^3 = standard cubic metres. Temperature and pressure references must be indicated to give the unit an unambiguous meaning.

Barrel at standard conditions = traditional American unit. The reference condition is usually 60°F and 0 psig.

Recalculation:

1 Sm^3 corresponds to approximately 6.29 barrels at standard conditions.

Quantity - gas

To a still greater extent than for oil volumes, the number value of a gas volume will be associated with the pressure and temperature to which the volume refers. Four reference conditions are fairly usual:

a) (60°F, 14.73 psig)
b) (60°F, 14.696 psig)
c) (15°C, 1.01325 bar)
d) (o°C, 1.01325 bar)

Reference conditions a), b) and c) are usually referred to as "standard conditions", d) as "normal conditions".

A volume cannot be recalculated exactly from one condition to another without knowing the physical properties of the gas. It may, however, be assumed for estimates that the volume of the same quantity of gas is approximately similar in conditions a), b) and c), and that the volume of the quantity is 5% less in condition d).

Usual abbreviations:

SCM or Sm^3 = standard cubic metres. Notice that the temperature and pressure reference must be stated to give the unit an unambiguous meaning.

Nm^3 = normal cubic metre

SCF = standard cubic feet. Temperature and pressure reference must be stated to give the unit an unambiguous meaning.

Recalculation

1 Sm^3 corresponds to approximately 0.95 Nm^3
1 Sm^3 corresponds to approximately 35.3 standard cubic feet

Quality - oil and gas

To characterise the composition of oil and gas, density or relative density is frequently used. A low value of this quantity indicates that the oil/gas is composed of lighter components.

OIL:

a) Specific gravity 60/60° F
Relative density of oil compared to water, oil and water have a temperature of 60° F and a pressure corresponding to atmospheric pressure at the point of measurement. The number is unnamed.

b) API gravity at 60° F:
Specific gravity 60/60° expressed on a magnified scale. The unit is °API. The conversion is done according to the following formula:

c) Density at 15° C:
Absolute density at a temperature of 15° C and a pressure corresponding to atmospheric pressure at the point of measurement. The unit is normally kg/l.

GAS:

a) Specific gravity
Relative density of gas compared to air. The meaning of this term is not exactly defined unless the temperature and pressure at which the densities of gas and air have been measured are stated. Very frequently, however, no temperature or pressure reference is stated for specific gravity. This is not so important for estimates, since the difference between the values which can be measured/calculated for the most used reference conditions is very small.

Stating oil and gas in oil equivalents
Oil and gas are frequently referred to as tonnes of oil equivalents when accurate statements of quantities or qualities are not necessary. The recalculation is based on the energy quantity released by compression of oil and gas. In the case of many oils and gases, the energy quantity of one tonne of oil will be close to the energy quantity of 1,000 Sm^3 of gas. This recalculation factor is very easy to apply, at the same time that the quality differential between oil and gas is so large both as regards processing, storage and distribution and utilisation that it would not be right to indicate the recalculation with more decimals. The usual practice is therefore:

1 tonne of oil equivalent corresponds to 1 tonne of oil or 1000 Sm^3 gas.

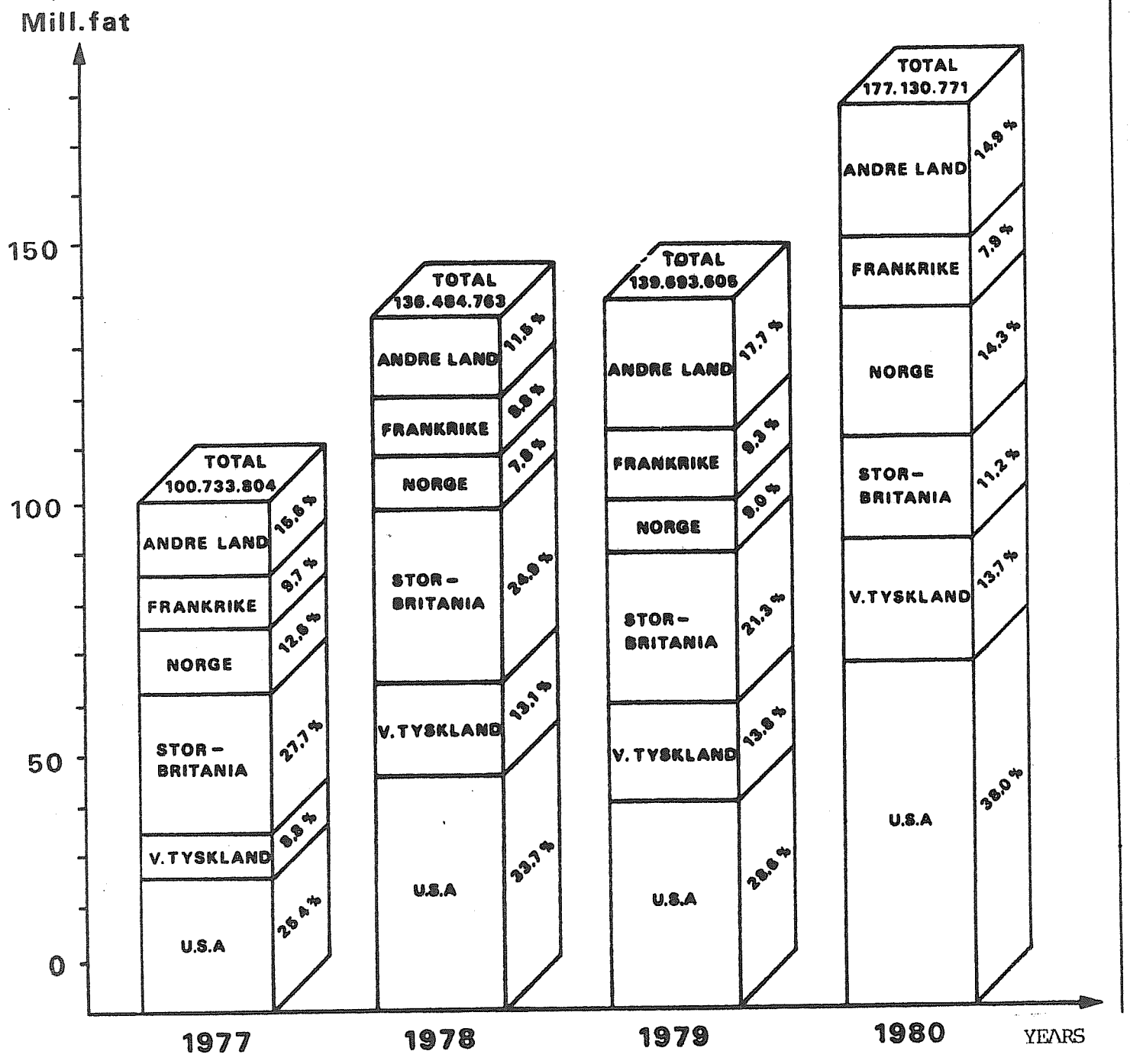
TABLE XXIII Some units from the SI-system with conversion formulas to other units (Ref. ISO R 1000, Api Publ. 2563)

Size	Unit from the SI-system	Abbrev-iation	Conversion formula	Comments
Length	meter	m	Inches x 0.0254 Feet x 0.3048 Yards x 0.91440 Miles(US st.) x 1609.344	
Mass	Kilogrammes	kg	Pound-mass(lbs avoirdupois) x 0.45359237 Long tons x 1016.047 Short tons x 907.1847 Tonn x 1000 (permissible in the SI-syst.)	
Temperature	Kelvin	K	^{o}Celcius + 273.15 Rankine x 5/9	
	^{o}Celcius		(^{o}F-32) x 5/9	
Amount of substance	Mol	Mol		Elementary units (atoms, molecules, etc.) must be stated
Area	Square meter	m^2	Acre x 4046.856 Foot x 0.09290304 Inch x 0.0006451600	
Volume	Cubic meter	m^3	Barrel x 0.1589873 Foot^3 x 0.02831685 Acre ft x 1233.5 US Gallon x 0.0037854	Note! Accurate statement of volume, oil or gas includes information about pressure and temperature reference. Approximate conversion of oil and gas volume is: To Sm^3 oil:Barrels x 0.159 To Sm^3 gas:Nm^3 gas x 1.055 Scuft x 0.0283
Density	Kilogramme per cubic meter	kg/m^3	$\frac{141.5}{^{o}API + 131.5}$ x 1000, lb/gallon x 119.83 lb/barrel x 2.8530, lb/cuft x 16.018	
Force	Newton	N	Pound-force (lbf avoirdupois) x 4.448221615260 kp x 9.806650	
Pressure	Pascal	Pa	Bar x 100000 (Bar permissible in SI-syst.)	1 Normal atmosphere=1.01325 bar 1 Techn. atmosphere=0.9806650 " $1kp/cm^2$ corresp. to 1 technical atmosph. $1kg/cm^2$ corresp. to 1 technical atmosph.
	Bar	-	mm Hg x 0.00133322 psi x 0.06894757	
Energy	Joule	J	Calories x 4.19 (approximately) Btu x 1060 (approximately)	The calorie and Btu units must be more accurately specified for accurate conversio
Effect	Watt	W	hp x 735.499	English/American horse power is not unambiguous. Normally approx. 745 w. Watt is defined as Joule pr. second
Dynamic viscosity	Pascal-second	Pa-s	Poise x 0.1, lbm/ft - sec x 1.4882	
Chimeatic viscosity	meters squared per second	m^2/s	Stoke x 10^{-4}	Defined as dynamic viscosity divided by density

8.3. Shipment of Norwegian crude oil

Figure 8.A shows the distribution of the exported crude oil from Teeside in the period 1977-1979 and the distribution of the exported crude oil from Teeside, Statfjord and Murchison in 1980.

FIGURE 8.A



YEARLY DISTRIBUTION OF EXPORTED CRUDE OIL FROM TEESSIDE, STATFJORD AND MURCHISON

8.4. Production from Ekofisk Frigg Statfjord and Murchison in 1980

The production of oil and gas on the Norwegian Continental Shelf in 1980 was approximately 49.5 million t.o.e. as it appears on table XXIV.

The production in 1979 was approximately 39.6 million t.o.e.

Table XXIV

Production on the Norwegian Shelf in tonnes of oil equivalent

	Oil (1,000 tonnes)		Gas (1,000 tonnes)	
	1979	1980	1979	1980
Ekofisk	18,599	21,457	12,503	15,154
Frigg			8,283	9,970
Statfjord	216	2,849		
Murchison		75		
Total	18,815	24,381	20,786	25,124

TABLE XXV

MONTHLY LIQUID AND GAS PRODUCTION FROM THE EKOFISK AREA IN 1980

	Liquid production 10^3Sm^3	Liquid production 10^3tonn	Gas production 10^3Sm^3	Gas as fuel 10^3Sm^3	Gas flared 10^3Sm^3	Gas sales 10^3Sm^3
January	2,609	2,071	1,520,509	64,000	9,000	1,319,697
February	2,631	2,088	1,581,893	64,000	6,000	1,392,914
March	2,518	1,997	1,553,848	66,000	10,000	1,353,068
April	2,291	1,814	1,442,143	61,000	9,000	1,243,767
May	2,498	1,974	1,580,998	65,000	12,000	1,379,565
June	2,336	1,843	1,518,247	63,000	6,000	1,330,896
July	1,221	966	721,767	32,000	7,000	635,631
August	2,345	1,857	1,497,167	70,000	10,000	1,197,923
September	2,084	1,642	1,438,217	62,000	7,000	1,275,322
October	2,287	1,801	1,592,382	65,000	17,000	1,368,463
November	2,190	1,718	1,558,853	65,000	7,000	1,348,884
December	2,153	1,686	1,600,188	71,000	3,000	1,307,664
	27,162	24,381	17,606,212	748,000	103,000	15,153,793

TABLE XXVI

MONTHLY GAS PRODUCTION FROM THE FRIGG FIELD IN 1980

	Gas production 10^3Sm^3	Gas as fuel 10^3Sm^3	Gas flared 10^3Sm^3	Gas sales 10^3Sm^3
January	1,110,673	2,616	27	1,116,691
February	981,168	2,452	27	984,336
March	1,024,203	2,575	110	1,024,378
April	857,367	2,321	53	863,451
May	672,956	1,999	23	689,210
June	629,999	1,877	9	634,754
July	738,346	2,003	0	746,928
August	677,857	1,850	0	685,909
September	675,192	1,749	0	663,363
October	689,978	1,999	0	700,682
November	848,082	1,800	0	859,602
December	973,540	2,321	0	1,000,829
	9,879,361	25,562	240	9,970,133

Figures are for the Norwegian part, ie. 60.82%

TABLE XXVII

MONTHLY OIL AND GAS PRODUCTION FROM THE STATFJORD FIELD IN 1980

	Oil production 10^3Sm^3	Oil production 10^3tonn	Gas production 10^3Sm^3	Gas as fuel 10^3Sm^3	Gas flared 10^3Sm^3
January	242	201	43,111	2,157	40,954
February	227	189	40,552	1,604	38,948
March	248	206	43,540	2,280	41,260
April	288	239	51,560	2,114	49,446
May	253	211	45,785	2,083	43,702
June	299	250	54,658	2,719	42,901
July	97	80	17,152	1,035	13,662
August	274	228	48,492	3,729	29,632
September	301	250	51,467	4,424	22,476
October	319	264	54,510	4,469	27,239
November	336	279	57,415	4,105	17,363
December	545	452	90,899	6,295	11,091
	3,430	2,849	599,142	37,014	378,674

The figures are for the Norwegian part, ie. 84.09322%

TABLE XXVIII

MONTHLY OIL AND GAS PRODUCTION FROM THE MURCHISON FIELD IN 1980

	Oil production 10^3Sm^3	Oil production 10^3 tonn	Gas production 10^3Sm^3	Gas flared 10^3Sm^3
October	18	15	1,799	1,799
November	35	29	3,656	3,656
December	38	31	4,130	4,130
	91	75	9,585	9,585

The figures are for the Norwegian part, ie. 16.25%

8.5. Publications issued by the Norwegian Petroleum Directorate in 1980

Regulations

Regulations for production and auxiliary systems on production facilities, etc.
Issued by the Norwegian Petroleum Directorate on April 3rd, 1978 with later amendments, most recently on July 1st, 1980.
Temporary regulations for diving.
Issued by the Norwegian Petroleum Directorate on July 1st, 1978 with later amendments, most recently on April 1st, 1980.
Temporary regulations about littering and pollution. Issued by Royal Decree of October 26th, 1979.
Regulations for collection of production fees. Issued by the Norwegian Petroleum Directorate on April 1st 1980.

Geological Publications

Well Data Summary Sheets, vol 5
NPD PAPER No. 25
Lithology Well No. 2/4-1, 2/4-2, 2/4-3, 2/4-4 and 2/4-5
NPD PAPER No. 26
Lithology Well No. 10/8-1
NPD PAPER No. 27
Lithology Well No. 9/12-1

Petroleum Documentation

OIL-INDEX. English edition of the index.

Maps

Map of the Norwegian Continental Shelf south of 62°N, also covers areas north of 62°N. Concession areas as per July 1st, 1980.

Other Publications

Condition monitoring of process plant on offshore installations.
Status of exploration north of 62°N.
Exploration results in the Norwegian North Sea.