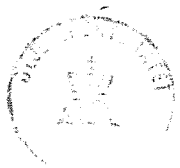
1976

ANNUAL REPORT

OF

THE NORWEGIAN PETROLEUM DIRECTORATE



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FORWORD

The Board hereby submits the Annual Report of the Petroleum Directorate for 1976.

This year one has found it to be expedient to let the report from the Board be included as Part I. The activity in general is discussed in Part II, and in Part III one has included, as in previous years, discussions of a general technical nature concerning the Directorate's field of specialty.

Stavanger, March 4, 1977

For the Board of the Directorate

(signatures)

PART I : THE REPORT OF THE BOARD

The year 1976 was characterized by a great deal of activity within the Petroleum Directorate. Significant development took place internally. 56 positions were filled, most of them in the Control Department. At the same time one was forced to work under some uncertainty concerning the organizational model. The leadership in the Ministry of Industry expressed the opinion that it could be expedient to establish a distinct division which would be concerned with control on the Shelf. This division would then take over the safety control duties which are now the responsibility of the Petroleum Directorate. There was agreement by a majority of the committee appointed by the Government to report concerning application of the new Working Environment Act to the Continental Shelf, that "with a starting point in the Control Department of the Petroleum Directorate there should be established a special Shelf Control Division administered by the Municipal and Labor Ministry".

In an extensive statement the Board has countered these proposals which would lead to the division of the Petroleum Directorate. However, at the same time the Board has been extremely concerned with the question of the desirability of making changes in the organization of the Directorate. In the course of 3½ years the Dirctorate has been built up from nothing to an organization with 152 empoyees. In 1977, 31 new employees will be added. It is not necessarily the case that the model which one originally followed, and which was based on the assemption of a more limited staff, will be equally expedient in the future. In this connection the Board is also concerned with defining its own areas of responsibility and authority.

The long awaited safety regulations for production, etc., of sub-sea petroleum deposits, were drawn up by the Royal Resolution of July 9, 1976. With authority in these regulations the Directorate ordered that a separate platform for living quarters be built for the Statfjord field with a link to the B-Platform there. This order has significant economic consequences and has very clearly emphasized the need for the best possible synchronization of the approval of field development plans by the political authorities and the approval by the technical bodies. It appears that the only practical method of doing this is to have the control authorities follow the project from the rough draft stage. The Royal Resolution of July 9, 1976, prepares for such a system.

The investigation which the Petroleum Directorate allowed done in the fall of 1976 on the sea bed around 17 abandoned drill holes showed that in conflict with the regulations for drilling activity, rubbish had been left behind which could pose a danger to fishing equipment. The experiences

from these investigations confirm the necessity of the authorities following up the control undertakings begun by the operators. In addition such experiences demonstrate that the authorities must have very advanced technical facilities at their disposition for the control work.

It is very often a weakness that the desired analytical tools and the technical equipment are insufficient, both in control work and in preparedness work. The Petroleum Directorate has presented to the Ministry of Industry an extensive proposal for research and development projects, which, in the opinion of the Petroleum Directorate, should be carried out in order to come to grips with the situation. The proposal assumes that there will be cooperation among a number of institutions and contributions of public funds.

In this connection it was decided in December 1976 to establish a working group with representatives from the Petroleum Directorate, NTNF (The Norwegian Research Council for Technical & Natural Sciences), the Ministry of Environmental Protection, and the Ministry of Industry, with the chairman and secretarial functions to be taken care of by the Petroleum Directorate.

Safety on the Continental Shelf is dependent to a very large degree on one having sufficient information concerning the wave strength, wind strength, etc., to which the installations are exposed. The Environmental Data Center which collects and organizes such information from a number of measuring stations has come into operation during the report period. The initiative for the establishment of this center was taken by the Petroleum Directorate in close cooperation with the so-called Otter Group in Trondheim, and the Weather Bureau. The Weather Bureau is in charge of data storage. In addition a weather ship has been stationed for registration of data of special interest in connection with operations on the Continental Shelf North of 62°N. The Board has decided to contribute to the support of the operation of both the Environmental Data Center (partial payment) and the weather ship (full payment).

The decision to open the areas North of 62°N. for drilling must be made by the political bodies. In this connection the duty of the Directorate is to obtain as complete information as possible as a basis for such decisions. Therefore the Directorate functions primarily as a source of petroleum-geology expertise in that the Directorate maps and evaluates the possibilities for finding hydrocarbons in different areas. In addition the Directorate gives safety evaluations, but it is the responsibility of others to express themselves concerning the consequences for fishing, etc. In addition the Board feels it is very important to have the best possible contact with fishermen and their organizations, and, among other things, the Directorate has a contact committee where cases of common interest can be brought up.

The Directorate acts as an expert body for evaluating the size and properties of the petroleum deposits with the thought of possible extraction. Naturally the oil companies evaluate these conditions themselves. In certain cases their estimates have been shown to differ considerably from those of the Directorate's. Such estimates will always be burdened with significant uncertainty, and it is not necessarily the case that the estimates of the Directorate will always be shown to be the most correct.

However, the Board feels that it is necessary for the State's planning and control that the authorities work from evaluations which have been prepared in a uniform manner, and which one can say, with certainty, have not been influenced by considerations other than the desire to arrive at a correct a result as possible.

In the course of 1976 the Petroleum Directorate made an evaluation of the total reserves on the Shelf south of 62°N. This evaluation shows that as of today slightly less than 1.5 billion tons of oil equivalents have been detected. In addition extractable reserves on the order of 2 billion tons of oil equivalents probably exist in structures in which no drilling has yet been done.

It is expected that the task of effecting a safe exploitation of the petroleum deposits will play a more and more prominent role as more and more fields are brought into production. Over the next 3 years the production activity on the Continental Shelf will increase to almost five times what it is today. It is the aim of the Petroleum Directorate to build up the competence and work capacity which is necessary to ensure control with this part of the activity.

PART II : THE ACTIVITY IN THE REPORT PERIOD

1. THE DUTIES, BOARD, AND ADMINISTRATION OF THE DIRECTORATE

1.1 INSTRUCTIONS FOR THE PETROLEUM DIRECTORATE

The objectives and duties of the Petroleum Directorate were stated in specific instructions which were originally stipulated by the Ministry of Industry on March 30, 1973, and by a delegation resolution of a later date.

As a result of the fact that appointment authority for certain positions was transferred from the Board to a newly established Appointment Council in 1976, the instructions were replaced by new instructions stipulated by the Ministry of Industry on June 17, 1976.

§ 1 - Purpose

The Petroleum Directorate is situated in Stavanger and it is administered by the Royal Ministry of Industry. It has the deciding authority in matters concerning exploration for and exploitation of petroleum deposits on the sea bed or its underlying layers, in Norwegian waters close to shore, Norwegian territorial waters, and on that part of the Continental Shelf which is under Norwegian sovereignty to the extent that the matters are not to be decided by the Crown, the Ministry of Industry, or other public authorities. In addition the Petroleum Directorate shall enforce the safety regulations, etc., for exploration and drilling for petroleum deposits, etc., in those areas defined in the Svalbard Treaty of July 17, 1925, §1, as well as in the territorial waters of those areas.

§ 2 - Duties

The Petroleum Directorate's duties within its area of authority are as follows:

a) To ensure that the exploration for and exploitation of petroleum is carried out managerially and financially in accordance with existing legislation, regulations, resolutions, terms of concession, agreements etc., cf. §1.

b) To ensure that the existing safety regulations are adhered to.

c) To ensure that the search for and exploitation of petroleum deposits do not unnecessarily damage or result in damage to other undertakings.

d) To ensure that the search for and the exploitation of petroleum deposits at all times takes place in accordance with the guidelines drawn up by the Ministry of Industry.

e) To collect and adapt geological, geophysical and technological material on underwater natural resources, and to assess it and the possibilities it may have to assist in shaping the government oil policy and negotiating policy, and to plan and administer the execution of geological and geophysical oil searches.

f) To keep constant financial control of the search for petroleum deposits and the exploitation thereof.

g) To report on permits granted for oil searches, and, on request, to assist the Ministry in its handling of applications for other licences, the formulation of regulations, etc.

h) To keep in touch with scientific institutions, and to ensure that material is made available for interested companies, scientific institutions, etc., to the extent that this is possible according to the rules which apply for confidential handling of material sent in by licensees, and otherwise in accordance with the Ministry's decision.

i) To keep the Ministry of Industry posted on activities mentioned in §1, and to place before the Ministry whatever matters the Directorate should take up, which are not covered by §2, a-h.

j) To prepare and submit for decision to the Ministry of Industry matters of importance for plant and animal life, or matters which otherwise touch on important nature conservation interests in those areas mentioned in §1, the last sentence.

k) To submit to the Ministry of Industry regulations and individual decisions concerning a safe exploitation of petroleum deposits (conservation).

i) To be the Ministry of Industry's legislative body in questions concerning the search for sub-sea natural resources or the exploitation thereof.

Even if a matter comes under the mandate of the Directorate according to §2, a-h, it shall be submitted to the Ministry if it is of particular importance or of fundamental interest.

1.2 BOARD AND ADMINISTRATION

1.2.1 The Board

The Board's composition during the first part of the report period has been as follows:

- Bank Manager Gunnar Hellesen, Haugesund
- Director Andreas Lønning, Oslo
- Member of the Storting Kirsten Myklevoll, Skånland
- Manager Aksel Olsen, Hammerfest
- Senior Geophysicist John Stangenes, Stavanger (elected by and from among the employees).

Deputies:

- Member of the Storting Gunnar Berge, Stavanger
- Senior Counsellor Erik Setsaas, Stavanger (personal deputy to the employees' representative to the Board).

This Board's term of office expired on September 12, 1976. The following members were appointed for a term extending to September 12, 1978, by the Crown Prince Regents Resolution of August 20, 1976:

- Bank Manager Gunnar Hellesen, Haugesund
- Director Andreas Lønning, Oslo
- Member of the Storting Kirsten Myklevoll, Skånland
- Manager Aksel Olsen, Hammerfest
- Senior Counsellor Erik Setsaas, Stavanger (electred by and from among the employees).

Deputies:

- Member of the Storting Gunnar Berge, Stavanger
- Senior Geologist Hans Chr. Rønnevik, Stavanger (personal deputy to the employees' representative to the Board).

The Board has held 10 meetings during the report period.

1.2.2 Staff

In its budget proposal for 1976 the Directorate asked for 38 new positions. 20 new positions were proposed in the Government's proposition to the Storting.

After a longer debate in the Storting concerning the Directorate's duties and its ability to carry out these duties, it was decided that the Directorate should get the 38 positions it had requested.

At the end of the report period the Directorate had 152 employees, including those appointed on a yearly basis, those engaged, and those employed on a contract basis.

14 employees left the Directorate in 1976. Most of these took over positions in other oil operations. The demand for qualified staff with experience in oil operations is great in the district.

21 new employees have come from areas outside of the Stavanger region during the report period. It has been difficult to find housing for the new employees this year.

Regulations for staff management in the Petroleum Directorate were drawn up by Royal Resolution of June 11, 1976. Among other things this resulted in the fact that appointment authority for some of the positions was transferred from the Board to an Appointment Council. This arrangement with the Appointment and Nomination Council was brought into effect on July 1, 1976.

1.2.3 Organization

Since it was established in 1973 the Directorate has not experienced any change in its organization. Organizational changes in the period 1973-76 have been a matter of organizing the departments into sections. Among other things, a legal and an economic section were begun on January 1, 1977. At that same time the Board found it to be correct to change the designation of the Administration Department to the Legal- and Economic Department, and that the Administration and Staff Office be changed to the Administration Department. These changes in the names of the departments do not result in any change in the Directorate's present work and responsibility areas. However, in the course of 1976 one has become aware of the fact that a more thorough analysis of the Directorate's organization, in the light of its duties, is desirable.

1.2.4 Training

There has been an extensive training program in 1976. This extensive activity is due to the fact that a large portion of the staff which is hired by the Directorate comes from industry or directly from educational institutions. Therefore specialization is often necessary. In addition the development within the petroleum industry takes place at such a pace that post-graduate work is often necessary.

In accordance with earlier plans, and with help from the oil companies, the Directorate has arranged portions of the post-graduate work under its own direction in 1976. This has been successful, and an attempt will be made to do the same to an even larger extent in the future.

1.2.5 Premises

In the course of 1976 the Directorate took over for its own use some of the premises which were previously rented out to Statoil. However, the office situation is still difficult. Among other things, the whole Control Department is still separated from the remaining departments. Therefore the Directorate has gone to the municipal authorities with a request for a lot where an office building can be raised in hopes of improving the situation.

1.2.6 Budget

In the State Budget for 1976, Kr. 69.855.000,- was appropriated for the operation of the Directorate.

Of this amount, Kr. 50.000.000,- was appropriated for payment of expenses in connection with safety control. The concessionaires will refund the control expenses.

Kr. 25.000.000,- was appropriated for the Directorate's geophysical and geological investigations, etc., on the Continental Shelf.

1.2.7 Cooperation Committee

By agreement of December 3, 1975, a special Cooperation Committee was established by the Petroleum Directorate. 4 of the council's members are appointed from the management and 4 are appointed from the organizations - with personal deputies.

8 meetings were held in 1976. Included in those matters which were taken up were: the budget, division of the Directorate, operation of the cafeteria, the company doctor arrangement, writing of reports, welfare activities, etc.

The Cooperation Committee had the following composition in 1976:

Members nominated by the management:

- Director Fredrik Hagemann
- Director Farouk Al-Kasim
- Director Dag Meier-Hansen
- Administration Manager Bjørn Bratbak

Deputies:

- Director Nils Vogt
- Head of Section Egil Bergsager
- Head of Section Magne Ognedal

Members nominated by the organizations:

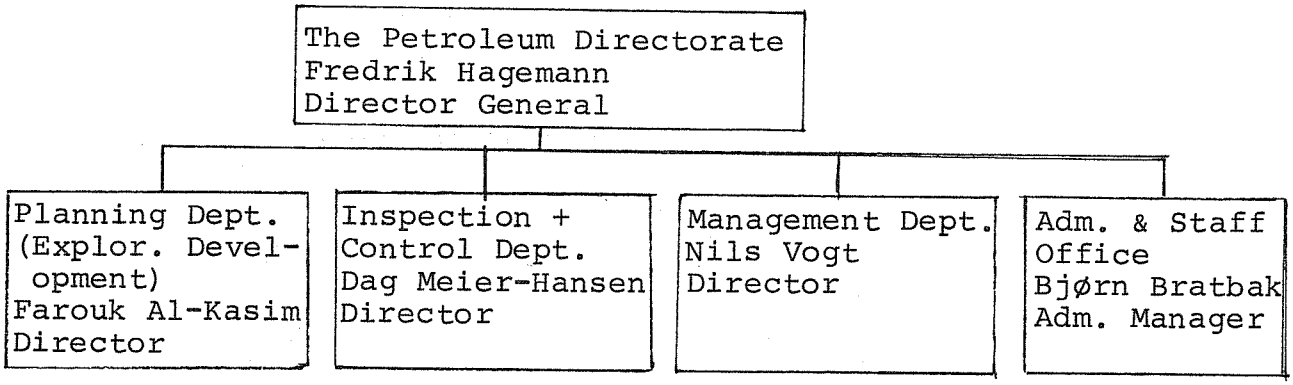
- Senior Engineer Bjørn Frøyland (Joint Academic Organization)
- Senior Councellor Erik Setsaas (Joint Academic Organization)
- Reproduction Supervisor Tor Inge Ottosen (Sivil Servants' Organization)
- Secretary Brit Borvik (Civil Servants' Union)

Deputies:

- Senior Engineer Arne Wyller Christensen (Joint Academic Organization)
- Senior Geologist Hans Chr. Rønnevik (Civil Servants' Organization)
- Senior Office Assistant Torunn Fraser (Civil Servants' Organization)
- Economic Officer Thomas Houge-Thiis (Civil Servants' Union)

The Council's permanent secretary:

Until September 17, 1976, Personnel Officer Brynhild Meltveit
After that time Counsellor Kåre A. Tjønneland.



2. ACTIVITY SOUTH OF 62°N.

2.1 SEISMIC INVESTIGATIONS

In 1976, 16.700 km of seismic reflection profiles were shot in the Norwegian portion of the North Sea. This is of the same order of size as in the three previous years, and in part reflects the tempo in assignment of new concessions. As one can see from figure 2A, this is approximately half of that which was shot in the top years 1971 and 1972 as there was a good deal of activity before the third round of concessions in 1973. All together approximately 192.000 km of profiles have been shot since 1962.

The seismic investigations in 1976 were undertaken on assignment from the different oil companies. An insignificant amount of seismic profiles has been shot with the thought of selling this information.

Other types of shallow seismic investigations were also done in connection with the rest of the installations and activity.

2.1.1 Petroleum Exploration Permits

62 exploration permits have been issued up to now. The following permits have been issued since the time of the last report:

Permit No. 055 Norske Shell Exploration and Production
056 Conoco Norway Inc.
057 Saga Petroleum A/S and Co.
058 Seiscom Delta Ltd.
059 Western Geophysical Co. of America
060 Elf Norge A/S
061 Norwegian State Oil Company A/S
062 Amoco Norway Oil Company.

2.2 DRILLING

2.2.1 Exploration and Delimiting Holes

5 exploration holes and 1 delimiting hole were being drilled at the turn of the year 1975/76. These are all completed. 20 exploration holes and 3 delimiting holes were begun in 1976. 3 of the exploration holes were in the process of being drilled at the turn of the year. The drilling activity is shown in Figure 2B. This was somewhat higher than predicted in the prognosis from the Petroleum Directorate due to the unexpected amount of activity in the 1965 concessions. This has to do with the voluntary relinquishment of areas covered by concessions due to the increased area fees. In 1976 approximately 27.000 km^2 were covered by concession in the Norwegian portion of the North Sea, and the activity can be presented as somewhat less than one hole per 1000 km^2. In comparison it can be mentioned that on

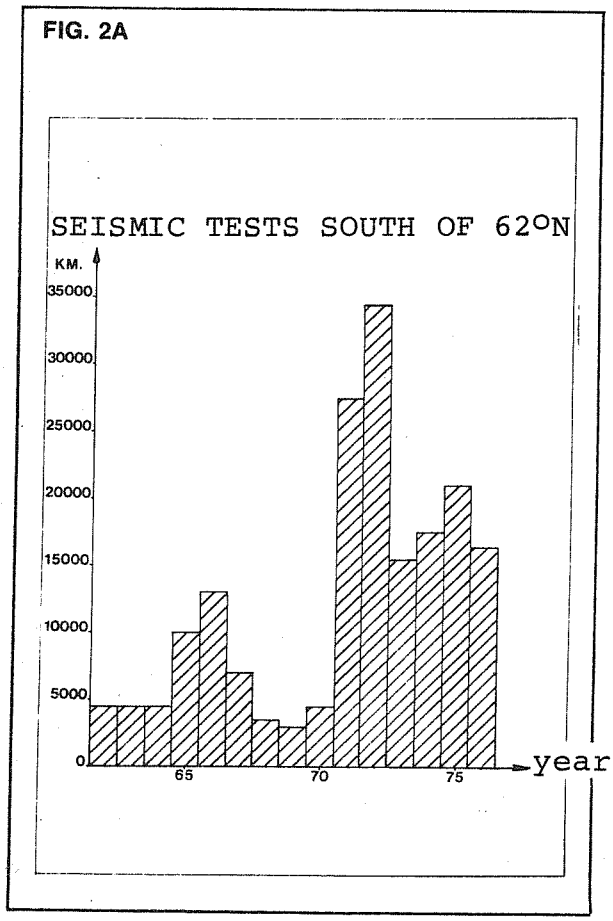
the British side approximately 90 holes were drilled per approximately 85.000 km^2, i.e., a little more than one hole per 1000 km^2. The prognosis of the Petroleum Directorate for 1977 is for slightly more than 20 holes.

One hole, 16/3-1, had to given up at rather shallow depths due to technical problems. Another, 35/3-1 on one of the so-called Måløy blocks, has been temporarily abandoned. One managed to drill down into the Jurassic layer but eventually the pressure became so great here that it was not safe to continue drilling with ordinary drilling equipment.

However, one intends to return with special equipment which can control this type of pressure. The drilling took place at an ocean depth of 304 m which is the deepest on the Norwegian Shelf up to now.

Hole 15/3-2 lies in an area where one knows from experience that high pressure occurs. Therefore the drilling is being done in two stages. One has drilled down to a zone just above the expected high pressure zone, and then temporarily plugged the hole until a specially equipped drilling rig can be brought in.

FIG. 2A



Hole 30/7-3 was also interrupted before the planned depth was reached due to high pressure. Unfortunately the species of rock in the hole is so weak that there is no possibility of using high pressure equipment, and the hole was plugged permanently. However, one did manage to drill through the primary prospect.

In the North Sea one has come upon high pressures in the deep basin along the borderline of the northern portion. 35/3-1 is drilled deeper into the sedimentation basin than the first two holes in the so-called Måløy blocks and shows that one must also expect high pressure in the deep basins further north beyond 62°N.

Three delimiting holes have been drilled on the Valhall structure which has turned out to have a complex geology. Further drilling is necessary to obtain a complete picture of this structure.

In the Statfjord area, 4 exploratory holes have been drilled in structures outside of the actual Statfjord field.

2.2.2 Production Wells

Two production wells were abandoned on the Ekofisk structure at the turn of the year 1975/76. These were reopened and completed in 1976.

The results from the drilling at West Ekofisk resulted in changes in the original drilling program. The original 8 wells were completed. Two of these were worse than expected. They were so little productive that they are now abandoned. However, some of the wells turned out to be more productive than expected. One plans to drill 4 more wells in the field.

Drilling of the production wells in the Cod field was begun in 1976. Two wells were completed. One of these was almost dry and was plugged. One well was being drilled at the turn of the year. Three more wells are to be drilled in the Cod field.

15 production wells are to be drilled in the Tor field. 30 inch conducting pipes have been emplaced in 18 holes (3 in reserve), and at the turn of the year, 20 inch casings had been drilled and emplaced in three wells.

Since the drilling of the wells in the Ekofisk field was almost completed before 1976, there was a definite decline in the number of production wells drilled in 1976 compared to the two previous years. The prognosis for 1977 is 14 production wells in West Ekofisk, Tor, and Cod. The drilling will be begun in the Frigg field in 1977, but at first only on the British side.

TAB. I SUMMARY OF WELLS DRILLED IN 1976

140	33/12-5	61°11'05.5"	01°51'53.4"	20.09.75	20.02.76	154	Statoil/Mobil gr.	Norskald
141	2/10-1	56°07'32"	03°18'06"	16.09.75	22.04.76	224	Phillipsgruppen	Ocean Viking
142	33/9-5	61°20'47.9"	01°56'51.7"	27.10.75	25.12.75	60	Statoil/Mobil gr.	Ross Rig
143	2/8-8	56°16'49.8"	03°24'12.7"	10.11.75	09.03.76	120	Amoco/Noco-gruppen	Deepsea Saga
144	1/6-4	56°44'52.1"	02°42'23.6"	29.12.75	08.04.76	103	Shell	Chris Chenery
145	8/9-1	57°26'28.9"	03°51'09.2"	22.12.75	12.02.76	53	Conoco	Ocean Victory
146	15/12-2	58°08'31.1"	01°55'47.3"	07.01.76	25.02.76	48	Statoil/Esso	Ross Rig
147	11/9-1	57°17'33.2"	06°44'52.6"	17.01.76	27.02.76	42	Petronordgruppen	Deep Sea Driller
148	16/3-1	58°47'12.9"	02°47'32.2"	31.01.76	10.02.76	11	Petronordgruppen	Polyglomar Driller
149	2/4-B-19	56°33'54.9"	02°12'13.2"	16.12.75*	15.03.76	91	Phillipsgruppen	Ekofisk B
150	33/12-6	61°04'36.4"	01°57'17.7"	02.03.76	20.06.76	111	Statoil/Mobil gr.	Norskald/Dyvi Alpha
151	16/3-2	58°47'12.8"	02°47'34.7"	10.02.76	06.03.76	26	Petronordgruppen	Polyglomar Driller
152	24/9-1	59°16'09.5"	01°47'31.2"	29.02.76	02.07.76	125	Conoco	Ross Rig
153	25/2-5	59°48'01.4"	02°28'18.4"	08.03.76	04.08.76	149	Petronordgruppen	Polyglomar Driller
154	17/11-2	58°06'54.9"	03°22'09.8"	12.04.76	17.05.76	36	Shell	Chris Chenery
155	2/8-9	56°17'48.5"	03°23'04.3"	09.04.76	27.06.76	80	Amoco/Noco-gruppen	Sedco 135 G
156	10/5-1	57°34'52.1"	05°35'25.9"	30.05.76	27.06.76	29	Conoco/Petrsw./Dem.	Norjarl
157	2/8-10	56°15'53.3"	03°24'58.8"	30.06.76	29.08.76	61	Amoco/Noco-gruppen	Sedco 135 G
158	33/9-6	61°25'12.8"	01°48'43.9"	22.06.76	31.08.76	71	Statoil/Mobil gr.	Dyvi Alpha
159	15/6-4	58°37'34.4"	01°48'19.8"	28.06.76	16.08.76	50	Esso	Norjarl
160	16/1-2	58°56'09.2"	02°13'20.0"	04.07.76	06.08.76	34	Esso	Ross Rig
161	7/12-2	57°06'41.3"	02°50'50.7"	04.07.76	23.09.76	81	CONOCO/BP	Norskald
162	35/3-1	61°50'41.9"	03°43'41.4"	19.07.76	26.10.76	100	Saga/BP	Deepsea Saga
163	30/7-3	60°17'09.2"	02°14'54.4"	05.08.76	24.10.76	82	Statoil/Petronord gr	Polyglomar Driller
164	2/8-11	56°16'56.2"	03°22'15.7"	10.08.76	12.10.76	64	Amoco/Noco-gruppen	Ross Rig
165	33/9-7	61°20'12.2"	01°59'12.7"	06.09.76	07.11.76	63	Statoil/Mobil gr.	Dyvi Alpha
166	16/8-1	58°27'24.8"	02°25'56.8"	25.09.76	25.10.76	31	Conoco/BP	Norskald
167	1/9-1	56°24'05.1"	02°54'06.5"	13.10.76			Statoil/Phillips	Ross Rig
168	15/3-2	58°59'00.5"	01°47'12.6"	29.10.76			Petronordgruppen	Polyglomar Driller
169	33/9-8	61°26'17.4"	01°55'04.9"	11.11.76			Statoil/Mobil gr.	Deepsea Saga

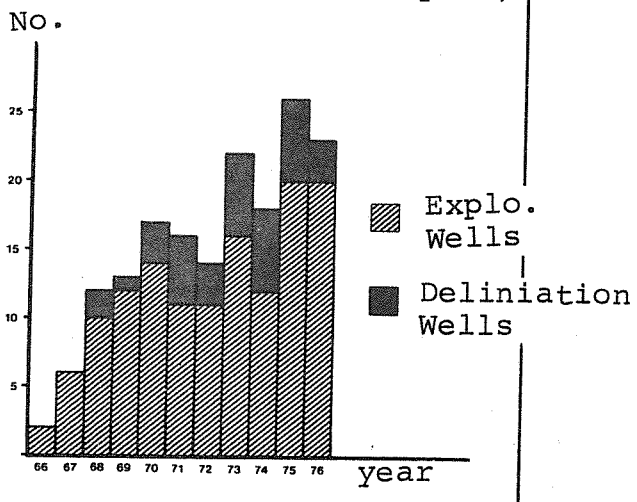
*

*) From 20" casing

FIG. 2B

DRILLING ACTIVITY ON THE NORWEGIAN CONTINENTAL SHELF

(No. of Wells begun per year)



TAB. II SUMMARY OF PRODUCTION WELLS

Prod. well No.	Well	Position		Well Pos. be-gun x)	Com-plet-ed	No. of days	Oper-ator	Field	Remarks
P 001	2/4-A-13	56° 31'15.23"	03° 13'22.21"	12.11.73	25.04.74	167	Phillips	Ekofisk	
P 002	2/4-C-13	56° 32'51.81"	03° 12'55.78"	12.01.74	08.07.74	180	"	"	
P 003	2/4-B-17	56° 33'58.80"	03° 12'13.02"	19.01.74	24.06.74	168	"	"	
P 004	2/4-B-7			28.02.74	11.06.74	103	"	"	
P 005	2/4-A-7			25.04.74	12.06.74	48	"	"	
P 006	2/4-B-15			11.06.74	15.10.74	96	"	"	P&A
P 007	2/4-A-8			12.06.74	03.08.74	45	"	"	
P 008	2/4-B-3			27.06.74	17.09.74	82	"	"	
P 009	2/4-C-8			08.07.74	13.08.74	36	"	"	
P 010	2/4-A-9			02.08.74	07.09.74	36	"	"	
P 011	2/4-C-5			13.08.74	26.10.74	75	"	"	
P 012	2/4-A-15			07..09.74	26.10.74	49	"	"	
P 013	2/4-B-18			17.09.74	24.10.74	38	"	"	
P 014	2/4-B-23			15.10.74	29.11.74	47	"	"	
P 015	2/4-B-10			24.10.74 24.02.75	03.02.75 17.03.75	123	"	"	
P 016	2/4-C-9			26.10.74	28.11.74	33	"	"	
P 017	2/4-A-5			26.10.74	02.12.74	42	"	"	
P 018	2/4-C-2			28.11.74	10.01.75	43	"	"	
P 019	2/4-B-22			29.11.74	05.01.75	37	"	"	
P 020	2/4-B-14			05.01.75 03.03.75	03.02.75 19.03.75	45	"	"	
P 021	2/4-A-2			08.01.75	23.02.75	46	"	"	
P 022	2/4-C-3			10.01.75	10.02.75	31	"	"	
P 023	2/4-D-9	56° 33'47"	03° 05'08"	21.01.75	20.04.75	90	"	Ekofisk	Temp.
P 024	2/4-C-14			10.02.75	19.03.75	37	"	Ekofisk	P&A
P 025	2/4-B-2			17.03.75	20.05.75	65	"	"	
P 026	2/4-C-12			21.03.75	23.04.75	33	"	"	
P 027	2/4-B-6			22.03.75	31.05.75	72	"	"	
P 028	2/4-A-3			28.03.75	14.07.75	100	"	"	
P 029	2/4-D-4			20.04.75	07.06.75	48	"	Ekofisk	Temp.
P 030	2/4-C-6			23.04.75	04.06.75	72	"	Ekofisk	P&A
P 031	2/4-B-1			20.05.75	12.07.75	53	"	"	
P 032	2/4-B-5			31.05.75	18.07.75	48	"	"	
P 033	2/4-C-15			04.06.75	13.07.75	39	"	"	
P 034	2/4-D-6			07.06.75	18.08.75	70	"	Ekofisk	
P 035	2/4-B-9			12.07.75 04.09.75	20.08.75 10.10.75	75	"	Ekofisk	
P 036	2/4-C-1			13.07.75	15.09.75	64	"	"	
P 037	2/4-A-11			15.07.75	20.08.75	35	"	"	
P 038	2/4-B-21			21.07.75	08.09.75	50	"	"	
P 039	2/4-D-8			16.08.75 08.04.76	17.11.75 14.04.76	93	"	Ekofisk	
P 040	2/4-A-14			17.08.75	22.09.75	35	"	Ekofisk	
P 041	2/4-C-10			15.09.75	03.12.75	79	"	"	
P 042	2/4-A-12			22.09.75 17.08.76	01.11.75 31.08.76	64	"	"	
P 043	2/4-B-19			16.12.75	16.04.76	122	"	"	
P 044	2/4-D-5			16.04.76 30.05.76	18.04.76 27.06.76	32	"	Ekofisk	Expl. Perm. No. 149
P 045	2/4-D-14			28.06.76	01.09.76	65	"	"	
P 046	2/4-D-1			01.09.76	30.09.76	31	"	"	
P 047	2/4-D-10			30.09.76	11.11.76	11	"	"	
P 048	7/11-A-7	57° 04'09.692"	02° 26'04.765"	23.08.76	21.10.76	59	"	Cod	
P 049	7/11-A-5			22.10.76	08.12.76	39	"	"	
P 050	7/11-A-3			12.12.76			"	"	

x) (from a 20" casing).

2.3 NEW DISCOVERIES

Hydrocarbons have been discovered in 6 new structures in 1976. See Fig. 2C.

25/2-5

In 1976 hydrocarbons were discovered in Jurassic sandstone under the East Frigg field. Hole 25/2-5 which was drilled in 1976 in a Jurassic structure further south in the block also resulted in a discovery. It is a relatively light oil, 0.81 g/cm^3 (43° API). The interpretation of the seismic data is ambiguous, and for the time being nothing can be said concerning the commercial value of the field. New seismic testing has been shot over the field.

The Statfjord Area

4 exploration holes have been drilled in the area, and oil has been found in three of these.

33/9-6 has been drilled in a structure north of Statfjord, just east of the British Murchison field. Oil was discovered, but because of technical problems the well could not be tested.

33/9-7 is drilled in a structure which lies as a north-eastern continuation of the Statfjord Field. It is possible that this structure continues into block 34/7 which is not covered by a concession. The preliminary results indicate that it is a relatively small but profitable field.

33/9-8 was being drilled at the turn of the year in a structure just northeast of 33/9-6. Oil has been discovered in the upper prospective horizon (Brent sand).

7/12-2 was drilled in a structure approximately 25 km east of the Cod field and oil was discovered in Jurassic sandstone. The oil has a specific weight of 0.82 g/cm^3 (41° API). One can still not say anything about the size of the deposit as no oil/water contact could be detected, but it is probably profitable. This discovery is very interesting as it is the first in the Jurassic formation in this area and opens the way for several new prospects, in part, in areas which have been relinquished.

1/9-1 was being drilled at the turn of the year. It was drilled in a salt structure of the same type as that in the Ekofisk area and both the Upper Cretaceous limestone and the Jurassic sandstone were prospective. Oil was found in the limestone and this is being tested. One will not be able to drill through the Jurassic prospect at this hole but it will probably be able to be investigated in a new hole in 1977.

2.4 EKOFISK AREA

2.4.1 Production Facilities and Permanent Installations

The development of the Ekofisk field has continued in 1976 and is being carried out in the following phases:

Phase I Tests and temporary production

Phase II Permanent production with direct loading into tankers.

Phase III Development of Ekofisk Center, link-in of the West Ekofisk, Cod and Tor fields, as well as the laying of the pipelines for oil and gas to Teesside and Emden, respectively.

Phase IV Construction and linking in of production facilities for the Edda, Eldfisk, and Elbuskjell fields.

The production from Phase I was completed in the spring of 1974, whereupon the temporary production platform, "Gulftide", was removed. At the same time, the development of the Phase II facilities was almost complete, and operations were begun with production from a couple of wells. The drilling of production wells with the Phase II facilities has been going on continuously since then, and is now finished, with 48 wells drilled, whereof 8 are being used for injection of gas.

The 2/4 A platform which was damaged after the accident in November 1975 was again ready for operation in the course of February 1976. The cause of the accident, a badly corroded riser pipe, resulted in all the riser pipes of the Phase II platforms being replaced in the course of spring and summer. This resulted in a severe limitation of the production while the replacements were being carried out.

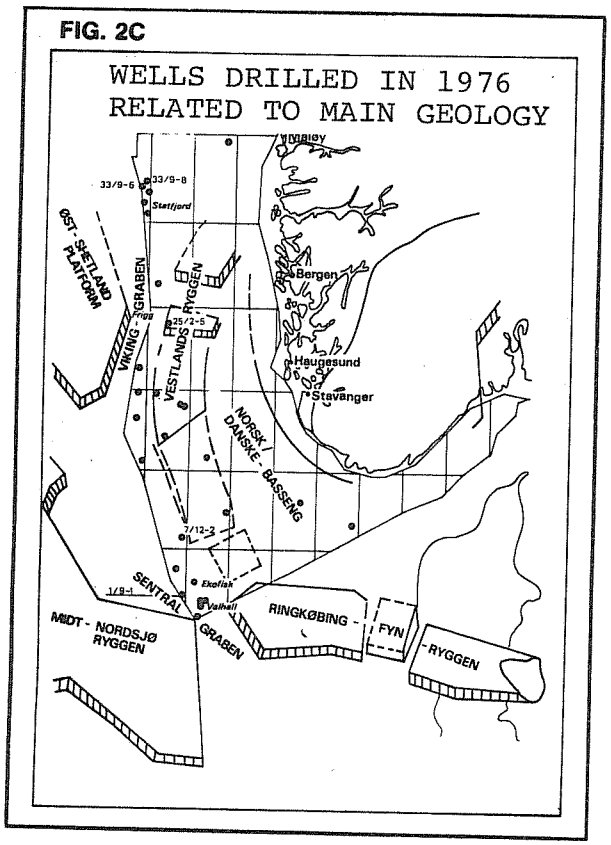
The oil pipeline to Teesside was brought into operation in October 1975 as the first part of the Phase III facilities. This means that there is no longer a need for buoy-loading the oil at sea. However, the loading facilities will be kept intact for use in case of need.

The West Ekofisk drilling and production platform was emplaced during the spring of 1974. It is, in fact, ready to be put into operation, but since it is to be connected to the equipment on the Ekofisk tank, there will be no production here until the facility on the tank is ready. Drilling of production wells has been going on since the fall of 1974 and is now completed, with a total of 9 production wells.

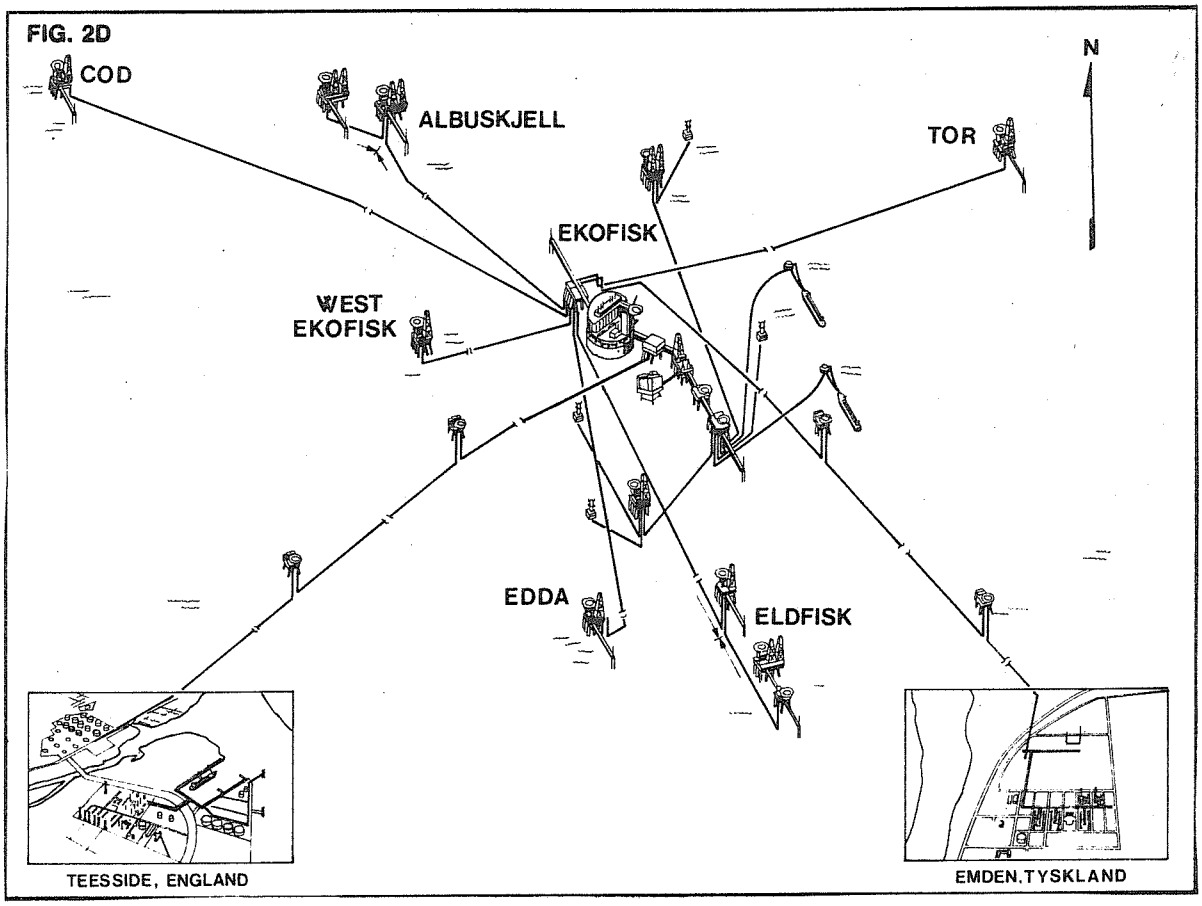
It is expected that the production equipment on the Ekofisk tank will be ready for operation in 1977. There has been an enormous amount of activity during the course of the year due to installation and welding together of the different modules. The 2/4-R platform was emplaced in the summer of 1975 and linked to Ekofisk Center by a bridge in the course of the spring of 1976. In the same manner the support structure for the new flaring tower was emplaced in the course of the spring and the installation work was completed in the course of the summer. The linking of the pipeline from West Ekofisk to the "R" platform was completed in July.

The delay in the development of the facilities in Teesside has resulted in a number of problems. NGL will not be able to be transported in oil pipelines before these facilities are completed. Up to now NGL has been reinjected into the reservoir together with the gas.

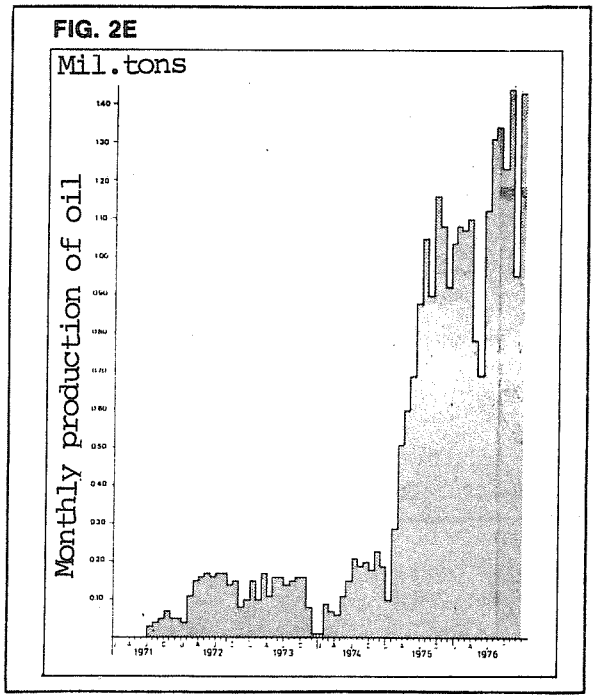
FIG. 2C



FACILITIES FOR FIELDS IN THE EKOFISK AREA



MONTHLY PRODUCTION OF OIL FROM EKOFISK



The NGL fraction must be injected back into the reservoir when gas begins to be delivered. This has effected a certain number of changes in the processing facilities, such as the additional installation of five pump units on C platform, to inject NGL.

The main structure facility at Cod field was erected in the beginning of 1975. The installation of modules at Cod field was finished during the spring and the facility was ready for production drilling in August 1976. During this period two production wells were drilled.

The damaged pipe from Cod to R platform has been under repair since last autumn.

The main structure for Tor was completed in autumn 1975. The deck and modules were installed and connected during the summer. It is estimated that this platform will be ready for production early in 1977.

The development of Phase IV is going according to plan. It concerns the following 6 platforms:

Eldfisk:	1 combined drilling/production platform 1 drilling platform 1 production platform
Edda:	1 combined drilling/production platform
Albuskjell:	2 combined drilling/production platforms.

The main structure of the Eldfisk, Edda, and Albuskjell installations were completed during the year.

On Eldfisk the main structure for 2/7-A was completed by the turn of the year, 2/7-B was finished in April, and 2/7-ETP in July. Albuskjell platform 2/4-F was also completed in July, while Albuskjell platform 1/6-A and Edda platform 2/7-C was finished in late autumn.

With this all the main structures except 2/4-H (Ekofisk hotel rig) were completed, and 2/4-H is expected to be finished in the second half of 1977. The whole of the Ekofisk area development is expected to be finished at the turn of the year, 1978-79.

2.4.2 Pipeline from Ekofisk

Ekofisk - Teesside

The oil pipe from Ekofisk to Teesside was put into operation in autumn 1975. The pipeline is 345 km long and 34 inches in diameter.

The pipeline is buried one meter below the sea floor for the whole of its length, except near rigs and land, where

the pipe lies 3 meters below the sea floor. The transport capacity of the pipeline has been estimated at around 160.000 cubic meters per day, when both rig pumps are in operation. Until now it has not been necessary to pump as the production capacity of the Phase II facility is around 60.000 cubic meters per day. Up to now only stabilized oil has been transported along the pipeline. When the Teesside plants are ready to receive NGL, the steam pressure on the oil will be increased to around seven atmospheres. Experience with the pipeline up to now is as expected.

Ekofisk - Emden

The gas pipeline from Ekofisk to Emden is expected to be ready for operation during the first half of 1977. The pipeline is 400 km long and has a diameter of 36 inches.

The pipeline will according to plan be buried around 1 meter below the sea floor, except in the areas near Germany, where because of the relatively shallow coastal waters and dense shipping it is necessary to bury the pipeline 3 meters below the sea floor. The plans however have been difficult to execute for a variety of reasons. Intense work is being done to make the pipeline as secure as possible.

The pipeline will probably have a transport capacity of near 65 million cubic meters of gas per day, when both compressor stations are in use.

2.5 Frigg Area

2.5.1 Production Facilities / Permanent Installations

The development of the Frigg field falls into two phases. Phase one concerns development on the British side and includes:

CDP.1.	A combined drilling and production platform
TP1	A processing and gas handling platform
QP	Living quarters and control centre.

Phase two concerns development on the Norwegian side and includes:

TCP	A gas treatment and compressor platform
DP2	A combined drilling and production platform

All platform installations on the Frigg field were in the autumn 1976 about 2 months ahead of the revised production plan time.

The drilling and production platform CDP 1 was begun in autumn 1975. During spring and summer 1976 holes were drilled in the bottom of the platform for production wells. The platform was originally meant as a pumping platform for the pipeline to St. Fergus. The drilling equipment was fitted after the summer. The connection of 24 inch formation pipes as well as the drilling of 3 production wells is expected to be finished in spring 1977.

The gas treatment platform TP1 which was built in Scotland was erected in June 1976. The installation of the module and the connection to the transport pipe was completed during the autumn. It is expected that the installation work will be continued over the new year and that the platform will be ready to go into operation in autumn 1977.

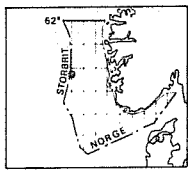
The main construction of the living quarters platform QP, was begun in autumn 1975. Since that time work has been going on, piling and cementing to attach the platform to the ocean floor. The installation of living quarters is expected to take place in the first half of 1977. In the meantime two mobile platforms serve as living quarters.

The main work for the combined drilling and production platform DP2 was begun in May 1976. Piling of the rig is expected to be finished at the turn of the year. Then the module will be fastened and it is estimated that the drilling of projection wells can begin in autumn 1977.

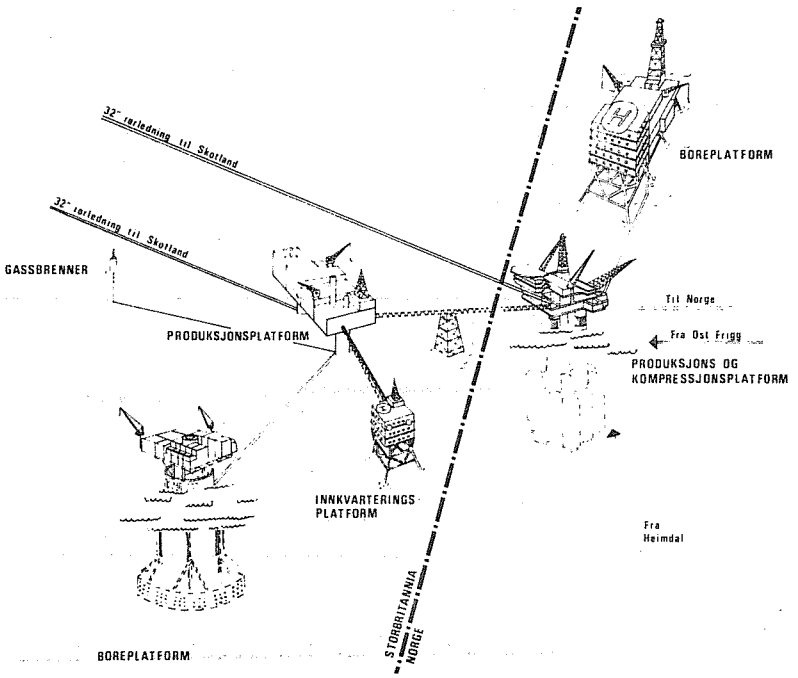
The concrete base for the combined gas processing and compressor platform TCP 2 is already built in Åndalsnes. The steel deck is expected to be in place by April 1977 and the towing will take place in May 1977.

It is estimated that production from the Phase I installation will start in October 1977 with a production capacity of 25 million cubic meters per day. Phase II installations should be ready for production by the end of 1978.

FIG. 2F



Planned positioning of the different platforms on Frigg Field



2.5.2 Pipelines from the Frigg Field

From Frigg to St. Fergus in Scotland there are two parallel pipelines. The pipelines have a length of 360 km and a diameter of 32 inches. Both operate via the same compressor platform. The total capacity through the pipeline before the compressor comes into operation is 60 million cubic meters per day, and 80 million cubic meters per day when the compressors are in use.

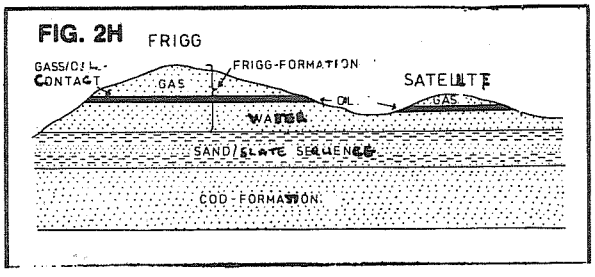
Phase I pipeline (The British) was begun in 1975 and is now sunk. Phase II pipeline (The Norwegian) was begun in 1976, except for a few kilometers near TCP 2 and the compressor platform. The pipeline has not yet been completely buried.

The compressor platform was begun in June 1976 and the necessary connections to the pipeline were achieved during the summer.

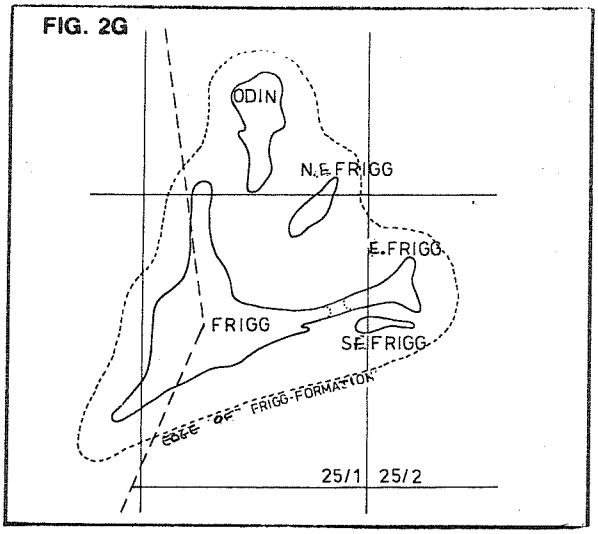
2.5.3 Joint Utilization (Unitization)

Both the concessionaires and the governments of the two countries have reached agreement concerning the combined utilization of the whole Frigg field. Nevertheless the distribution of the field between the two partners has not been brought to a conclusion. The concessionaires on both sides of the division have agreed to allow the American consultant firm, De Golyer & McNaughton, to resolve the question. The British and Norwegian governments will not decide on the question of reserve distribution until the consultant's statements and the concessionaires' acceptance of same, have been made. This is expected to happen in early 1977. The distribution the governments agree upon, will be decicive for the concessionaires.

The Petroleum Directorate has kept in touch with the development of the consultant's work, and has together with the Ministry of Energy been an observer in all the meetings between the consultants and the concessionaires. Furthermore the two institutions have worked closely together to handle the control, attributed them in accordance with the Frigg agreement.



Cross Section - Frigg Formation/Cod Formation



Frigg Formation, with Main Fields and Satellite Fields

2.5.4 Satellite Fields

The Frigg reservoir is found in a sand deposit which dates from the Eocene age. The sand has been given the geological description, the Frigg formation. The thickness of the Frigg formation varies over the area where it is found. The Frigg reservoir itself covers the area where the sand thickness is greatest. Around this area the sand generally thins out towards the outer borders. However in some places towards the edge one finds local thick zones which constitute seperate structures in the sand. These structures form the socalled satellite fields, of Frigg: East Frigg, South-East Frigg, Norsk-East Frigg, and Odin. The Frigg formation is thus an inter-connected sand body with a central structure and several smaller structures towards the margin: (Fig. 2G)

Gas is found in the upper part of the structures. Under the gas one generally finds a thin oil zone and under this the pores in the sand are filled. (Fig. 2H).

There is much to suggest that the East-Frigg is a part of Frigg, connected through the gas zone. Frigg and the other satellites have on the other hand different depths for gas/ oil contact, which exclude connection in the gas zone.

It is however very likely that a connection between Frigg and all the satellites exists in the water zone. This implies that all the reservoirs, are part of the same pressure system. Under the Frigg Formation one finds an older sand layer, the Cod Formation. Between the two sand formations there is a middle zone with alternation between sand and slate. (Fig. 2H). If the slate formations are dense and continue in an expanding width in the area in question pressure connection between the Frigg and Cod Formations will be prevented. The Frigg formation will in these circumstances have an isolated pressure system.

In this situation the pressure in the Frigg reservoir will gradually decrease when production begins. The pressure reduction will spread through the water zone in the Frigg Formation to the satellites fields. When the pressure is reduced in a gas reservoir the gas expands and the gas/oil contact is pushed downwards.

If the gas/oil contact in a satellite field is pushed down to the deepest point in the saddle between the satellite field and the main field, the so called spill-point is reached, and gas will begin to leak over from the satellite to the main field. The gas which is produced from the Frigg field will be divided between the partners on the British and Norwegian sides, according to an advance distribution agreement which will not include the satellite fields.

Even if the oil/gas contact in the satellite fields does not go down to the spill point, when the pressure falls, there will still be loss of gas. This is due to the resulting gas expansion with pressure reduction, the same amount being distributed over a greater area than previously, and the ability to take out the fraction of the total reserve that can be utilized for production, will be reduced.

As production from Frigg will be already started in 1977, it will be important to appraize the possibility of developing the satellite fields as soon as possible, so that production can proceed at the same time as that of the main field.

2.6 Statfjord Field

Development plans for the Statfjord field were put forward in Storting Report No. 90 (1975-76). In the main development in relation to the plans consists of three combined drilling/production platforms of the Condeep type.

Phase I of development consists of Statfjord 'A' platform which is being built at Stord Verft. The building of the concrete structure was finished during the summer and the platform was towed from Stavanger to Stord in August. The steel deck which was built at Stord Verft was transferred to the platform in the beginning of September. The living quarters' module was put in place during end November/early December.

The towing of Statfjord 'A' is planned to take place in May 1977. It is estimated that the schedule for the future development will run on time, despite delay in construction of some of the modules. Some difficulties have been experienced in assembling the projected work force at Stord Verft. Another problem has been the submersion of the platform to the proper work elevation at Stord.

A letter dated 11.11.76 from the Petroleum Directorate to the operators has led to alternations in the development

plans for the Statfjord field. It is pointed out in the letter, that 'B' platform must be built with its own living quarters platform for safety reasons. The letter points out further that there should be a reconsideration of safety conditions on Statfjord 'A'.

Several alternatives for the remainder of the Statfjord development are being considered by the Statoil/Mobil Group. Safety conditions on Statfjord 'A' are being reconsidered. It is as yet too early to say what the consequences of this will be.

In connection with the landing of oil from Statfjord 'A' a loading buoy is being built in France and Norway. It is expected that the various sections will be manufactured and assembled during 1977. The towing of this buoy is planned to take place in summer 1978.

For Phase I it has been decided to land the oil by loading buoy. At present there is a great amount of study being done by the Statoil/Mobil Group, to consider the possibility of landing the oil by pipeline to Norway, in Norwegian Trench at a depth of 330 meters have been suggested. The group is now working on a development project with a pipeline to Sotra, where it is intended to built a terminal with a capacity of around 40 million tons of oil and 2 million tons of NGL per year.

2.6.1 Joint Utilization, (Unitization)

A small section of the Statfjord field lies on the British side of the dividing line. This means that agreement must be reached both by the Norwegian and British concessionaires, and between Norway and Great Britain, according to the regulations of the continental shelf agreement of 10 March 1965.

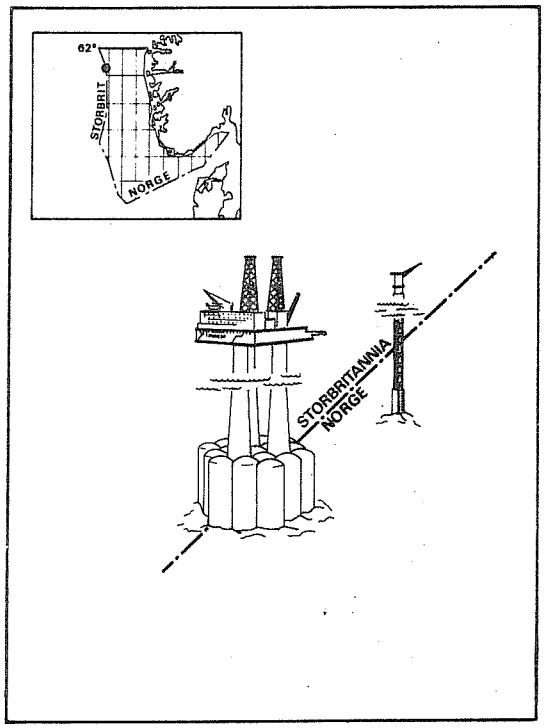
The two groups of concessionaires had reached a tentative agreement on the combined utilization of Statfjord field, on 17 June 1976. This will eventually be replaced by a final agreement, which is now being worked on.

To further decide the questions which should be controlled in the agreements between the two countries, and bring to a conclusion the agreement with the British authorities, a Norwegian delegation was formed with representation from the Ministries of Industry, Finance, and of Foreign Affairs, and from the Petroleum Directorate by Royal Resolution 2.5.75. The same type of delegation has been formed by the British authorities. The Statfjord delegations expect to have finished negotiations before production from Statfjord begins.

It will be much more complicated, both to extract the oil from the Statfjord field effectively, and to distribute the profits, than is the case for the Frigg field. This is because the petroleum in Statfjord field is composed of

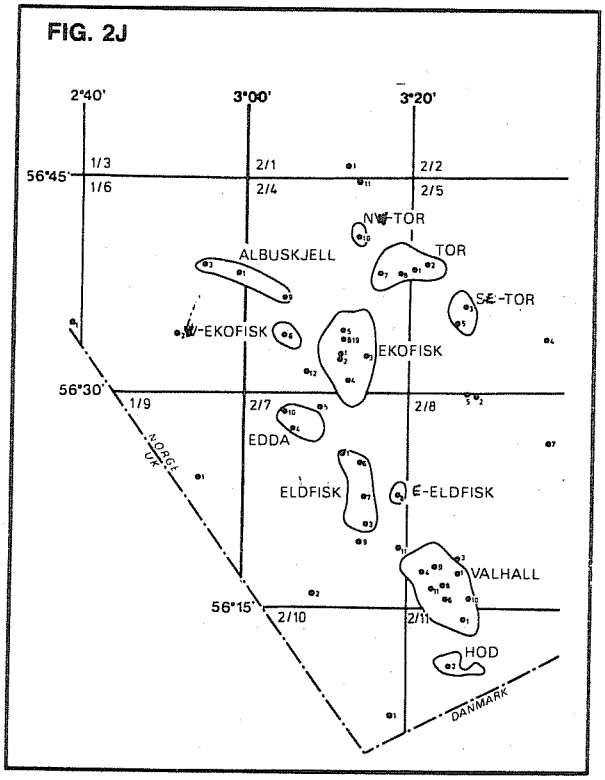
a broader spectrum of components which give more products (Gas, oil NGL, and a mixture of these) than the petroleum from Frigg. Furthermore the products can be extracted easier from the Statfjord field by both water and gas injections.

FIG. 2i



STATFJORD PHASE 1

FIG. 2J



EKOFISK AREA

2.7 Other Fields

2.7.1 Heimdal

As mentioned in the Petroleum Directorate's annual report for 1975, the Ministry of Industry received in November '75 a preliminary request from Pan Ocean/Petronord Group for permission to build a pipeline for the export of gas from Heimdal field to Scotland.

The recent seismic exploration seems to indicate that the reserves are less than the concessionaires previously thought. The request to develop the Heimdal field is therefore not confirmed by the concessionaires. The

concessionaires are now working on methods of determining the cheapest method of developing the field, and of making it profitable. It is not expected that an eventual new request for the utilization of the Heimdal field will be put forward before the end of 1977.

2.7.2 Valhall-Hod

Valhall and Hod are two fields which lie on the same structural trend about 35 km South-East of Ekofisk. The structure lies in block 2/8 and 2/11 and is around 15 x 30 km in size, with the largest stretch lying North-West, South-West in direction. The water depth is 70 meters approximately.

As of 31.12.76, 10 wells at Valhall and 1 well at Hod have been drilled. In Valhall there is evidence of Hydro Carbons in three zones, in chalk formations from the upper chalk age. The upper-most two, were not present in the well which was drilled at Hod (2/11-2). The first well drilled at Valhall 2/8-1 was finished as early as July 1968.

It has taken a comparatively long time to show the extent of the reservoir and estimate its size, which is partly due to the difficulties in getting seismic data of satisfactory quality in this area.

In a manner similar to the other reservoirs in Ekofisk, the reservoirs in Valhall and Hod are of a fine grained chalk with a uniformly high porousity. The permeability, which is an indication of the ease with which liquid can move through the reservoir, is however low. The oil containing zones in Valhall have a porousity of up to 50 per cent, and they are divided by smaller porous zones. Most of the reserves are to be found in the upper zones, from the Maastricht age which from a geological viewpoint consist of a formation termed the Tor Formation. The two lowest zones are presumed to be of respectively Coniac and Coniac-Turon age, and together constitute the Hod Formation.

The oil has approximately similar composition in Valhall and Hod. The density is around 0.83 g/cm3.

Preliminary reservoir estimates indicate that development amount will lie at about 20 per cent for oil and 70 per cent for gas. This is similar to the other fields in the Ekofisk area.

The Amoco-Noco Group put forward plans to the Ministry of Industry in October 1976 for the devleopment of Valhall-Hod. Initiation of a gradual development is proposed partly because the reserve estimates are uncertain and partly because there have been problems during test production from Valhall.

The Amoco-Noco Group suggested several alternative transport

methods for production from Valhall-Hod. The agreed solution is a pipeline to Ekofisk and from there transport of the oil through Norpipe's pipeline to Teesside. At present there are negotiations concerning the sale of gas to the Phillips Group for transport in a pipeline to Emden.

Den Norske Stats Oljeselskap A/S has the right to 10 per cent of the concessionaire's net earnings from the production sector in block 2/11 (Permit No. 033).

2.7.3 Murchison Field

The Murchison field lies northwest of Statfjord in block 211/19 (British) and 33/9 (Norwegian). The greater part of the field lies on the British side of the dividing line:

The field is approximately 2 x 6 km in size. The depth of the water is around 160 m. The field was discovered in August 1975 when drill hole 211/19-2 was drilled. Three holes have now been drilled in the field, all on the British side.

There is evidence of hydro carbon contained in sandstone formations from Middle Jura age, (Brent Formation). This formation has very good reservoir potential, i.e. high porousity and good permeability. The Brent Formation also contains petroleum in the Statfjord field. The oil has a lower gas content in Murchison than in Statfjord and the density is around 0.83 g/cm3. The Statfjord Formation is of sandstone which is separated from the Brent Formation by a dense slate layer termed the Dunlin Formation. In Murchison, hydro carbons however, have not yet been shown in the Statfjord Formation, which is the other petroleum-containing formation in the Statfjord field.

Conoco North Sea Inc. which is the operator for the Group which has concessions for the field on the British side, had put forward a development plan for the field to the British authorities. It is proposed to extract the Murchison product from a single steel platform. The most immediate transport possibility for oil produced, consists of building a pipeline to the Dunlin field, and then using the established pipeline system. The transport system for the gas has not yet been decided upon.

2.7.3.1 Joint Utilization (Unitization)

It will be necessary to proceed with a similar agreement for joint utilization of the Murchison field as for the Statfjord field, as the Murchison field also crosses the dividing line between Norway and Great Britain. The same group of concessionaires participate in the utilization of the field on both sides of the mid-line.

Negotiations have been started with a view to reaching agreement on such joint utilization of the field, but before the Norwegian concessionaires can reach a formal agreement

on this, it is necessary to first demonstrate the field's commercial ability and request permission for the development and possible landing from the Norwegian sector of the field. It is expected that the Norwegian concessionaires will complete studies in connection with the commercial declaration shortly. In the meanwhile the negotiations continue and cooperation with the British concessionaires in accordance with the development, proceeds. The Petroleum Directorate act as observers together with the Ministry of Energy in all the technical meetings.

2.8. Petroleum Reserves

2.8.1 Status

In 1976 ten years had elapsed since the first well was drilled on the Norwegian continental shelf, and as a result of the work done during this period, a good indication of the petroleum reserves south of 62^{o} North can be obtained. Similarly there will be considerable uncertainty as to the extent of reserves for a long time in the future.

The most positive figures concern finds which have been made and which are termed known reserves. Much more uncertain is the extent of undiscovered reserves.

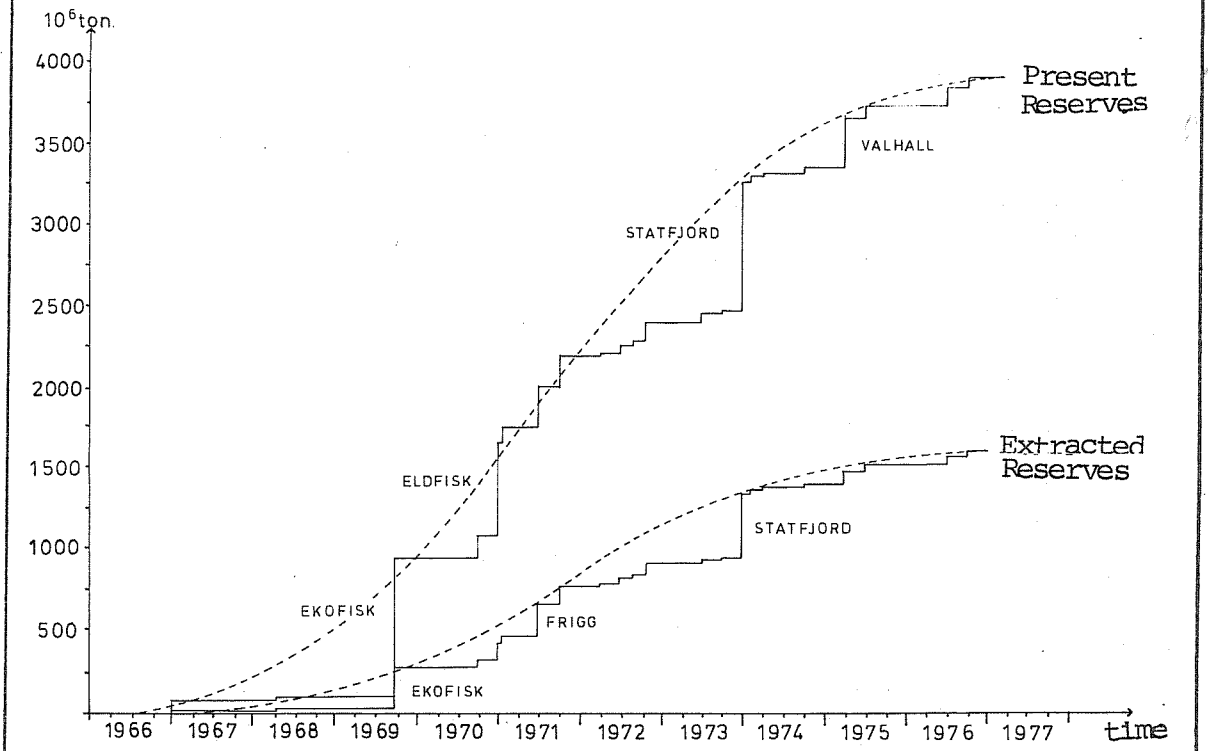
For the Norwegian shelf south of 62^{o} North, the following figures are available of reserve amounts, which can probably be extracted in million tons oil equivalents:

Known reserves	1400
Undiscovered and doubtful reserves	2000

To illustrate the development in size of known reserves on the Norwegian shelf since drilling began in 1966, a graph has been drawn of cumulative reserves in million tons of oil equivalents. In fact this appears in step-like stages. In Figure 2K this step by step development of present and possible reserves is shown together with smooth curves of the development. The stage itself where the reserve amount in a field manifests itself is connected to the quarter in the year of the find when the field was first registered.

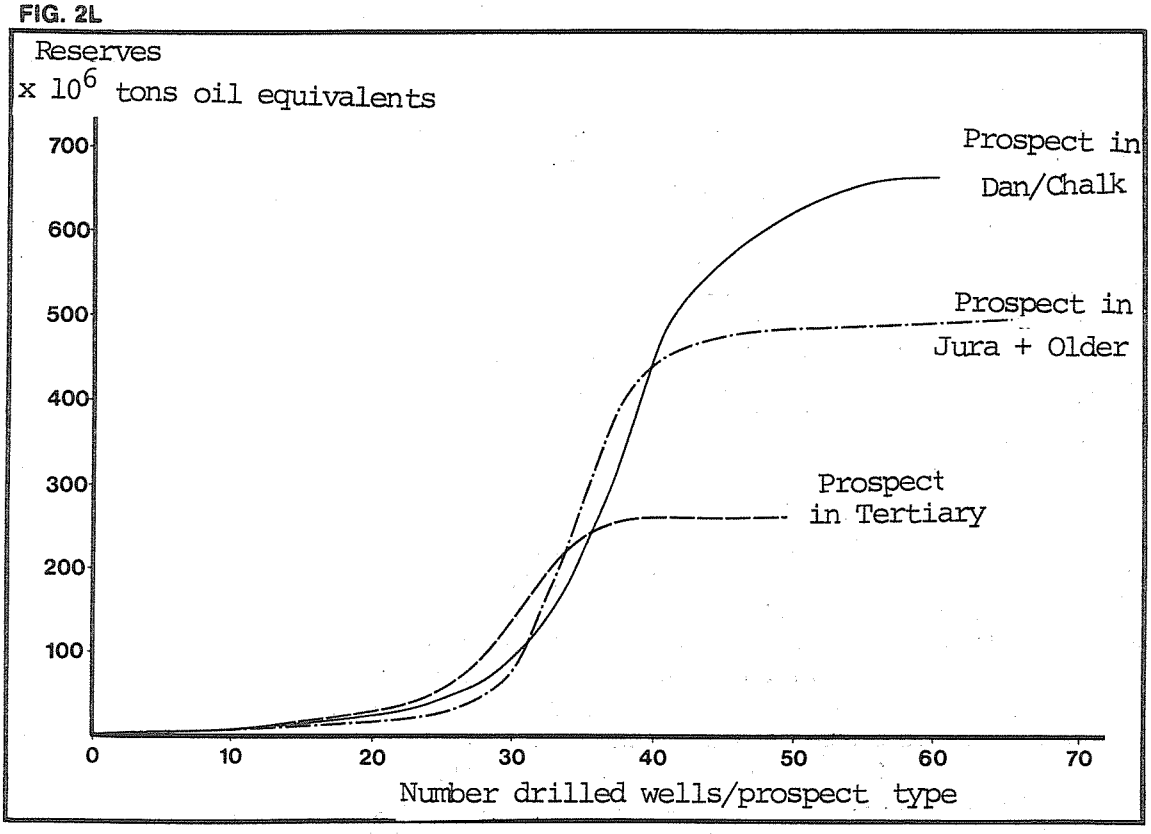
If a straight line was drawn through the top of the Ekofisk stage, and the top of the Statfjord stage on figure 2K (Stipled line) it is seen that from the period 1967 to 1975 there is an almost linear increase of known present oil reserves. This has close connection with the concession policy adopted. However since Statfjord field was found, sufficient reserve quantities have not been discovered. If the situation is to be "back on line" in 1977, 1675×10^{6} tons of oil equivalents must be discovered during the year. This seems unrealistic, and it can be presumed that the very good period from 1967 to 1975 is terminated. During that period one had an average find frequency of equivalent petroleum reserves of about 560×10^{6} tons oil equivalents per year.

FIG. 2K



KNOWN NORWEGIAN RESERVES

FIG. 2L



DEVELOPMENT OF DIFFERENT PROSPECT TYPES IN NORWEGIAN PART OF THE NORTH SEA

Even though this period may be considered ended, correspondingly favourable periods might be experienced in the future. This depends on various factors including the size of the area
This depends on various factors including the size of the area
covered by awards, exploratory activity and breakthrough for new types of potentials.

The potential types which have formed the basis for investigation on the Norwegian Continental Shelf have undergone changes and development since the start of oil activity. The potential types that have been realistic may be summarized as follows:

1. Gas reservoirs in Permian sandstone.

2. Oil/gas reservoirs in Tertiary sandstone (e.g. Cod, Frigg).

3. Oil and condensate in Danian and Cretaceous limestone (e.g. Ekofisk).

4. Oil and gas in sandstone reservoirs of Jurassic or greater age (e.g. Statfjord).

The first potential type has hitherto provided no finds on the Norwegian Shelf. Drilling results indicate a lack of the most important bases for gas finds of this type such as are found in the southern part of the North Sea and off Netherlands, namely gas generating coal in strata of Carboniferous age.

The three other potential types were all established only after an exploration period involving 25-30 dry holes before the discovery period began. (Fig. 2L). All three potential types have a small discovery increase as of today. Based on geological knowledge of the Norwegian sector of the North Sea, potential types (2) and (3) have reached the third phase mentioned in the introduction. These potential types are thus regarded as having relatively slight remaining possibilities. The low rate of discoveries for potential type (4) is considered temporary, and there still remain undrilled low-risk potential of this type within awarded blocks. The essential part of undiscovered reserves in blocks not awarded is also appraised as being of this potential type.

An important basis for the three potential types appears to be the presence of upper Jurassic oil and gas generating shale rock types. Large quantities of this type of rock are found in a zon e which follows the borderline between Great Britain and Norway from 56°N - 60°N. The zone widens north of 60°N and the maximum trend swings north-northeast onto the Norwegian Shelf. A secondary maximum is found about field 9.

2.8.2. FIELDS FOR WHICH DEVELOPMENT IS PLANNED.

As of today, the decision has been made to develop 13 fields which in toto or in part lie in Norwegian territory. (Table III). Knowledge about these fields varies considerably. Ekofisk is the only field where drilling has been completed with production holes. More information has thus been assembled about this field than about the others. The least information is available about Hod where only one hole has been drilled.

Three of the fields lie partly on the British and partly on the Norwegian Shelf. This is true of Frigg, Statfjord and Murchison. The estimated Norwegian portion is given as a percentage, shown in parentheses alongside the field name in Table III. It should be noted that these proportion figures are preliminary and subject to further appraisal.

The following changes have taken place as compared with the previous year's report:

The changes for Cod and Ekofisk are due to new production holes which have provided data which, together with previous information, has resulted in a new interpretation.

New interpretation has been made of the fields Edda, Ekofisk, Eldfisk and Tor. Increased understanding of the geology of the Ekofisk area generally together with more detailed analysis has resulted in new reserve figures for these fields.

In the case of Albuskjell, Edda and East Ekofisk there has been no change in the estimates of reservoirs present, but there has been a reappraisal of exploitability.

The Frigg reserves remain unchanged. The concessionaire's figures were provided last year, while this year the figures of the Petroleum Directorate are used.

TABEL III Probable Reserves in fields planned to be developed

Field	Present		Exploitable	
	Oil - 10^6 tons	Gas - 10^9 Nm^3	Oil - 10^6 tons	Gas - 10^9 Nm^3
Albuskjell	51	55	32	51
Cod	5	14	3	8
Edda	26	8	6	6
Ekofisk	690	174	133	117
Ekofisk Vest	60	36	22	20
Eldfisk	430	140	55	48
Eldfisk Øst	41	13	5	8
Frigg (50 %*	–	(250) 125	–	(200) 100
Hod	29*	10*	9*	3*
Murchison (20 %)	(81) 16	(6) 1	(41) 8	(3) 1
Statfjord (88,9 %*	(660) 590	(136) 120	(330) 295	(68) 59
Tor	100	29	26	19
Valhall	235*	60*	52*	39*
Total Norwegian Reserves	2.273	785	646	479

* Concessionaire's data

TABEL IV Probable Reserves in other fields

Field	Present		Exploitable	
	Oil - 10^6 tons	Gas - 10^9 Nm^3	Oil - 10^6 tons	Gas - 10^9 Nm^3
Balder	70		14	
Bream	< 1		< 1	
Brisling	< 1		< 1	
Frigg Nord-Øst		13		10
Frigg Sør-Øst		2		1
Frigg Øst		8		6
Heimdal		50		40
Murphy		< 2		< 2
Odin		40		30
Sleipner	22	161	4	104
Tor Sør-Øst	14	4	3	3
Total	108	280	23	196

Valhall, Hod and Murchison are new fields as far as concerns last year's report.

The total quantity of oil present in commercial fields has increased by 28 x 10^6 tons while gas present has been reduced by 16 x 10^9 M^3. Exploitable oil has been reduced by 71 x 10^6 tons and the gas quantity reduced by 37 x 10^9 M^3.

2.8.3. OTHER FIELDS.

In this group there are three types of fields:

a. Minor fields that are not economically exploitable.

b. Economically marginal fields.

c. Fields still being investigated in order to obtain further information as to size.

All fields in this group together with their probably reserves are shown in Table IV.

The three largest fields are Sleipner, Heimdal and Odin, and these are also the ones with the greatest possibility for production start. Further discussion of these fields has been provided in reports of previous years. Both Sleipner and Heimdal are being given continuing appraisal and at least one hole will be drilled in each of these reservoirs during 1977.

All of the other fields in this group have been discussed in previous annual reports except Balder, Bream and Brisling which are included herein. The reason they have not been included previously is because of their modest size.

BALDER.

The Balder oil field lies in the northwest corner of block 25/11 with a small portion on block 25/10. The discovery

was made with drill hole 25/11-5 which tested 4000 barrels of oil daily in sandstone of the Paleocene age and at ca. 1750 m. depth. Average water depth is 127 m.

There have been a total of 7 holes drilled in this structure and it has been found that the geological conditions are especially complex as regards this reservoir. The field, which has a dimension of 5 x 6 km. contains ca. 70 million tons of oil, but it will be possible to extract only about 20% because of unfavourable conditions. The viscosity of the oil is more than 10 times the viscosity of water. It is, however, as yet to early to abandon the field as being uneconomic for exploitation. Special extraction techniques and favorable economic circumstances could mean that there could be production from the field.

The concessionaire for block 25/11 is Esso Exploration and Production Norway Inc. The same company also holds the rights to 25/10, but here the government has the right to 17.5% of the net profit of the concessionaire in the event of production.

BREAM

The Bream Field lies in the northeast part of block 17/12. There is only one drill hole on the field, 17/12-1. This well which discovered the field was completed 21/6/72. The find was made in a sandstone formation of the Middle Jurassic Age at ca. 2340 m. Average water depth is 116 m.

The concessionaire is the Phillips Group and the find is, as of today, considered too small to be economically exploitable.

BRISLING.

This field also lies in block 17/12. It was found by drill hole 17/12-2 which is the only well in the structure. Drilling was completed 10/10/73. Brisling is a sandstone reservoir of the Mid-Jurassic Age and at 2160 m depth. Average water depth over the field is 98 m.

The Phillips Group is the concessionaire also for this field, and, even combined with Bream, the reservoir is too small to be economically exploitable under today's conditions.

Even if the Bream and Brisling fields are in themselves of minor interest, they are geologically very interesting. They demonstrate that there are liquid hydro-carbons in the area which again means that there are source type rock structure which have been exposed to the "right" temperature.

2.8.4 NEW DISCOVERIES.

In addition to the fields listed in Tables III and IV there have been made a number of discoveries for which there is as yet insufficient data to make a satisfactory appraisal. These finds are discussed in greater detail under 2.3.

2.8.5. RESERVES NOT YET DISCOVERED.

Estimates of reserves not yet discovered are of necessity extremely uncertain. By means of seismic maps of structures in the presumed potential sectors and by extrapolation of drill hole data, it is, however, possible to obtain relevant information regarding the factors included in normal volume calculations for hydro-carbons.

The estimate arrived at is not concerned with whether or not oil will be found. In evaluating reserves in undrilled areas it is therefore customary to establish a geological exploratory risk. It is customary to multiply the volume estimate by the exploration risk so that a risk weighted estimate is the result. The total of several risk weighted estimates is used to express the possible reserves in a large area.

An appraisal of the size and distribution of non-discovered reserves on the Norwegian Shelf in the North Sea was made by the Petroleum Directorate prior to the selection of blocks for an eventual 4th round of awards.

The total of the estimates for the risk weighted reservoirs in all structures in blocks not awarded on the Norwegian Shelf comprises 1.6×10^9 tons of oil equivalents. In addition it is assumed that there are 0.4×10^9 tons of non-discovered reserves in areas where blocks have already been awarded.

The total estimate of risk weighted reserves is uncertain and may easily be changed with access to new information. It is, however, the view of the Petroleum Directorate that non-discovered reserves are distributed on a relatively small number of blocks.

2.9. UTILIZATION OF PETROLEUM DEPOSITS.

2.9.1 GENERAL.

Utilization of petroleum deposits includes exploration for and mapping of deposits, planning and development of extraction installations and operation of these during the actual production phase. In order to make a correct evaluation of these, it is necessary to review the economic resources required for each phase of utilization.

Activity on the continental shelf hitherto and forecasts available for the future activity provide the best foundation for such a review. Fig. 2M shows the outlays that have hitherto been required in the exploration phase and those which have been required and expected for the development and operational phase. Magnitude of sales income over a period is also shown.

The seismic investigations that have hitherto been carried out have in total required ca. 0.4 billion Kroner south of 62°N. They have constituted the basis for exploratory and delimination wells to a total of kroner 3.5 billion.

The fields which have been decided to be developed contain ca. 2730 million tons of oil equivalents, of which ca. 1020 million tons are estimated to be extractable. The cost of developing these fields is estimated at ca. kr. 70 billion. Operation of the extraction installations is estimated to require about kr. 90 billion (1977 kroner) during the life of the fields. The sales value of the extracted petroleum will be ca. kr. 500 billion at present price.

There is presently great uncertainty as regards the forecasts both for development costs, operating costs and production volume. There is similar uncertainty as regarding the sales price of petroleum for the future. The depiction given here is meant primarily as an illustration of the interrelationship among the various types of activity. Rather than complicating the picture unnecessarily, the 1976 price of petroleum has been used in conversion of production quantities to sales income. The actual sales income will be affected by price changes over time. This will distort the interrelationship among the various activities to some degree, but hardly significantly.

If one views the distribution of activities over time, as presented in Fig. 2M, it is clear that the outlays for extraction installations and the operation of these are considerable while the costs of seismic investigation and exploratoty drilling are of lesser importance. All the costs are, however, far exceeded in magnitude by sales income. Gradually, as the deposits are tapped, it will be necessary to initiate new production in order to maintain a given production level. Over the longer term it must also be assumed that the cost of producting petroleum will be higher per unit than the cost of the petroleum already planned for production. Operating costs are first and foremost a function of the number and size of the production units. These must be expected to increase relative to sales income as production from more and more installations nears the border of marginal economic operation.

The actual production of petroleum is of overhelming significance. It is, however, important to make provision so that development and operating costs do not become unnecessarily large. Both of these place heavy demands on the data basis on which the planning of exploitation is built. There is also much to be gained by a close cooperation betwen the authorities and the firms organizing and carrying out utilization. Reference in this regard is made to 6.1 regarding administration of resource utilization.

2.9.2 PRODUCTION FORECASTS.

Fig. 2N. provides a greater insight of the reserve situation as it appears today. At the top are the known and exploitable reserves in commercial fields. In the time to come, the extractable petroleum quantities in discoveries hitherto made gradually be depleted as production continues. New reserves must be found in order to compensate for this. It is relevant to seek these in the deposits that are or are expected to be declared commercial, especially in the fields in the Ekofisk area where the extraction level is expected to be low. A certain amount of time pressure is involved here, since it may be considerably more difficult to increase the production level from these fields as the reservoir pressure drops as a result of earlier production. One of the reasons that such measures have not yet been considered is that the rock structures in the area are difficult. Another reason may be the high investment that may be expected in connection with production may be reduced, if, for example one uses gas as a means of displacement for oil before it is produced for sale, or one chooses to limit the production rate in order to increase the extraction level. It may be found to be both a difficult technological and administrative problem to see that these fields are fully utilized.

The lower part of Fig. 2N depicts the quantities of petroleum so far extracted as well as the quantities expected from discoveries made as of 1/1/77. The figure also shows how large a part of the expected production comes from fields where a decision in favor of development has already been made. The corresponding forecast provided in the Petroleum Directorate's annual report for 1975 is shown in dots for purposes of comparison. The forecast for the previous year is based on production estimates for only those fields which it had then been decided to develop. During 1976 the British decided to develop the Murchison Field. The Norwegian share of production from this is, however, modest. The extractable reserves on the Norwegian side do not amount to more than 9 million tons of oil equivalents.

Production in 1976 was somewhat smaller than anticipated, 13.6 million tons of oil produced as against 15 million tons expected. The main reason for this was the replacement of risers on the platforms in the Ekofisk area. The year's forecast will in the near future be adjusted somewhat downward relative to that made last year. This is primarily due to the postponement of the completion of the gas pipline to Emden, of the NGL

FIGURE 2M Summary of monetary resources in exploration for and exploitation of those petroleum deposits for which a decision to exploit has been made on the continental shelf.

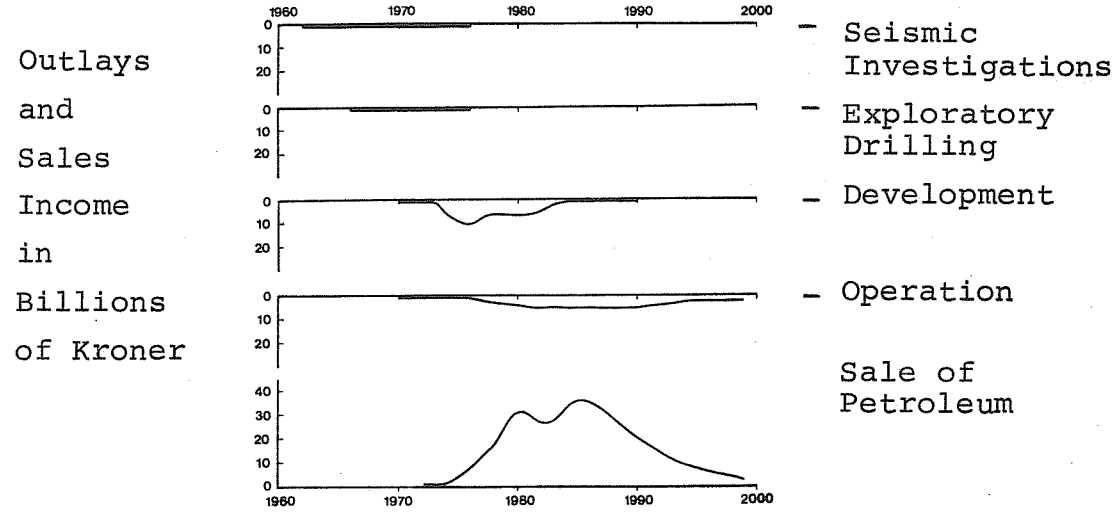
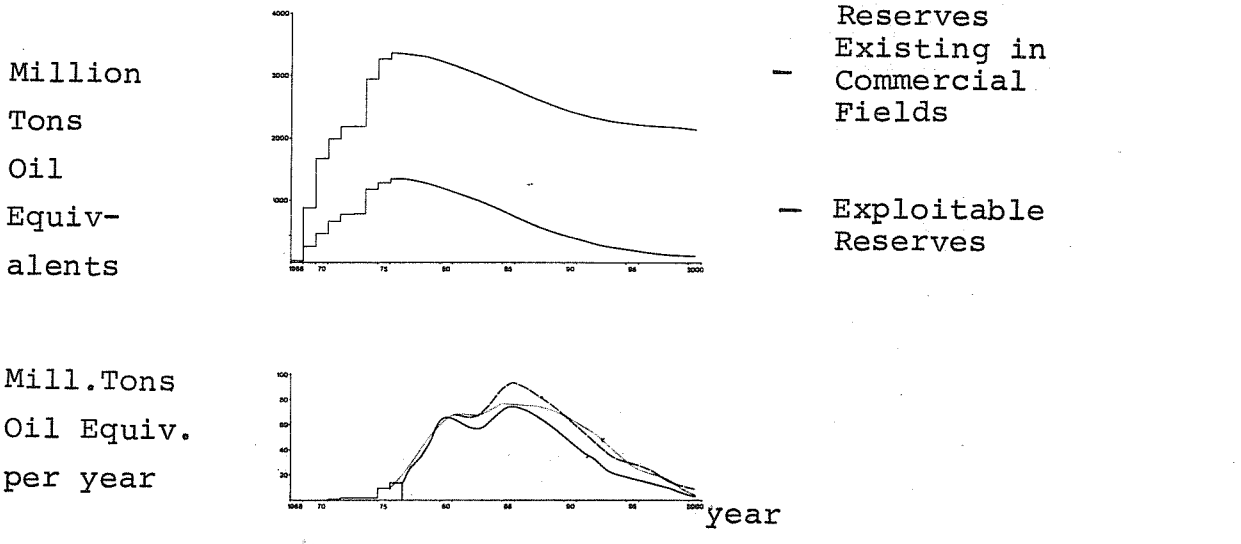


FIGURE 2N Existing and Exploitable reserves and extraction from deposits discovered as at 1.1.77.



installations at Teeside and of the production facilities for the Eldfisk Field. The estimate for the Cod Field has also been adjusted downward due to poorer results than one had been led to expect from the first production wells. A part of these reductions are compensated for by better progress in development work at the Frigg Field than had been expected and a reappraisal of the production results from the Albuskjell reservoir. Even if this year's forecast is somewhat altered from that of last year for the years up to 1980, the difference is not so great as to lie within the uncertainty area inherent in the forecast for the year. The year's forecast shows some decrease in production from deposits already decided upon for development. This is mainly due to the very considerable delay in the further development of Statfjord Field after 1980. Whether or not the reduction will occur depends upon whether it will be possible to develop new exploitable reserves. A 1977 decision to exploit Valhall and Hod can contribute to lessen the reduction in production. Measures making it possible to maintain the productivity of the Ekofisk Field will also contribute to lessen the reduction.

Production from fields for which development has been decided is again expected to increase with further development of the Statfjord Field towards the mid-1980's and is expected to reach the maximum level of ca. 75 million tons of oil equivalents by 1985.

Expected production from all finds made as of 1/1/77 shows an increase towards a maximum production of about 90 million tons of oil equivalents annually by 1985-86. This forecast is based on highly uncertain estimates of production from fields for which there are no development plans. The maximum production can hardly be reached before expected, since it is, among other things, dependent on a transport alternative for gas. It is difficult to press planning and construction of this. Maximum production may on the other hand come later and then be somewhat lower as a result of postponements etc. The result will, however be that production will continue longer both as a result of time shifts to later dates and because new exploitable deposits will be found.

2.10 REDELIVERY OF CONCESSION AREAS.

There have been no obligatory redeliveries of concession areas during 1976.

As a means of leverage in concession policy there is included a provision for progressive area fees which are intended to prevent a concessionaire from "sitting on" blocks which they have no intention of developing. As of now, this policy appears to be functioning as intended in that a number of the blocks awarded in 1965 were voluntarily

redelivered during 1976. A total of 27,423 km^2 or 65.1% of the original 42,106 km^2 have as of now been redelivered. The Petroleum Directorate has also received and approved proposals for in part voluntary redelivery of 1965 concessions which will take effect 1/9/77. This concerns an additional 7895 km^2 so that as of 1/9/77 only 18.5% of the areas awarded in 1965 will be under concession.

25 of the blocks awarded in 1965 have now been redelivered in their entirety. These are blocks: 2/2, 3/1, 3/2, 3/3, 6/3, 7/8, 7/9, 8/1, 8/5, 9/7, 9/8, 9/9, 9/10, 9/11, 9/12, 10/7, 10/9, 10/10, 10/12, 11/7, 11/8, 11/10, 16/7 and 16/9.

As of 1/1/77 the total areas under concession are as specified in Table V.

TABLE V

Concessions Awarded	Original area km^2	Redelivered area km^2	km^2	Distributed by number blocks
1965	42106.041	27422.604	14683.437	53
1969	5878.647	1489.264	4389.383	13
1971	523.937	0.0	523.937	1
1973	586.834	0.0	586.834	2
1975	2329.206	0.0	2329.206	8
1976	2068.318		2068.318	7
	53492.983	28911.868	24581.115	84

The following table shows the extraction licenses in effect on the Norwegian Shelf:

TABLE VI

Awarded Effective from	Exploitation Licenses No.	Total Area km^2	Number Blocks
1 sept 1965	001-021	39842.476	74
7 des 1965	022	2263.565	4
23 mai 1969	023-031	4107.833	9
30 mai 1969	032-033	746.255	2
14 nov 1969	034-035	1024.529	2
11 juni 1971	036	523.937	1
10 aug 1973	037	586.834	2
1 april 1975	038-042	2329.206	8
6 aug 1976	043	604.559	2
27 aug 1976	044	193.077	1
3 des 1976	045-046	1270.682	4
		53492.983	109

2.11 AWARD OF NEW CONCESSIONS.

There were 4 new extraction licenses granted during 1976. The participants in these are:

Extraction licence 043:

Statoil	50%
BP Petroleum Development of Norway (operator)	50%

Extraction license 044:

Statoil (operator)	50.10%
Phillips Petroleum Norsk A/S	25.87%
Norske Fina	15.00%
Norsk Agip	9.13%

Extraction license 045:

Statoil (operator)	50%
Texaco North Sea Norway A/S	35%
Norsk Hydro Produksjon A/S	10%
Saga Petroleum	5%

Extraction license 046:

Statoil (operator)	50%
Esso Exploration and Production Norway A/S	40%
Norsk Hydro Produksjon A/S	10%

2.12 TRANSFERS OF RIGHTS.

The following transfers of concession rights have taken place during 1976:

Conoco, Petroswede, Chevron and Texaco have given up their interests in extraction licenses 013, 014 and 015 and the new interest holders are now:

Deminex Norge A/S	75%
K/S Pelican & Co A/S	25%

None of the participants can at the present time act as operator so it may be expected that there may be an additional transfer of rights in order to obtain participation by an operator.

The following blocks are affected by the transfer:

License 013	8/6, 2/1, 7/12
License 014	8/12, 16/8
License 015	10/5

Gulf Oil has given up its interest in licenses 019 and 020 during 1976 and BP Petroleum Development of Norway A/S has taken over the interest. The participants are now:

PB Petroleum Development of Norway A/S	70%
Norske Conoco A/S	25%
K/S Pelican & Co. A/S	5%

In connection with the transfer of rights, the working program tied to the license was expanded by two exploratory holes. Statoil has also obtained an option to participate to the extent of 12.5% (carried interest) in the event a commercial find is made.

The following blocks are affected by the transfer:

License 019	2/1, 7/12
License 020	16/8

Conoco has transferred a part of its rights under license 039 to Norsk Hudbay A/S, a subsidiary of Hudson Bay Oil Company which is in turn controlled by Continental Oil Company (Conoco).

There is now the following distribution of interest among the licensees:

Statoil	50.00%
Norske Conoco A/S	23.33%
Norsk Hudbay A/S	16,67%
Norsk Hydro Produksjon A/S	10.00%

The transfer affects block 24/9.

The interest of Norsk Brændselolje A/S in license 041 was taken over by BP Petroleum Development of Norway A/S in connection with the governments acquisition of the former company. Distribution of interest among the licensees is now:

Statoil	50%
Saga Petroleum A/S	15%
BP Petroleum Development of Norway A/S	35%

The transfer affects block 35/3.

3. ACTIVITY NORTH OF 62° NORTH

3.1 Geophysical Exploration

In the long term planning of this area, the Petroleum Directorate aimes at a systematic mapping of all resources on the continental shelf. Normally the mapping proceedures are conducted regionally, then gradually incorporating a more semi-detailed mapping. The Petroleum Directorate itself has of today not conducted any geophysical exploration. This work is considered to be part of the preparation for the actual drilling and should be undertaken by the relevant concessionaire.

The approximately 10.000 km's of geophysical tests completed this year is a natural continuation of the Petroleum Directorate's earlier work. The exploration was intended to answer better some of the questions regarding the coast of Helgeland where surveys have taken place since 1969. The majority of the work however, has been done in the Barents Sea. This area is considerably less explored than the shelf further south. Regional findings have been added to the results of the exploration that was carried out throughout the last few years.

The geographical division of the exploration is:

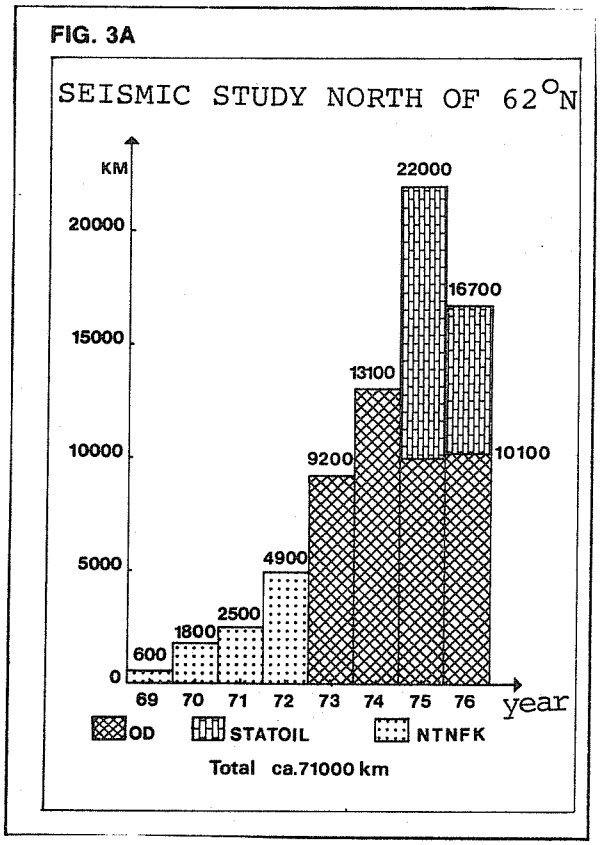
The coast of Helgeland	1375 km
The Barents Sea	8732 km
	10107 km

In addition to the regional and semi-detailed seismic exploration the Petroleum Directorate has tried out a special type of energy source developed by Shell, for use during seismic measurement. The tests were conducted off Helgeland, Troms and in the Barents Sea. They include a total of approximately 900 km, and are used in conjunction with earlier profiles.

The early results show a considerable improvement in the quality of the data and the experiment is thus considered successful.

In the years 1969-76 a total of approximately 71000 km of reflected seismic tests were completed north of 62° north. Figure 3a indicates that the amount of exploration conducted by the Petroleum Directorate normally reaches approximately 10.000 km a year. Figure 3a also showed 1975 to be an active year for seismic exploration north of 62° north. Here Statoil has covered large areas (off Troms and Møre/ Trøndelag) with semi-detailed and detailed seismic surveys.

Figure 3a see next page.



3.1.1 Helgeland Exploration

Up till the end of 1975, - 15,650 km of reflected seismic data had been collected by the government off Helgeland, (Fig. 3B). On the basis of reprocessed data off Helgeland together with the 3000 km shot in 1975, a study concerning the area was sent to the Ministry of Industry on 21.7.76. As far as petroleum is concerned, the area seems to be promising. The sediments are believed to contain source rock and reservoir rock.

This years exploration of 1375 km was covered by Statex. The program, see figure 3B, was designed to amplify some of the questions raised during the interpretation of the exploration carried out in earlier years. The lines were also placed in direct relation to the structural picture in order to produce a maximum of information on the area. The data will eventually be included in the study under discussion.

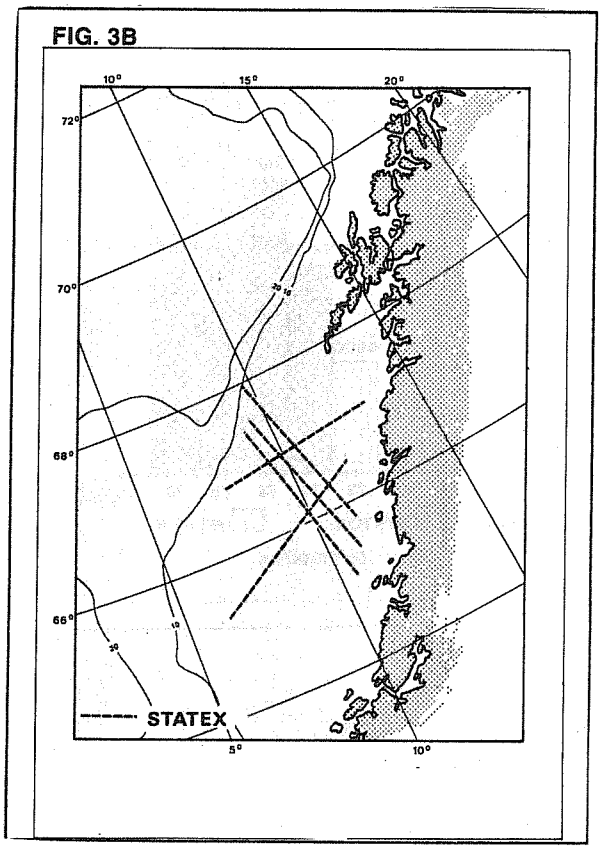
3.1.2 Exploration in the Barents Sea

By the end of 1975 a total of 10.375 km of seismic material had been collected in the Barents Sea. On the basis of this data, a report designed to analyse the results was published.

Large sections of the Barents Sea were at the time still unknown, and as figure 3c shows, a major part of that area, a total

of 8732 km, was covered by the exploration. The work was undertaken by Geco, Statex and Seismograph Ltd.

The areas explored so far have shown evidence of considerable sedimentary depth.



SEISMIC STUDY OF HELGELAND 1976

3.1.3 Experiments with Linear Energy Sources

In addition to the usual surveys, the Petroleum Directorate has completed a seismic experiment in the Barents Sea. The background for this was that in one part of the area it had been difficult to get seismic data of good quality. The specific problem seems to lie with the fact that a few of the transmitted pulses remained swinging back and forth in the water rather than penetrating down into the seabed. Theoretical studies show that by using a linear source of energy rather than the traditional (and approximate) point source, the problem would concievably be solved. In September/October approximately 900 km of data was collected, using a linear source of energy measuring up to 250 meters. The exploration was conducted by the Norwegian company Geco A/S.. The result will be evaluated by a special data-processing system and the final result will be published in the spring of 1977.

SEISMIC STUDY IN BARENTS SEA 1976

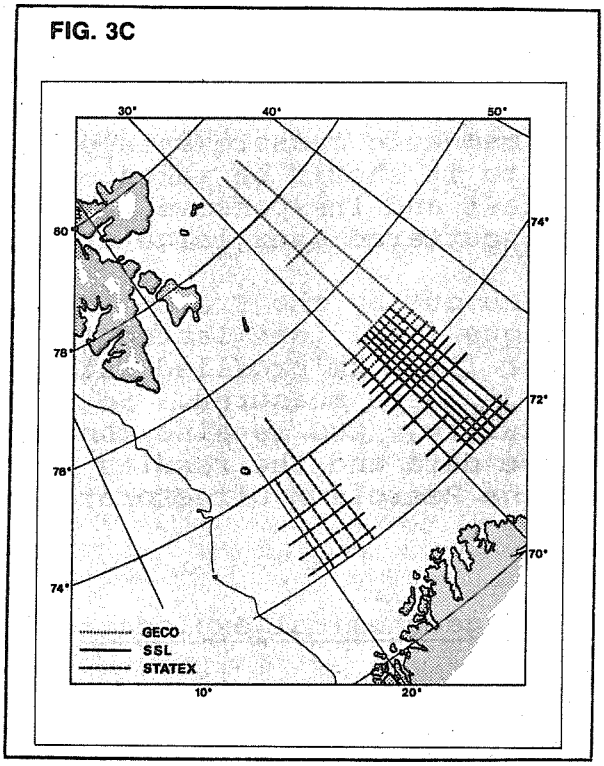


TABLE VII

Year	Møre/Lofoten	Troms[x]	The Barents Sea[xx]	Total
1969	600			600
1970	850	950		1800
1971	1400	700	400	2500
1972	3800	675	425	4900
1973	3000	5850	350	9200
1974	3000	3700	6400	13100
1975	3000	900	6000	9900
1976	1375	-	8732	10107
	17025	12775	22307	52107

x) Boundary between Troms and the Barents Sea is set at approx. 72°N and 25° E.

xx) In addition at least 10.000 km reflection seismic carried out in the Barents Sea by scientific institutions

3.1.4 Aerial Magnetic Measurements in the Jan Mayen area

According to the latest scientific exploration, the shelf encompassing Jan Mayen is built up of sedimentary rocks similar to those located off the mainland. Therefore it was decided that aerial magnetic measurements of the island and the shelf belonging to it should be taken. This is considered to be a fast and inexpensive way of measuring extent of sediments scattered over large areas.

The tests were carried out by the French company Compagnie Générale de Geophysique (CGG), and lasted from 13.8.76 till 26.10.76. Altogether 11620 km profiled with a line density as showed on figure 3d, were measured. So far the collected data is of a good quality. CCG is also conducting the interpretation of the data and the results of this will be made available for the Petroleum Directorate in late January 1977.

3.1.5 Geological and geochemical explorations in the Barents Sea.

The Petroleum Directorate has since 1973 conducted a systematic geophysical mapping of the Barents Sea.

The exploration has resulted in a far better understanding of the existing structural conditions. The reflective seismic profiles show the seabed in the Barents Sea to be built up of layers of varying ages. From what is already known of the map of the seabed off Finmark, one is aware that different geoseismic units are present in large areas.

Based on this map, and on a number of seismic profiles, the Petroleum Directorate chose various stations for geological and geochemical sampling.

865 tests from altogether 582 stations (Fig. 3e) were collected in the period August-September 1976. The vessel that was used was M/S Havdrøn and the trip was incorporated into a program sponsored by the Ministry of Fisheries and completed in conjunction with that Ministry's Maritime Research Institute. Together with the sampling done by the Petroleum Directorate, the Institute gathered data for future pollution-research. The technical aspects of the tests worked well and the program was completed according to plan. From a financial point of view, the cooperation between the Ministry of Fisheries and the geological/ geochemical testing enabled the program of collecting data to be effected quite inexpensively.

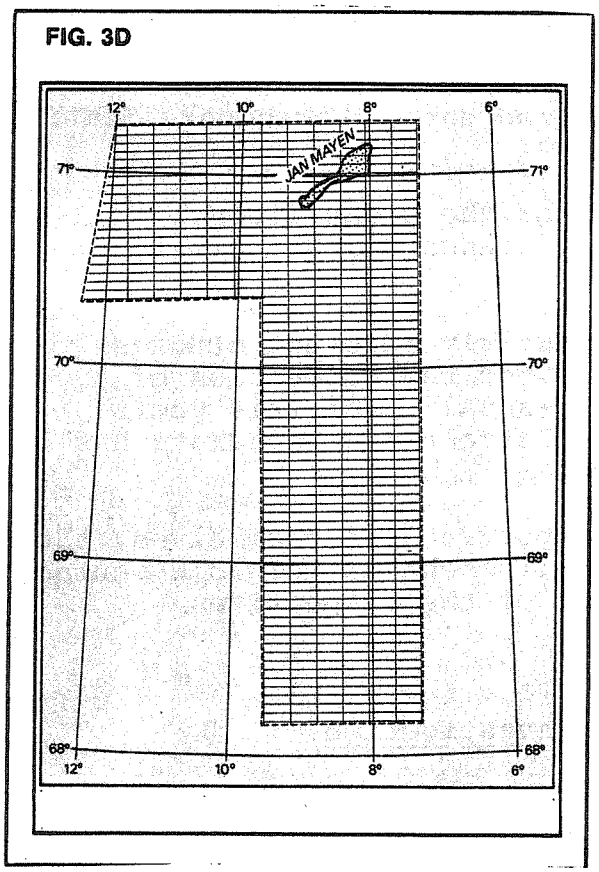
The tests are sent to various geological and geochemical institutions and companies for analysis. The final results of these analyses will be ready by about May 1977. The Directorate will evaluate, coordinate and interpret the results. The geological analyses will make possible an

appraisal of the minerals seismically surveyed, their age and general qualities in regard to source and reservoir rock.

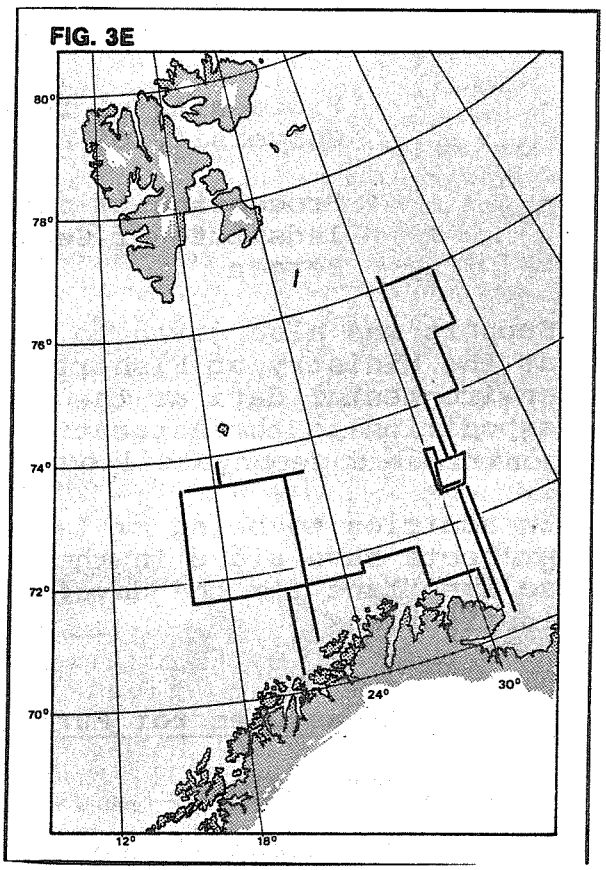
Geochemical analyses of the clay-content material from the upper 2-3 meters of the bottom have been attempted during 1974-75 from the North Sea area off Troms. The statistical and regional results show that such geochemical petroleum-oriented exploration to some extent is reliable and can show whether the seabed minerals contain petroleum or not.

The seismic exploration and the geological/geochemical analyses results from this years expedition will enable the Directorate to give a better evaluation of the potential of the exploration area.

Comparisons and interpretation of the data are expected to be available in the summer of 1977.



Magnetic meaurement - Jan Mayen



Geochemical/Geophysical Exploration 1976

3.1.6 Other Exploration

In addition to the exploration that the Petroleum Directorate itself conducts support is available for exploration and projects at different scientific institutions. Common to these projects, that are within the geological and geophysical fields, is their direct relevance to the work of the Petroleum Directorate. In 1976 the following projects were granted support:

- The production of depth maps and the interpretation of aerial magnetic measurements from 1973, 1974 and 1975 at the Norwegian Geological Survey.
- The renewal and expansion of the marine/ geophysical scientific data-bank. The Institute of Geology, University of Oslo.
- Sedimentological and stratigraphical exploration of parts of the sedimentary layers at Spitsbergen, The Institute of Geology, University of Oslo.
- Geophysical exploration of the continental shelf. Earthquake Station, University of Bergen.
- Processing of refraction data, Earthquake Station University of Bergen.
- Processing of data from the ocean floor. Indsitute of Geology, Branch B., University of Bergen.

Support was also given to particularly relevant studies at the Ministry of Fisheries and for the collection of environmental data at the Tromsø-shoal. For this years expedition to the Antarctic the Petroleum Directorate has contributed geophysical equipment.

In addition to being of large importance in themselves, these projects have aided in the establishment of valuable contacts so important for the development of the respective institutions.

3.2. Areas Open for Further Investigation

3.2.1 Møre/Lofoten-

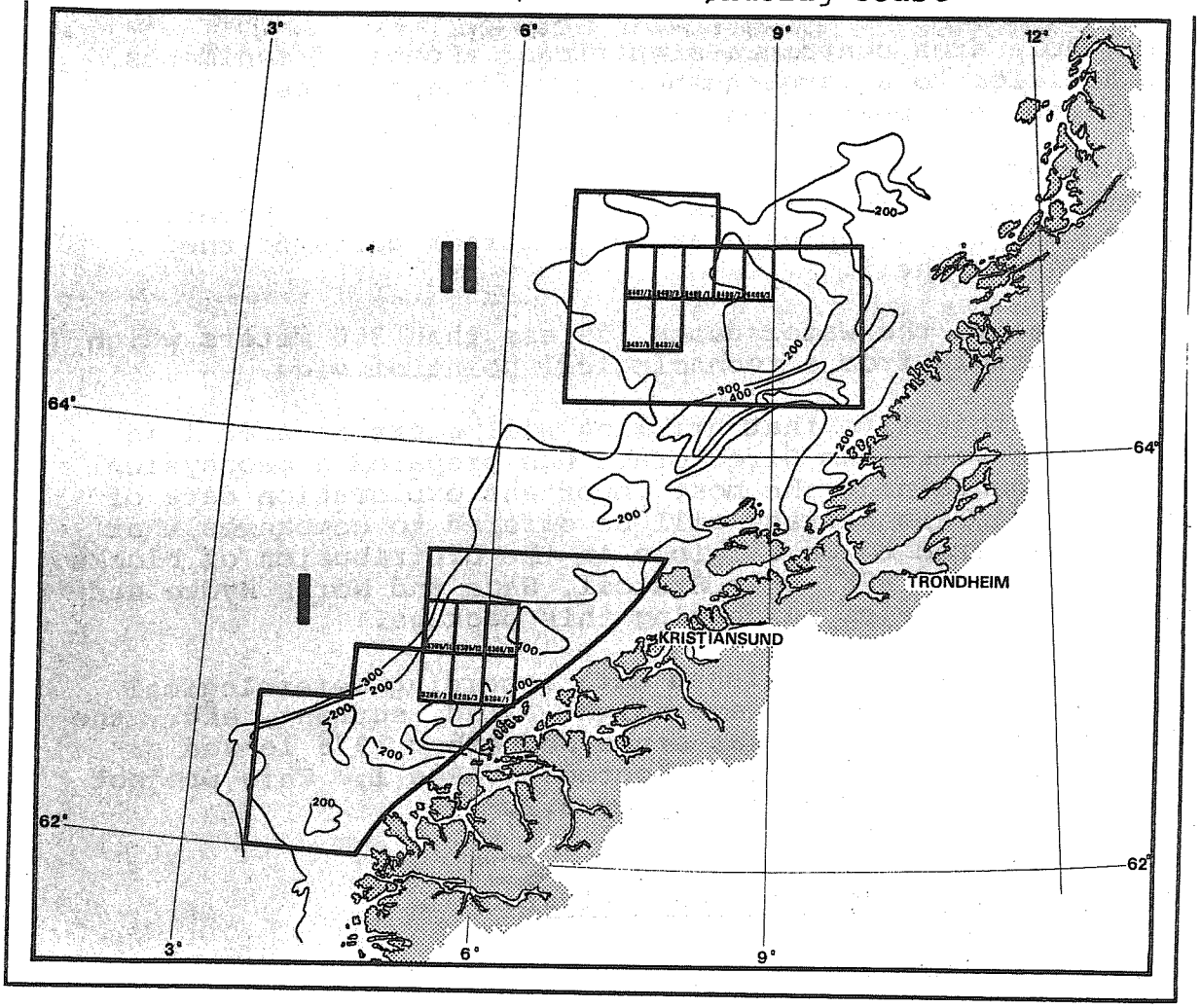
In 1975 the areas (1 and 2) along the coast of Møre and Trøndelag were covered by a semi-detailed seismic, gravimetrical and magnetometrical survey with a profiled distance of approximately 3-4 km. Statoil collected the data while both Statoil and the Petroleum Directorate interpreted the information.

On the basis of this and earlier data the Ministry of Industry suggested that the Petroleum Directorate concentrate their

activity in two smaller areas. (Fig. 3f). These areas constitute altogether 5850 square km. - or the equivalent of 13 blocks. The areas were chosen according to the following criteria:

- Geological conditions which give the possibility of good prospects.
- Various kinds of prospects to insure a continuity of the activity.
- Central geological situation
- Water depth within technological and safety limits.

FIG. 3F Area 1 & 11 - Møre and Trøndelag coast



In the summer of 1976 Statoil provided a part of the proposed blocks with detailed seismic coverage. Combined this constitutes 6600 profiled km., and the interpretation of this data has recently been initiated. The coverage is detailed enough to give a good picture of the structures and it should be sufficient to decide eventual drilling locations.

3.2.2 Area 1 Off Troms

No geophysical exploration was conducted in Area 1 in 1976. The report based on the interpretation of the data gathered prior to 1975 was completed and the interpretation of the data collected by Statoil and the Petroleum Directorate has been commenced.

The present report confirms that Area 1 satisfies the technical/geological criteria used in the selection of the area specified in the Storting Report no. 91, 1975-1976. (See chapter 3.2.1).

The whole area contains a significant amount of sediments, in addition to a large number of different traps. Different prospect types are also identified.

The area includes more major structural elements in the Troms area and thus it has a central geological location such that it is representative of larger parts of the Barents Sea shelf.

Essentially, the water depth is less than 300 meters which is acceptable from a technological point of view.

With the objective that drilling will start in Area 1 in 1978, the Petroleum Directorate has prepared a geophysical package containing the most important exploration data of the area. This package will be offered to companies that are considered to be eligible in the distribution of blocks. At the end of 1976, only Statoil, Saga and Norsk Hydro had the opportunity of purchasing this package.

In order to get established data regarding meterological conditions as well as wave height, wind, current, etc., the Petroleum Directorate has since September 1976 leased a weather ship which is now located in ARea 1. This project is further discussed in chapter 8.2.

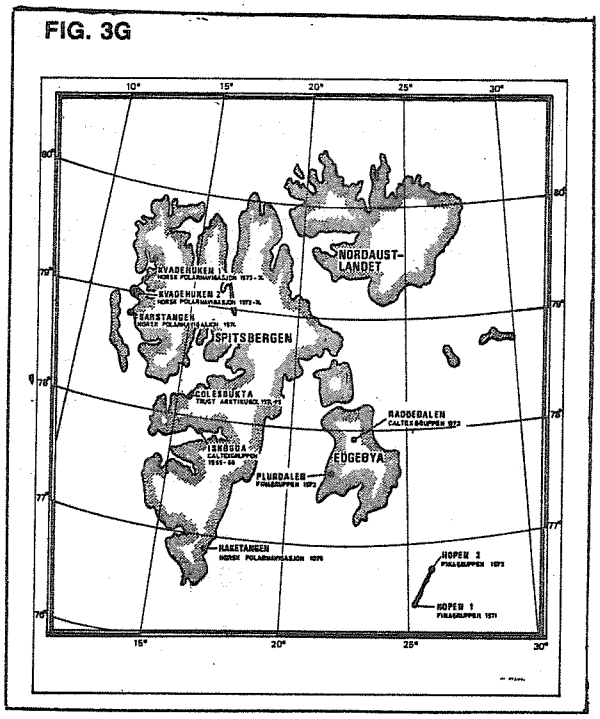
3.3 Drilling Activity on Svalbard

3.3.1. Colesbukta

The Soviet Russian company Trust Arktikugol ended their drilling in Colesbukta in 1975. The dismantling was carried out over the winter and the location was left on 6.5.76.

3.3.2. Haketangen

Polar Navigation initiated drilling of a testwell at Haketangen by the Tromsø-glacier on 11.9.76. Technical problems were encountered from the start and the drilling had to be halted. The Petroleum Directorate has inspected the drilling site and has issued a number of conditions to be complied with before drilling be continued.



Drilling for oil on Svalbard - 1965 - 1976

4. SCIENTIFIC INVESTIGATION AND THE RELEASE OF GEOLOGICAL MATERIAL

4.1 Investigations Conducted by Scientific Institutions

As of 31.12.76, 78 licences for scientific investigations on the Norwegian continental shelf had been issued. (Table IX shows those granted in 1976).

For the most part they are geophysical and geological exploration. A number of them are also extensions of earlier years exploration. Geographically they span the entire Norwegian continental shelf - from Skagerak in the south to Spitsbergen in the north and to Jan Mayen in the west. Some of the exploration deals with deep seismic tests of the same kind that are utilized in petroleum exploration. The most important difference is the fact that the results must be published. Table 8 summarizes the deep seismic surveys conducted by scientific institutions in the Norwegian Sea and the Barents Sea.

TABLE VIII . Deep seismic exploration carried out by scientific institutions

Institutions	Number profile kilometers				
	1970	1974	1975	1976	Total
Centre National pour l'Exploitation des Oceans	11400	3700	5200	-	19 300
Bundesanstalt für Geowissenschaften und Rohstoffe	-	-	6900	1200	8100
University of Bergen, Earthquake Station	-	-	-	600	600
Total	11400	3700	12100	1800	28 000

The Joint Oceanographic Institutions Deep Earth Sampling - JOIDES in late 1975 presented the Norwegian authorities with plans to conduct new drilling with the vessel 'Glomar Challenger'. This was intended to be part of the Deep Sea Drilling Project.

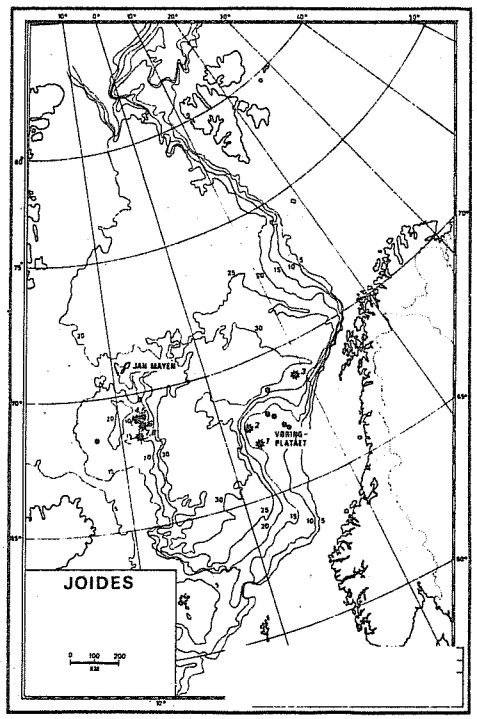
Eight drilling locations in total were suggested to be divided into five locations on the Jan-Mayen shelf, two at the Vøring Plateau and one in the Lofot basin. The locations are indicated on Figure 4a together with the wells which were drilled without licences in 1974.

The Ministry of Industry and the Ministry of Foreign Affairs had in the first instance no objections to the plan.

The Petroleum Directorate decided, after evaluating the safety aspects, to permit drilling of wells 5 and 6. Permission was also given to drill wells 1 and 3 provided the positionings were changed and that the drilling would be halted at a certain depth. Also, permission was granted with the specific condition that agreement regarding the liability aspects of the activity could be reached.

It materialized in the meantime that JOIDES was not able to satisfy required guarantees. The Directorate then withdrew the permission. Before it was revoked, however, JOIDES announced that the intended drilling would not be carried out owing to the time required to clarify the liability aspects of the operation mentioned.

FIG. 4A



PETROLEUM DIRECTORATE

- Wells drilled in 1974
- Proposed drilling wells in 1976

4.2 Release of Geological Material

In 1976 the Petroleum Directorate published two editions of summary information "Well data summary sheet" concerning all wells of over 5 years of age. In addition the Directorate's publication series (NPD Papers) published two

issues containing detailed information on well 25/11-1 and well 16/2-1.

In 1975 the staff responsible for this part of the Directorate's work was increased, such that data regarding a greater number of wells will be released in 1977.

In addition to the usual release of well-data, the Petroleum Directorate has provided the Universities of Oslo, Bergen and Trondheim with a large amount of reflective seismic data, well logs and rock tests - all for educational purposes. Also all data collected in the years 1974-1976 from the Directorate's geochemical projects have been made available for interested institutions. Currently, the Norwegian Geological Survey, Institute for Continental Shelf Exploration and the Universities of Oslo, Bergen and Tromsø are working on this data. A summary is given in table 10. Early results of this work are expected to be published in theses form in 1977.

The Directorate has in 1976 been visited by researchers and students who have commenced studies of material from the North Sea. Some of the students have also been working in the Directorate's laboratories and have accumulated valuable practical experience.

The release of data allows good contact between the educational and research communities. The Directorate regards this as most important. To strengthen the contact, Norwegian and foreign institutions concerned with work on the Norwegian continental shelf are invited to attend annual meetings. Here the relevant institutions present their respective programs. The scientific institutions in addition to the Directorate have profited greatly from this professional contact. The meetings also lay the foundation for coordination of work on the continental shelf.

Tab. IX. Permits for Scientific Exploration of Natural Resources Pursuant to Royal Resolution of 31.1.69

Permits	Name	Field of Work				Area
		Geo-phys.	Geo-log.	Bio-log.	Other	
068/76	University of Bergen Earthquake Station	X				Off Sotra
069/76	Norwegian Geological Survey		X			Fjords in Hordaland and Sogn and Fjordane
070/76	University of Bergen Geological Institute		X			North Sea off Stadt
071/76	Centre National pour L'Exploitation des Oceans	X				Norwegian subsea area in Lofoten - Vesterålen and over Voringsplataet

/continued .....

TABEL 1X continued

Permits	Name	Geo-phys.	Geo-log.	Bio-log.	Other	Area
072/76	Institute for Continental Shelf Exploration					Coast off Møre-Trøndelag and Lofoten-Troms
073/76	Nederlands Instituut voor Onderzoeck der Zee		X			North Sea and Skagerak
074/76	University of Bergen-Earthquake Station	X				Along W. Coast of Spitsbergen
075/76	University of Bergen-Earthquake Station	X				Along west and north coast of Spitsbergen
076/76	Bundesanstalt für Geowissenschaften und Rohstoffe	X				Vøring-plateau Lofotbasin, Barents Sea, Jan Mayen and E. Greenland
077/76	Biologische Anstalt Helgoland		X	X		Whole of North Sea
078/76	National Environment Research Council supported by University of Durham	X				North Sea off Møre

TABEL X. TEST MATERIAL RELEASED FROM THE PETROLEUM DIRECTORATE'S GEOCHEMICAL PROJECT

Institution	Testing Station and type	Geographical Spread	Objective
University of Tromsø. Inst. of Biology & Geology	64 core tests max.3m under sea bed	Continental Shelf off Troms & Finnmark	Tests are processed for basic research & results used for University students & more longterm scientific projects. Investigation concentrated on:1.General Quarternary geology.2.Quarternary litology & biostatigraphy. 3.Recent & subrecent sedimentation environment (marine geology)
University of Bergen. Inst. of Quarternary Geology, geomorphology & Marine Geology	23 core tests max.3m under sea bed	Måløy blocks (35/3 & 36/1	
University of Oslo. Inst. of Geology	22 core tests max.3m under sea bed	Måløy blocks	
Institute for Continental Shelf Exploration	77 core tests max.3m under sea bed Field data	Måløy blocks & Continental Shelf off Troms & Finnmark	1.Testing of equipment for geochemical prospecting 2.Geotechnical evaluation & grain size distribution analysis 3.Mapping of surface sediment
NGU	16 core tests max.3m under sea bed	Balder Field in North Sea	Chemical & mineral geological exploration

5. SAFETY CONTROLS

5.1. Exploratory Drilling

5.1.1 Regulations

The first safety regulations for activity on the Norwegian continental shelf were issued through Royal Resolution of 25 August 1967. These concerned only exploration and drilling, not production. The reasons for this included the view that it was of greatest importance to formulate safety regulations for the activity then underway. This body of regulations was superseded by Royal Resolution of 3 October 1975.

The provisions of the safety regulations are comprehensive and in part relatively detailed. The body of regulations does, however, confine itself to general principles as regards several points, and there has therefore been supplementation to some extent with detailed regulations, as seen below.

It is the Ministry of Industry that has the basic responsibility for controls as prescribed by the safety regulations. The control authority has, however, been delegated to the following agencies:

- Shipping Directorate - Labor Supervisory Directorate
- Norwegian Waterways and Electricity Agency
- Directorate of Aviation
- Directorate of Telecommunications
- Institute for Radiation Hygiene
- Health Directorate
- Explosives Inspectorate
- Petroleum Directorate

The safety regulations may be sub-divided into two main categories, namely regulations imposing requirements on the drilling platform together with contents and equipment and regulations establishing the procedure for the carrying out of the actual drilling operation.

The Shipping Directorate coordinates controls in connection with approval of the drilling platform proper, distributes material received to the other control agencies, arranges for the initial and later periodic inspections in cooperation with the concessionaire/owner, as well as coordinating formulation of orders.

The control over the performance of the actual drilling operation lies within the Petroleum Directorate's area of responsibility. No single well may be drilled before the Petroleum Directorate, after advance application has been made, has given its permission.

In accordance with the safety regulations mentioned, there have till now been established the following detailed regulations:

- Regulations for helicopter decks on mobile plat-

forms, established by the Directorate of Aviation on 18 April 1973.
- Regulations as to the use of radio active materials on board mobile platforms, established by the Institute for Radiation Hygiene on 15 May 1973.
- Regulations for mobile platforms with contents and equipment, established by the Shipping Directorate 10 September 1973.
- Regulations for electrical installations on board drilling platforms, established by the Waterways and Electricity Agency in December 1974.
- Regulations for the drilling for petroleum, established by the Petroleum Directorate on 29 August 1975.

5.1.2 Control Program

The control work carried out by the Petroleum Directorate in connection with drilling on Norwegian territory has the primary goal of preserving the safety of personnel drilling on Norwegian territory and at the same time to meet the environemntal pollution problems which can be a direct result of drilling.

In connection with the Petroleum Directorate's control of drilling on Norwegian territory there arises involvement in technical control of drilling equipment on all Norwegian registered drilling platforms regardless of the location of their operations. This is a temporary arrangement, but the aim is to make it permanent through an amendment to the Seaworthiness Act.

In order that the Petroleum Directorate can give approval for drilling on the Norwegian continental shelf, the following factors must be evaluated:

- Evaluation of the operator and contractor firm which is to perform the drilling.
- Geological conditions of the drill well. Work program/procedures, samples, etc. which are to be used during drilling. This includes the program for abandonment of the well.
- Equipment to be used in drilling, the platform type itself, technical drilling equipment, equipment in the drill well such as well head liners etc.

5.1.3 Control During the Period of Report

Exploratory drilling during 1976 has been at a relatively low level with 4-6 drilling platforms in activity on the Norwegian continental shelf, and the Petroleum Directorate has considered approx. 25 drilling programs. Certain of these programs have been of such a nature as to require considerable preliminary work. Thought here is especially

regarding drilling of deep wells and drilling at points where there is danger of encountering poisonous gases.

Before final approval for a drilling start is given, there is usually a inspection of the drilling platform condition, while spot checks of technical equipment and operations are made during drilling. Another condition for drilling is that the requirements for qualifications and training of the drilling crews have been satisfied. The Petroleum Directorate is also involved in establishing the training and qualification requirements for drilling crews and treats special cases in this connection such as exemptions etc.

In connection with the discussion of the drilling activity which has taken place on the continental shelf during the period of the report there may be mentioned an explosion which took place on the drilling platform 'Deep Sea Saga'. The explosion took place while the platform was in the process of cutting off the well head when the well was to be abandoned. The explosion caused the Petroleum Directorate to amend the regulations governing such operations.

Drilling equipment approval for platforms to be used world-wide, pursuant to the Seaworthiness Act, has represented a problem requiring much work, mainly because there are at present many platforms under construction. This control work consists of an initial inspection together with followups by means of annual inspections and a four year survey.

5.2 Production, Landing

5.2.1 Regulations

It because necessary to prepare regulations covering the production phase after commercial discoveries were made on the Norwegian continental shelf. The regulations were established by Royal Resolution of 9/7/76.

The safety regulations are applicable to design, construction, installation and operation of production facilities, pipeline systems and loading installations that are placed in a fixed position on the Norwegian continental shelf.

The regulations are in principle based on the responsibility of the operator to see that operations are in accordance with the safety requirements established and that these obligate themselves to carry out necessary tests and to provide own controls.

The control exercised by the authorities rests in seeing that the operation is carried out in a manner reflecting this responsibility. The regulations established that the authorities are to be provided all information necessary to evaluate whether operations are performed in accordance

with the regulations and various main categories of information are mentioned.

Control during development of a field will in practice take place by means of continuing two-way communication between the authorities and the operator. The regulations are formulated on the basis that design and construction can normally take place without specific advance approval. It can be determined, however, that certain phases are not to be begun before such approval is obtained. Installation of larger units on a field such as platforms, decks and modules, as well as initiation of actual operations, must not be begun without prior approval.

The regulations include requirements for testing and control of equipment before initiation of operations together with periodic testing and control during operations.

The concessionaire obligates himself to maintain an effective preparedness against certain hazard and accident situations and preparedness programs are to be submitted to the authorities for approval.

In addition to these more general provisions, the regulations include further provisions concerning materials and operations which from experience have been shown to entail special hazards or where an error can lead to serious damaging results. The regulations thus contain requirements as to the strength of the bearing structure, i.e. their ability to withstand both functional and environmental stresses. There are further provisions regarding living quarters, their location and design. There are regulations on the operational side regarding telecommunications, identification and marking of installations and regarding transport installations. Special requirements are established for cranes and other lifting facilities. There are regulations regarding production drilling which are largely based on the regulations for exploratory drilling. In connection with pipelines weight is given on both the special problems presented by the placement of this type of installation and that they meet requirements from a safety point of view, as well as regarding safety in operation and proper maintenance. The regulations also include proposals for ship loading installations at sea including requirements both as regards the installation itself and the loading operation.

The regulations are assumed primarily to have value as the formal basis for public control and as a framework for the more detailed provisions having precise technical specifications expected to be prepared. Work on such detailed provisions is performed under the supervision of the Petroleum Directorate.

As of the end of the year, the following detailed provisions had been prepared and had been distributed for comment:

- Provisions for calculation and dimensioning of fixed bearing structures

- Provisions concerning production and auxiliary equipment
- Provisions for lifting facilities.

In process of preparation are:

- Provisions for use of personnel nets.
- Provisions concerning railings, stairways, ladders.

5.2.2 Control Program

In the above-mentioned Royal Resolution of 9/7/76, the following Ministries have been assigned independent responsibilities:

Ministry of Industry
Ministry of Justice
Ministry for Environmental Affairs
Ministry of Social Affairs

The Ministry of Industry for its part has delegated authority to a number of government agencies for:

a) Inspection
b) Preparation of regulations
c) Authority in special instances to grant exemption from the provisions of the safety regulations which the particular agency is authorized to administer
d) Authority to halt operations immediately in such instances where continuance could be accompanied by serious danger to life or health

The Ministry of Industry had made delegations to the following agencies:

Petroleum Directorate
Labor Supervisory Directorate
Shipping Directorate
Directorate of Telecommunications
Coast Directorate
Directorate of Aviation

Pursuant to the delegation of 12 July 1976 the Petroleum Directorate is to coordinate the practical administration of control activity subject to the agencies which have been delegated authority by the Ministry of Industry.

The Petroleum Directorate's coordination also includes the authority assigned the Ministry for Environmental Affairs and the Ministry of Social Affairs by the Resolution. The coordination is carried out in accordance with an instruction to the Ministry.

After a discovery of hydro-carbons has been declared exploitable and the operator has decided to develop it for

production, the operator must prepared plans as to how it is intended to develop the field as well as to land oil and gas. The plans must include information regarding the reservoir and information as to how it is desired to exploit it., the location of each individual platform and the activities it is desired to have on each platform at various times. Essential portions of the platform construction should be provided in the early planning phases. This means primarily the platform type, number, size, outfitting and the activities carried out by the platform at various times.

Royal Resolution of 9 May 1976 includes the provision that drilling and production is not to be performed from the same platform without permission being granted in each instance. It is also provided that living quarters are preferably to be on a separate platform. When evaluating the platform design, the Petroleum Directorate makes an overall evaluation of the activities planned for the platform and at which time periods phases overlap one another. Of special significance is the number of persons, number of production wells and production volume for a platform. The number of persons and the production volume of hydro-carbons to a major degree gives an indication of the possible consequences in the event of a possible catastrophe.

Before an installation is placed in operation the affected authorities perform a control to see that it is in proper condition from a safety standpoint.

In order for the Petroleum Directorate to carry out this assignment in a proper manner, it is necessary that control be exercised as design and engineering work progress. The companies submit plans, drawings and calculations based on the specifications as directed by the Petroleum Directorate.

The documentation and information must be considered to comprise necessary basic material required in order to grant the above-mentioned permission for operation. In order to avoid problems when the construction work has been completed the Petroleum Directorate checks the documents submitted on a continuous basis.

The Petroleum Directorate makes use of consultants in certain area in order to carry out this control work. The procedures for submittal of documentation and preparation of commentaries may vary for various types of work. The dynamism of the oil industry presents an essential problem in this connection. At the same time that drawings are submitted to the Petroleum Directorate, they are also sent to yard and construction locations, so that the construction work can parallel the consideration of the matter by the Petroleum Directorate. This can easily result in a situation where even minor orders can easily have major economic consequences in the form of additional costs and delays to the project.

Construction and installation takes place in part on shore and in part at the field. The Petroleum Directorate

exercises control at the point of construction in this phase. As mentioned, the Petroleum Directorate otherwise imposes the requirements that operators carry out own controls and this relates to all phases of activity. The safety control of the Petroleum Directorate is thus not meant as a substitute for the control performed by the operator.

Before the installation or parts of it are placed in operation there is to be approval of the authorities. This approval relates especially to crew quarters, drilling and production.

As mentioned the Petroleum Directorate is responsible for ascertaining that other affected authorities have the possibility of exercising their control.

The Petroleum Directorate is to assure itself that all prior orders and comments are followed in a satisfactory manner, that the platform is in a satisfactory condition from saa safety standpoint, that laws and regulations are observed and that other authorities involved have no objections. Permission for use will be given only after an inspection of the platform.

After a platform or installation has been placed in use for crew quarters, drilling or production, there is a transit to a phase requiring continuing control. A sharp distinction is made between a platform which is used only for living quarters and one from which there is drilling and/or production of hydro-carbons. The most important safety aspects which may be affected during the operational phase include:

- Work and living environment
- condition of structures, drilling and processing equipment as well as transport equipment
- drilling procedures, operating systems and procedures for maintenance of production wells
- administrative routines (for all activities)
- maintenance
- supervision
- rescue equipment and evacuation routes
- preparedness and drills
- operator and authorities' safety controls
- collection of environmental data
- collection of damage and reliability data

All these points must be followed up in detail.

Special emphasis must be given to the safety aspects of preventive maintenance. A good system of preventive maintenance will reduce the possibility of eventual defects or damage. It can also be combined with a system for recording of reliability data of systems and components.

The Petroleum Directorate is presently considering the use of EDP for the registration of reliability data.

As far as concerns production equipment and safety systems, the operator is responsible for development of procedures for exercise of own controls and maintenance. The procedures are to be approved by the Petroleum Directorate and the operator is thereafter responsible for seeing to it that they are followed. The Directorate's control procedure is then to check the operator's documentation in connection with maintenance and own control, as well as to check the platforms to see that equipment and systems are in a satisfactory condition.

The platform's structural strength and the condition of pipelines and containers are checked by the Petroleum Directorate, largely by use of consultants for this work.

5.2.3 Control During the Reporting Period

At the end of the report period the design control had been completed for all Ekofisk installations except for the production and auxiliary systems on Edda, Albuskjell and Eldfisk. The design control has similarly been completed for Frigg Phase II installations except for the emergency shut-off systems and pressure relief systems.

In the case of Statfjord A there remains final treatment of the fire extinguising systems as well as pressure relief and emergency shut-off systems. A good deal of the design control for the loading buoy remains to be performed as well.

Construction and installation control for modules and bearing structures has been performed on a continuing basis during the period as regards those which have been and are under construction both at yards and at the field. The control is performed by Det norske Veritas and Dr. Eng. A. Aas Jacobsen under contract. Construction and installation control of the production and auxiliary systems for Statfjord A at Stord yard is in progress, while control of the installation work at the Ekofisk Center is practically complete.

The damage resulting from the fire on the Ekofisk A platform in November 1975 was corrected satisfactorily by February 1976. Production was permitted to resume at the end of the same month after inspection by the authorities. After inspection there was also during the summer granted permission for both living quarters and production drilling from the Cod platform. At the end of the year there were inspections under way and follow-ups of start-up procedures at Ekofisk Center and the gas pipelines with their pumping stations.

As previously mentioned, there were certain modifications required for the Ekofisk installations as regards NGL injection. This included the installation of five pump units on the 'C' platform. One of these pump units was tested in the US with representatives of Det norske Veritas and the Petroleum Directorate present during testing. Mounting and installation on the field has been supervised by representatives of Det norske Veritas.

Operational control has essentially been carried out by the Petroleum Directorate by means of frequent inspection in the field. These were especially concerned with fire safety systems. Other inspection carried out related to technical equipment as well as corrosion/erosion checks of process equipment and pipes.

Much of the operational control takes the form of an evaluation of the operator's own control, both his arrangements for preventive maintenance as well as a check on procedures and frequency of tests of the various safety systems.

The companies' appraisal of the crew requirements in the installation phase led to major quartering problems in this phase. These problems have been solved through extensive use of temporary living quarters. The quality of these living quarters has left much to be desired both hygienically and from a fire danger point of view. Upon demand of the Petroleum Directorate the temporary living quarters at Ekofisk Center were removed at the end of 1976. The crew quarters on the 'R' platform, permitted to be used as of spring 1976, are to be removed before the gas pipeline to Emden becomes operational.

Permission for use of temporary living quarters on DP2 was given in connection with development of the Frigg field. These are to be removed before drilling begins.

Another solution for the living quarter problems has been to use mobile drilling platforms as crew quarters units. Such have been permitted to be used on Frigg and Ekofisk as well as at the pumping stations on the Emden pipeline.

5.3 Separate Platforms for Living Quarters

The safety regulations for production contain two paragraphs of basic significance for a overall platform safety and economy.

- § 74 states, among other matters, that the living quarters are to be so located as to be safely separated from danger areas and, if necessary, be placed on a separate platform
- § 97 states that simultaneous drilling and production from the same production installation is not to take place unless the Ministry gives special permission in the individual case.

The desire to achieve a start in production as rapidly as possible and therewith an oil/income flow, has led to the development of production installations into industrial units having a number of simultaneous activities, each individually creating a high level of risk.

During the summer of 1976 a working group of the Petroleum Directorate was assigned the task of establishing the criteria which should be satisfied in order to provide exemption from the provisions of § 97.

Through this work it was found that it was correct to view the simultaneous activities on a platform as elements in the overall safety of the installation.

The most difficult element in the overall safety picture on a production installation are the living quarters. There is great difficulty in obtaining overall safety in a defensible manner, if the crew quarters are on the production installation.

The problem is simplified both as regards evaluation and solution, if the production installation is divided into a living unit and an industrial unit. The living quarter unit and the production unit may be separate platforms at a secure distance apart and connected by a bridge. The distance between the two units is determined with relation to fire and explosion danger criteria. The industry unit can then be designed in such a manner so that the simultaneous activities can take place.

Based on the appraisal made, the Statoil/Mobil Group were by letter on 11/11/76 advised as to the Petroleum Directorate's views on safety in connection with Statfjord 'A' and 'B'.

The Petroleum Directorate concluded in the letter that a separate living quarters platform be built in connection with Statfjord B as well as requesting the company to evaluate the living quarter conditions on Statfjord A.

5.4 Worker Protection

The year 1976 has been marked by a greater control effectiveness for the Directorate as regards labor conditions on the Norwegian continental shelf. This has led to correction of a number of violations of existing regulations. Pursuant to the amendments to the Law Concerning Worker Protection, the average working hours were, as of 2/4/76, reduced to 36 hours per week for those categories of employees having their employment on petroleum installations on the continental shelf.

During the summer of 1976 the committee established to study the application of the Worker Protection Law in oil activity on the continental shelf etc. - the Halden

Committee - submitted its first part study No. 1 which was distributed to those affected for comment. Part study No.2, together with comments received as well as changes, is expected during the first part of 1977. The Work Environment Law will also take effect for petroleum activity on the continental shelf during the course of 1977.

5.5 Registration of Damages

The companies operating on the Norwegian shelf are imposed a certain responsibility for reporting. This concerns the operation in general as well as special reports regarding accidents and damage.

All operational mishaps and damages are in principle to be reported to the Petroleum Directorate but for the time being this has only been arranged in a reasonably proper manner as regards personal injuries, fires and explosions as well as major operational mishaps. All personal injuries are reported to the Petroleum Directorate on a form provided for this purpose. In the event of fatal accidents and in the case of serious work accidents both the police and the Petroleum Directorate are to be advised. Representatives of both these authorities proceed to the scene and cooperatively investigate the matter. A detailed report is also required from the operator.

All fire and explosion damages are to be reported to the Petroleum Directorate no matter how small the fire or explosion. This is to take place immediately via telephone and telex and the Petroleum Directorate will normally send out an inspector as rapidly as possible to view the damages and to record all relevant data. The operator is also responsible for writing a report in a form established by the Petroleum Directorate.

5.6 Preparedness

The safety regulations establish as a basic principle that the concessionaires are responsible for taking necessary measures so that the preparedness plan is activated in the event of accident or danger situations. Pursuant to the regulations the affected public authorities can, however, wholly or in part take over the direction of an action if this is found necessary.

The regulations further provide that the Petroleum Directorate can in the event of a blow-out, and for account of the concessionaire, requisition the necessary number of drilling units for the drilling of relief wells. The Petroleum Directorate can likewise, if necessary, and for account of the concessionaire, requisition in a similar manner special vessels, platforms or similar. The Petroleum Directorate is the coordinating agency for the affected authorities' approval of preparedness plans.

The preparedness plans are to cover the following accident and hazard situations:

- Situations which have resulted or may result in personal injury, serious illness or loss of life.
- Situations which have resulted in or may result in pollution.
- Situations which wholly or in part have or may result in causing a halt in activity of drilling platforms or production installations.

Responsibility and authority is otherwise distributed among the Ministries as follows:

Ministry of Justice	preparedness for saving of life
Ministry for Environmental Affairs	preparedness for collection and removal of oil spills
Ministry of Industry	all other preparedness as well as coordination of other authorities' approval of preparedness plans

Most of the oil companies have now formulated preparedness plans for exploratory drilling. The Phillips Group has developed a special preparedness plan for the production installations in the Ekofisk area. All these have interim approval and may be required changed if so dictated by experience.

There is considered to be an immediate need for the performance of an overall analysis of preparedness goals, installations to be provided for in terms of preparedness, what risk (probability/consequence) exists in connection with various types as regards damages, accidents and catastrophes, as well as alternative types of preparedness. Of special interest is an appraisal of the degree to which various types of preparedness may affect the overall risk relative to the cost of the alternative types of preparedness, in such manner to obtain optimum preparedness. A working group is engaged in a preliminary study of this.

5.7 Inspection of Sea Bottom at Abandoned Drill Holes

The Petroleum Directorate in the fall of 1976 carried out two investigations of the sea bottom after drill holes had been abandoned. Examination was made of a total of 17 wells drilled by 9 operators.

The first investigation was initiated as a result of a theoretical study 'Location and inspection of abandoned drilling areas' (discussed in greater detail under special projects). Trawler reports of damages indicated that a major part of damages were concentrated on the Patch Bank. It was therefore normal to begin the investigation there.

The investigation was carried out by the Petroleum Directorate in the period 1-12 November 1976. The Institute for Continental Shelf Research was engaged by the Directorate to carry out the actual work of the project. The drill holes were located by use of side-sweep sonar and magnetometers. The side-sweep sonar was used to provide a relatively rough mapping of the sea bottom around the drill hole. The registrations showed reflections indicating abandoned objects at all locations. The drilling areas 25/10-3, 25/11-4 and 16/6-1 were further investigated by the robot submarine craft 'Snurre'. It had previously been decided that an area of at least 100 x 100 meters around the drill hole should be investigated visually. The video photography was generally of good quality and showed that there were abandoned objects at all three of these drilling areas investigated. In two areas it was found that the well head protruded above the sea bottom. The Petroleum Directorate's regulations require that well head and auxiliary equipment be removed to a depth of at least 5 motors below the sea bottom.

The oil companies Esso and Elf were immediately notified of the results of the investigation and they were ordered to prepare a plan for removal of the scrap, as well as to submit a plan for investigation of the companies' other wells on the Norwegian continental shelf. Esso began cleanup and the further investigation in the beginning of December 1976 while the Elf plan called for a start in February 1977.

In order to obtain a basis for a decision as to what futher measures should be taken, the Petroleum Directorate found it desireable to make further investigations. Geoteam A/S was therefore engaged to make an investigation with the same type of equipment as used in the first investigation. The investigation took place between 6-20 December 1976. The purpose was this time to investigate wells of other operators and both recent and older wells.

Due to difficulties with the undersea craft it was unfortunately impossible to obtain visual documentation of conditions on the sea bottom. Investigation was, however, made of 14 drilling areas of 7 operators with use of side-sweep sonar. These registrations were generally of good quality and the interim interpretations show abandoned objects at most locations. The operators have so far been notified orally regarding the investigations and the Petroleum Directorate will adopt a position as to what is to be done when the report is received during February 1977. If it can be proven that the sea bottom has not been left as called for by regulations, the operators will be ordered to clean up.

The Petroleum Directorate's investigations have hitherto shown that the inspection and cleanup procedures so far used by the companies have not been adequate. Based on the experience obtained, it is expected to arrive at more satisfactory guides so that the condition of the sea bottom after a drilling operation will not hamper other activity.

6. OTHER CONTROL

6.1 Regulation of Resource Exploitation (Conservation)

Draft regulations for a reasonable exploitation of petroleum deposits were prepared in 1976. There is a report available on this subject (no. 2) by the Committee for submitting proposals for safety regulations in regard to production installations and equipment for pipelines and storage facilities on the sea bed, and rules for the exploitation of petroleum deposits (the Vogt Committee).

In the wake of the new Petroleum Act, petroleum resources are governed by the existing rules and regulations. The aim is to ensure that petroleum resources regarded as economically viable, for the community as a whole, be exploited in the best way possible. This can be achieved mainly by:

- the offering and allocation policy pursued
- systematically exploring all deposits
- establishing a processing, storage and transportation system offering joint exploitation of several deposits
- exploiting each individual deposit in a reasonable manner.

A pattern is established for mapping out the shelf by pursuing a publicity and allocation policy which decides the areas to be mapped, the terms, and how detailed the mapping of each area should be.

All viable deposits will be exploited within the areas allocated. The allocation of areas, therefore, also influences the location of production, storage and transportation installations. In new areas this will be a decisive factor for the infrastructure of major units to be established.

These processing, storage and transportation installations already built on the continental shelf will largely lie idle as field production diminishes. This particularly applies to installations in the Ekofisk and Statfjord areas where oil production is expected to drop fairly shortly after development of the field has been completed. By exploring the areas surrounding these installations in time, it will be possible to make better use of them. It will also be possible to exploit deposits otherwise not viable. The allocation of block 1/9 near Ekofisk in 1976 was the first step towards ensuring that deposits near existing installations are being exploited. Existing installations will also be considered when future allocations are made.

When a discovery has been made, the Petroleum Directorate is informed immediately. In most cases, survey results are put before the Petroleum Directorate before the discovery is tested for production and drilling is terminated. The reason this practice has envolved is

mainly that the results of production testing have considerable bearing on the appraisal of the discovery's viability the dimensioning of any production installations and on long-term planning objectives. All observations made during the drilling procedure are furthermore submitted, including an accurate description of the actual drilling operation. The Petroleum Directorate also receives specimens of all minerals which are pierced for analysis and safe custody.

The Petroleum Directorate wishes the licensee to ascertain as soon as possible after a discovery has been made whether or not it is viable. This will provide a basis for assessing whether the terms may be adjusted to making exploitation of the deposits viable. A complete plan for the exploitation process is required before major financial commitments can be made. The plan must include proof that sufficient research has been carried out to justify exploitation of the deposit. The plan is also to ascertain that the main factors of the expansion, such as the number of types of platform, the time estimated for expansion, etc., are such that technically safe conditions may be established in the expansion and operating periods. Good safety conditions are extremely important for the furtherance of effective and regular exploitation of petroleum resources on the continental shelf.

The decision to go ahead with production is usually made before everything is finalized due to the unique conditions prevailing on the continental shelf. A good plan should therefore normally be flexible enough to make allowances for the solution of unsolved problems. This requires the plan to be followed up and brought up to date through most of the development phase.

This is exemplified by the Statfjord field development plans. Plans for the exploitation of the field have been made without first deciding how the natural gas is to be employed. There are, generally speaking, two alternatives. The gas can either be sold as quickly as possible, after a short injection period, or it can be injected with the intention of increasing the extent of oil production, before being processed for sale.

Gas injected into the bottom Statfjord reservoir can mix with oil, which means that it will displace almost all the oil in the mineral it penetrates. Water, for instance, will only displace 70-80 per cent of the oil in the mineral.

If conditions in the Statfjord reservoir are such that gas may be injected into a sufficiently large volume of mineral, oil may be gained by using gas as a displacement agent before being reprocessed for sale. This question is now being discussed. Immediately quantitative estimates are reached for the effects of gas injection

on production from the Statfjord reservoir, plans for employing the gas from the field may go ahead. According to these plans, it will not be necessary to decide how the gas is to be employed until production-well drilling is started, or in the event of a decision to build a gas pipeline.

A plan for the drilling of production wells should be submitted before the drilling starts. This plan must take into consideration the fact that the wells must be located so as to exploit the whole deposit to the full. The order of drilling is considered carefully, bearing in mind the fact that a detailed map of the reservoir must exist in time for the drilling plan to be adjusted according to the results. It is also important to obtain adequate output from the first wells to be operated. For safety reasons the drilling scheme is planned so as to make operations as simple as possible on the drilling deck and just below the platform. This also contributes towards deciding the order in which the wells should be drilled.

The actual production is governed by the fact that production licences have a limited duration. In 1976 production licences for the Ekofisk field were granted for six months at a time. One of the main conditions for allowing production there has been that gas produced in conjunction with oil be injected into the reservoir as much as possible. The intention has been to prevent gas being wasted when combusted, while at the same time one has wished to maintain the energy potential in the reservoir and increase the extent of oil production. The injection of gas which went on until 1 January 1977 retained 6 billion normal cubic metres of gas for future exploitation. This has influenced the extent of oil production favorably. Reservoir surveys are not adequate to stipulate the amount of increase in produceable oil with any certainty. Keeping up the energy potential of the reservoir has contributed towards postponing the drop in oil productivity expected around 1979.

The production licence governs the production from each of the wells to make the degree of production as high as possible. A plan for the reservoir surveillance has been prepared in conjunction with the operator. The operator is committed to adhering to this scheme, according to the production licence. Information gathered during surveillance is of vital importance to the planning of a rational exploitation of the deposit.

The practice established for the Ekofisk field will form the basis of governing production from other fields on the continental shelf.

6.2 Control of Produced Amounts of Hydrocarbons

Prior to landing, the gas and oil produced are gauged. These gauges form the basis of royalty calculations and

therefore it is important that the figures are as accurate as possible.

Supervision of technical gauging equipment and calculations included in the total gauging operation are controlled by the Petroleum Directorate. The technology of the current gauging system is very advanced, and it has therefore been necessary to appoint independent consultants to appraise the application of the systems.

Inspection of the technical gauging equipment has been carried out for Ekofisk phase II in the operating stages. These inspections are for the present being conducted by a firm of independent gauging experts on a contract basis. Our aim is to employ inspectors specifically for this job. Supervision in the design and functioning test phase is underway for Ekofisk phase III. The design and functioning test/control of the Frigg gauging systems takes place in St. Fergus, in the field and on Statfjord 'A'. The supervision of Frigg and Statfjord is in conjunction with British authorities.

With regard to the regulations on the designing of gauging systems, emphasis has been placed on following up work carried out by the international standardization organization, and on basing the supervisory work on standards laid down by that organization, if applicable.

The Ministry of Industry has ordered the Petroleum Directorate to supervise the technical aspects of gauging the landing terminals of Teesside and Emden according to treaties made between Norway and Britain, and Norway and Western Germany respectively. Varying forms of supervision have been considered, the conclusion being that a relatively comprehensive engagement may be necessary in order to supervise at the required level.

When production starts for Ekofisk phases III and IV at Frigg and Statfjord, the supervision of these fields will be more operation-oriented.

7. ASSISTANCE TO FOREIGN STATES

Civil servants in the Petroleum Directorate have in 1976 assisted three foreign states in providing geological and geophysical expert advice on petroleum matters. These are Tanzania, Vietnam and Portugal, the first two being included in the Norad projects, and Portugal being engaged in a special assistance agreement. The projects have differed for the three countries concerned, having included the appraisal of specific fields, prospect assessments, assessments of the regional petroleum potential, plus training and the development of oil administration.

8. SPECIAL REPORTS AND PROJECTS

The Petroleum Directorate will require further reports on problems within several areas in connection with its continental shelf activities, for short and long-term planning. While such matters will primarily be solved within the Directorate, certain matters are of such a nature that they necessitate assistance from other sources. Resources being limited, both manpower and funds, it is necessary always to consider carefully which projects to execute.

The following describes some of the projects carried out on the advice of consultants in 1976:

8.1 Environmental Report

In order to assess the safety level of the installations on the shelf it is necessary to have a good knowledge of the outer environment in the area concerned.

In 1975 the Petroleum Directorate appointed several Norwegian Scientific institutions to co-operate in gathering and assessing data on waves, wind, currents and temperatures on the Norwegian continental shelf. The final report entitled "Environmental Conditions on the Norwegian Continental Shelf" was available in January 1976. This report contains paragraphs dealing specifically with waves, currents, wind and temperature conditions. These paragraphs describe existing data and current or planned gauges, as well as theoretical methods for the calculation of different parameters and methods used for data analysis.

Part of the object of this study was to provide a basis for appraisals and priorities when studying the physical environment on the continental shelf and using this knowledge in relation to marine technology.

The following of the report's recommendations may be mentioned:

- Further work on environmental data should be concentrated on the collection of new data rather than on the development of new methods of analyzing

- Particular attention should be directed towards the areas north of the 62nd parallel, particularly those areas marked for oil exploration

- The collection of data from the open sea should be carried out in relation to a permanently based ship. The automatic collection of all types of data from unguarded buoys may be expected in the years ahead.

The report goes on to say that, due to the considerable costs involved in operating a met. vessel the number of such vessels will probably be small. The most effective way to improve the situation will be to concentrate on at least one met. vessel north of the 62nd parallel in addition to an increase in the number of buoy stations near the coast.

8.2 Weather Observations in the Troms I Area

In Storting Report No. 91 (1975-76) Ch. V.1. the Petroleum Directorate was ordered to co-ordinate the necessary surveys to collect environmental data north of the 62nd parallel.

In the event of oil discoveries and the subsequent field development relatively extensive series of environmental data will be required for the calculation and dimensioning of platforms and plant. The Petroleum Directorate has therefore considered it to be very important to go ahead with the collection of environmental data prior to the start of the actual petroleum activity.

In order to carry out this collection the Petroleum Directorate chartered the M/S AMI from Kåre Misje & Co. Rederi A/S in Bergen. The vessel is based at the TromsøShoal in the Troms area which has been marked for exploration drilling north of the 62nd parallel, in position 71° 30'N and 19°E. The vessel collects data on the physical environment of the area, and waves, wind, currents and icing as well as meteorological data are gauged for that purpose.

The Waterways and Port Laboratories at Trondheim have been assigned by the Petroleum Directorate to administer the instrumentation and the actual collection of data. After being controlled and processed the data will be stored in the new Environmental Data Centre at the Meteorological Institute in the same way as environmental data from permanent and floating platforms elsewhere on the continental shelf.

The Meteorological Institute has equipped the ship with instruments and gear for meteorological observations. Every three hours the vessel sends meteorological observations via Harstad Radio to Meteorological Institute in Oslo. Here the data form part of the forecast service, interim reports implying a great interest in the observations.

Weekly water and plankton tests are carried out for the Maritime Research Institute in Bergen. Water tests are also carried out every month at several places on the way in, from the permanent position to Hammerfest for crew replacement.

The vessel is also used in connection with the employment

and normal maintenance of an observation buoy located near the ship. The buoy has been developed as part of the Norwegian Data Buoy Programme at the Christian Michelsens Institute and is owned by Statoil. Here the buoy is tested for performance and the results are co-ordinated with the observations from AMI.

At a later stage it may become important to carry out other scientific research from the ship over shorter or longer periods of time.

The vessel has been chartered preliminarily for a period of 12 months from 15 August 1976, and is now being financed over the Petroleum Directorate budget.

It is too early yet to say anything about what results the observations will lead to. The data are being analyzed, but observations must be conducted over a longer period of time to enable us to draw any conclusions.

8.3 Effluent in the Case of Pipe Breakage

The Petroleum Directorate has been aware that a fair amount of uncertainty has prevailed as to how one theoretically calculates the amount of oil that will escape in the event of a burst underwater oil pipeline. A British firm, Ralph M. Parsons Co. Ltd. was therefore engaged to carry out a theoretical analysis of the burst pipeline issue.

The analysis was based on Norpipe's pipeline from Ekofisk to Teesside in England. This pipeline is approximately 350 kms long and is situated at up to 95 m below the sea surface. In all, it will contain approximately 150,000 tons of oil, the steam pressure being about 100 psi. The pipeline emergency shut-off valves are about 115 kms apart, which means that there are about 5,000 tons of oil between each of the shut-off valves in the pipeline.

Immediately the control instruments in the pipeline register a rupture, the emergency shut-off valves in the pipeline on the production platforms and ashore are to be closed automatically and all pumps stopped.

The analysis reveals that after the closure of the valves, the effluent will be determined by the balance between the pressure inside the pipeline and the water-pressure outside at the place of the rupture. This may be estimated on the basis of known hydraulic theory.

In the course of a few minutes the pressure balance in the pipeline will be a fact, and other effluent mecanisms will take over. If the steam pressure of the oil is higher than the hydrostatic pressure at the place of the rupture gas will develop and displace the oil near the place of the rupture. The amount of effluent will increase considerably as the steam pressure in the pipeline increases.

Oil will be exchanged for seawater due to their different specific weights. This will be a fairly slow procedure, in the range of 5-10 hours, which will depend on the rupture and its location, among other things.

The total amount of effluent in the event of a burst pipe will largely be determined by the location of the rupture in relation to the depth of water and the distance to the nearest "water trap" in the pipeline. They occur as a result of natural irregularities in the sea bed.

On the basis of these theoretical considerations, the maximum oil effluent has been calculated at somewhere in the region of 5-6,000 tons of oil from the oil pipeline between Ekofisk and Teesside. This figure does not include any effluent prior to a burst pipe being observed and the emergency closing-off operation has been completed.

The calculation methods which have been developed were presented at the oil conference, Offshore North Sea 1976 at Stavanger, between 21 and 24 September.

In order to undertake this survey, the Petroleum Directorate liaised with Norpipe A/S, the survey being financed jointly by the Petroleum Directorate and Norpipe.

8.4. Identification System for Oils

In the event of oil spillage in the North Sea, the Petroleum Directorate regards it as being very important to establish the source of the oil spill accurately and quickly. The Central Institute for Industrial Research (SI) was therefore assigned to undertake a survey with the object of assessing and recommending identification systems for mineral oils.

The project started in the autumn of 1975, the final report being available in July 1976. The report comprises straight literature studies as well as experimental research. The Petroleum Directorate has managed to provide 26 different oil samples for this survey. Out of these, 16 were from the North Sea, the remainder being mainly from the Middle East and Africa.

The report includes the following:

- a description of the literature studies
- a discussion on the so-called disintegrating effects (i.e. how oil is influenced by wind and weather after escaping).
- a description of chemical analysis methods used to identify oil
- a discussion on the results of the experimental work
- conclusions and recommendations

In order to identify a sample of such a complicated compound as mineral oil, it is necessary to carry out chemical analyses, combining several methods, which may each have their advantages and supply important information. The techniques most often used are either based on a type of light observation (spectroscopy), or on a separation and registration of single components in samples (chromatography).

The results of the survey indicate that, in most cases, a distinction may be made between North Sea oil and Middle-East oil. it will, however, be difficult to differentiate between some of the North-Sea oils.

Three alternative identification systems are recommended in the conclusion, a "simple" system, and "advanced" system and a "compromise" system.

8.5 Identification and Inspection of Abandoned Drilling Localities

The Petroleum Directorate's drilling regulations § 25 (2.9) read as follows:

> "When a well is abandoned, that part of the pipe and other installations which protrude from the sea bed shall be removed - with restrictions as per sub-section 1.2 - down to such a depth (at least 5 metres (15 feet) beneath the sea bed) that fishing and shipping activities are not subjected to danger or obstruction. Before the well is finally abandoned, the licensee must carry out a special inspection to make sure that no obstacles of any kind, caused by this activity, are left on the sea bed near the drilling location, to the detriment or impediment of fishing, shipping or other activity".

Inspection is currently carried out by divers as a rule, or, in some cases, by employing a TV-camera. The Petroleum Directorate regarded such an operation to be of limited use and extent, and believed that improved methods were required. They were also aware that it might pose problems to find an easy way back to an abandoned drilling location.

In order to find the right methods and equipment for retrieval and inspection the Otter-Group in Trondheim was engaged in conjunction with NTNF's Continental Shelf Office (now called the Institute for Continental Shelf Investigations) to carry out a survey.

As a part of the survey, the Petroleum Directorate contacted all operators on the Norwegian shelf for their opinion of the various methods and equipment.

Equipment both for retrieval and inspection has been assessed in the survey, with regard to:

- technical descriptions
- limitations
- general operating experience
- operational demands
- environmental effects
- expected future development

The report ends with a proposed scheme to retrieve and inspect abandoned wells, plus a technical description and time and cost estimates. It is recommended that the area in question be searched with a sideways-seeking sonar and magnetometer. On the basis of the inspection by sideways-seeking sonar and magnetometer, the well and the surrounding area should be inspected by underwater TV and photography. An unmanned underwater vessel is considered for this purpose. Documentation will be in the form of underwater photographs and video-tapes. For surface navigation, a 24-hour system with adequate short-term stability and repetitiveness is recommended.

For subsea navigation a transponder system which is put out and calibrated from the surface vessel, must be implemented.

8.5.1 Field Survey

The Petroleum Directorate considered a field survey to be important for the further appraisal of the scheme suggested by the consultants, and, if possible, for the inspection of the sea bed near certain drilling locations.

It was agreed with the Institute for Continental Shelf Surveys to rent a magnetometer and a sideways-seeking sonar and the submarine 'Snurre'. The trawler 'Havdrønn' was hired from the Ministry of Fisheries. Observers from Rogaland Fiskarlag and the Government Pollution Agency participated, on the invitation of the Petroleum Directorate.

The survey lasted from 1 November 1976 to 12 November 1976. During that period, 3 different drilling areas were inspected. The experiment must be regarded as extremely successful in spite of certain initial difficulties. The drilling location was retrieved relatively simply thanks to navigational equipment, sideways-seeking sonar and magnetometer. 'Snurre' managed to obtain photographic documentation of all 3 places, showing that the regulations

were not adhered to as far as the removal of the well heads and clearing of the sea bed was concerned.

The field survey and its subsequent results are described in detail under subsection 5.7.

9. DUES PAID TO THE PETROLEUM DIRECTORATE

9.1 Royalty

The Petroleum Directorate has collected Kr. 712,169,063.61 in royalty in 1976. Out of this amount Kr. 260,983,226.00 is in settlement of oil produced on a commission basis in 1975. The remaining kr. 451,125,837.61 is in settlement of Statoil's production in the first three quarters of 1976.

The norm principle has determined the 1976 settlement. This means that Statoil buys oil from the Government at norm price. In the first three quarters of 1976 an interim norm price applies, necessitating an adjustment when the final norm price is stipulated some time at the beginning of 1977.

9.2 Area Dues for Concession Areas

The Petroleum Directorate has collected Kr. 93,677,550.- in area dues in the course of 1976, broken down as follows:

Kr. 85,679,600.- on concession granted in 1965

Kr. 7,400,200.- on concessions granted in 1969

Kr. 597,750.- on concessions granted in 1976

When paying royalty, the area dues are deductable. Due to the fact that in 1976 the Government has also collected royalty in the form of crude oil, Kr. 4,099,933's worth of area dues have been refunded the Phillips Group.

9.3 Dues for Exploration Licences

The Petroleum Directorate announces the granting of exploration licences in accordance with the provisions contained in chapter 2 of the Royal Decree of 8 December 1972.

Exploration licences are granted for a period of 3 calendar years, a fee of Kr. 20,000 per calendar year being paid in advance. The Petroleum Directorate is in charge of collecting this due. Since the last report was submitted, 8 licences have been granted.

9.4 Refund of Control Expenditure

Kr. 23,268,490.- in payment of technical and safety control broken down as follows:

Det norske Veritas	Kr. 18,926,451.-
Dr. Ing. A. Aas Jakobsen A/S	" 2,017,768.-

cont.

Otter-Group	Kr.	969,090.-
Fjellanger-Widerøe	"	184,151.-
Lloyds Register of Shipping	"	29,839.-
Skandinavisk Kontroll A/S	"	281,348.-
Control expenditure for the Petroleum Directorate	"	859,850.-
	Kr.	23.268,490.-

The amount will be covered 100 per cent by the licencees.

At 31 December 1976 Kr. 26,717,367.- had been received.

10. INTERNATIONAL STANDARDIZATION OF SAFETY MEASURES

The 1973 Northwest Europe Conference in London on the subject of "Safety and Pollution Safeguard in the Development of Northwest European mineral Resources" and the work on standardization of safety measures resulting from the conference has been discussed in the Petroleum Directorate's annual reports for 1974 and 1975. The three working groups continued their work in 1976.

Working Group I, led by Great Britain and concerned with questions concerning collection, analyses and publication of data including wave and current data, has not met during 1976. The sub-committee of experts did, however, submit its first partial report.

Working Group II is primarily engaged in work concerning standardization of safety measures for mobile drilling platforms and is led by Norway with the chairmanship and secretary positions held by representative of the Petroleum Directorate. The Group met in Oslo 16-17 November 1976. It considered the final reports of all 4 sub-committees. The Secretariat is processing the material at hand with a view to production of a final document suitable for presentation during a new conference of same nature as the 1973 London Conference.

Working Group III is led by West Germany and is engaged with questions concerning safety, health and welfare of personnel including safety regulations for diving. The group met twice during 1976, and reports of its 3 sub-committees were considered.

PART III - PROFESSIONAL ARTICLES

11. Calculations of Reserves

Introduction

The Petroleum Directorate engages itself in a continuous evaluation of petroleum potential on the Norwegian continental shelf. Appraisals of reserve magnitude are, however, uncertain both as regards confirmed and potential reserves.

The uncertainty can be made use of in several ways. In a given situation it may be desireable to have either a pessimistic or an optimistic estimate. It can, however, be difficult to specify known errors in estimates as uncertain as those in question. It is, therefore, in the government's interest to have its own estimates of reserves for confirmed fields and the possible reserves in undrilled structures.

In the following a look will be given to the manner in which such estimates are prepared.

Hydrocarbon pore Volume

The simplest form of reserve data used is hydrocarbon pore volume, HCPV. This expression means the volume of the hydrocarbons found in the pores of the reservoir. In order to arrive at this figure it is usual to calculate the gross volume of the oil bearing portion of the oil bearing rock structure, V. This is done with help of drilling and seismic and possibly by use of simple geological models.

The volume resulting in this manner will, however, contain zones of dense or 'unclean' sediments, e.g. shale. In order to correct for this, there is a relationship figure established between gross and net rock type volume, α. This figure is based solely on measurements made in drill holes.

It is now desired to ascertain the part of volume made up of pores in the net volume arrived at. A porosity factor is, therefore, calculated by use of drilling data, $\emptyset$. A porosity of 20-30% is not uncommon in good reservoir rock, structures. Both water and hydrocarbons will, however, be found in pore volume. The hydrocarbon saturation, Sh, is also determined from drill hole data.

The total hydrocarbon pore volume may thus be calculated bu use of a the following very simple equation:

$$HCPV = V \times \alpha \times \emptyset \times Sh$$

Contraction Factor and Extraction Extent

The amount of petroleum found in the reservoir is, however, not equal to the amount that can be extracted from the field. This is due two conditions.

(1) The volume is altered during production, since temperature and pressure in the reservoir and at the surface is different. In the case of oil this difference results in a reduction in oil volume in lifting to the surface, because the oil releases gases. The extent of the change in volume also depends on the oil's chemical characteristics. The correction factor concerned with this condition is frequently called the 'contraction factor', (b). In the case of gas, however, the volume will be greater under surface conditions than in the reservoir.

(2) A portion of the hydrocarbons will be 'locked in' in the pores and cannot be 'washed out', by means of methods known as of today. It is, therefore, necessary to make use of an extraction factor, (r) in order to calculate the petroleum guantity that can be produced.

Extractable reserves are, thus, describable as HCPV x b x r.

A number of fields produce both gas and oil. It is usual, therefore, to provide a gas/oil relationship which specifies gas volume relative to produced oil volume. Its magnitude is determined by test production in exploration holes. The extraction factors for oil and gas from the same reservoir will often differ.

Data from the production phase of a field are essential for determination of extractable reserves. Information regarding falls in pressure, movements of the border surfaces between oil and water or between oil and gas will be able to provide better estimates as to the extent of possible extraction. The amount of the part of the oil volume present which can be extracted depends upon the type of production and injection equipment used, and, in some cases, on how earlier production from the field has been carried on. In some fields a fast production will destroy the balance between the liquids so that gas, oil and water are intermingled in the reservoir. A slower production will permit maintenance of a separation of these phases.

Experience in the production phase at various fields can thus result in changes for both reservoir estimates and production estimates.

Units

The figure of greatest interest has now been arrived at, namely the extractable quantity of oil and/or gas. These

final figures will, however, frequently be provided different units so that they are not directly comparable.

Oil reserves are described in numbers of barrels, cubic meters or tons. In order to state the number of tons it is necessary to know the oil's specific gravity. In general, 1 m^3 = 6.29 barrels. Gas reserves are stated in either standard or normal cubic meters or the corresponding number of cubic feet. Standard and normal makes reference to two different bases. and from which pressure and temperature the volume measurement is to be determined.

PROBABILITY CALCULATION.

The actual calculation procedure to arrive at reservoir figures is thus very simple. The uncertainty in the data is due other factors. It must be remembered that the Norwegian oil fields are found at depths of as great as 3000 m., and may cover as much as 100 km^2. It is customary to have 2-10 measurement points (drill holes) in fields when production is to be planned.

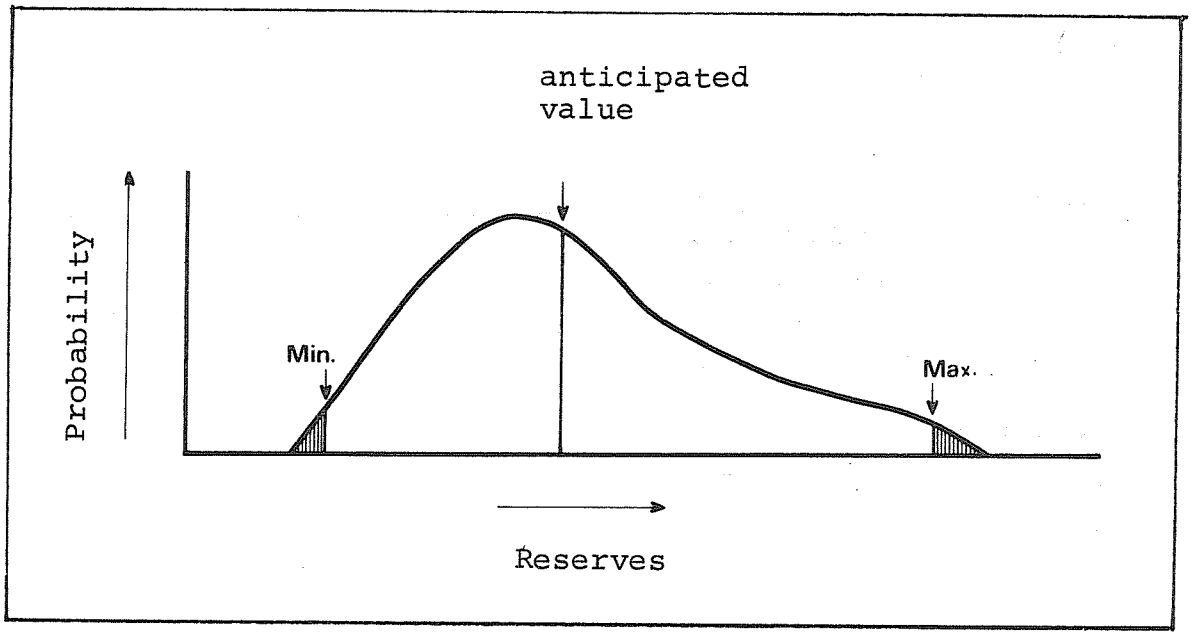
The seismic data to be used for support between the holes and the flanks are really only indicative and not "proof"

In such a situation it has been found useful to utilize probability analysis in connection with calculation of reserves. Each parameter is provided a potential for variance within a given interval and by choosing the most probable value arriving at a simple probability factor. The calculation of the probability distribution for reserves must be undertaken numerically (Monte Carlo method).

This probability distribution results in the reserve figures which may be expected of the field, but it also provides an indication of the possibility for larger or smaller reserves than expected. (Figure 11A)

See page 89 for Fig. 11A

FIGURE 11A Probability Function For Oil Reserves



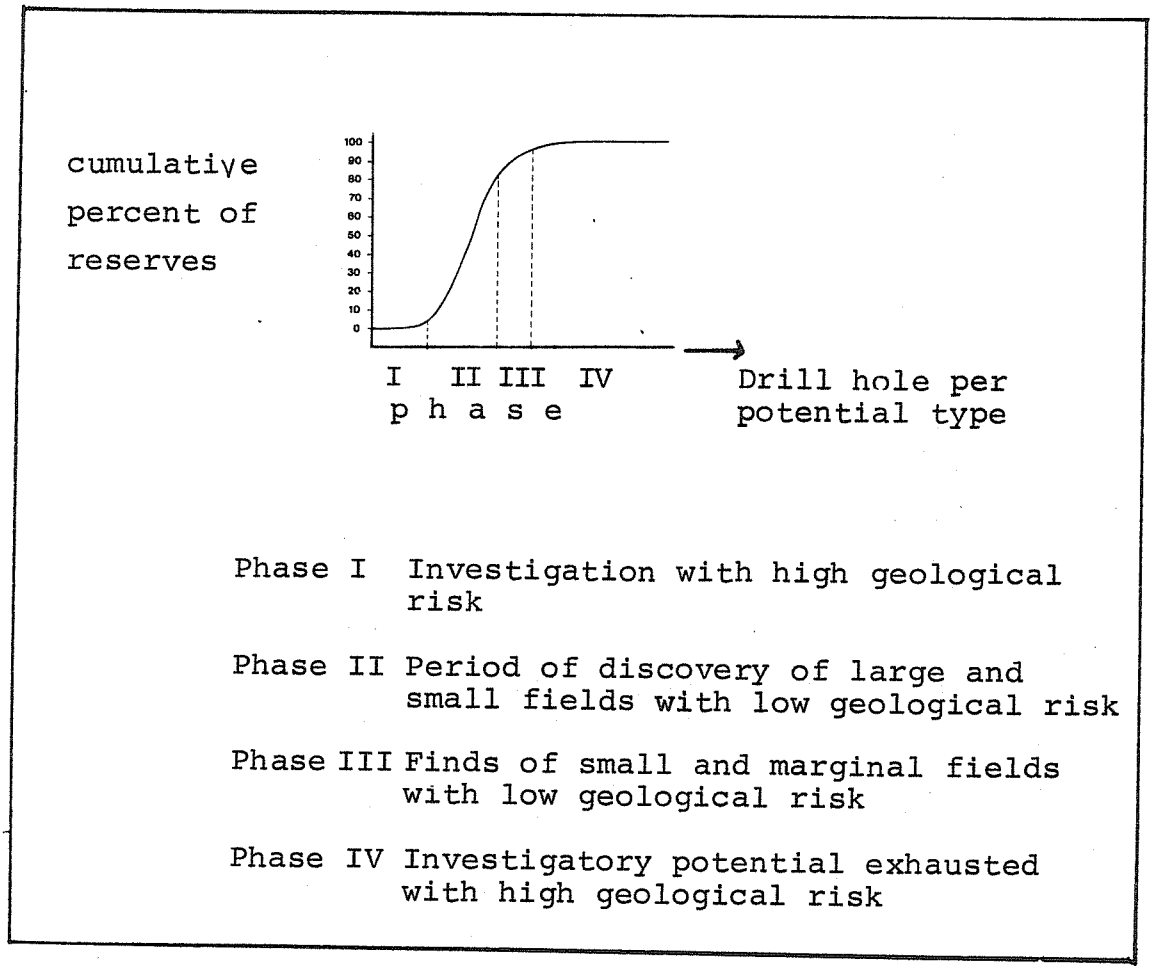
RISK FACTOR.

When hydrocarbons have been confirmed in a structure, the situation is entirely different for reserves in such a structure than for reserves in undrilled structures. Where a discovery is made, the question is solely how large they may be. In undrilled structures there is also the question whether hydrocarbons exist at all. The possibility of finding anything in a structure may be appraised on the bases of geological information, and the knowledge of characteristics of the area in question. The risk factor is the probability of conditions having been favorable for a hydrocarbon accumulation. In an undrilled area the estimated reserve figures are reduced by multplying by the risk factor.

The risk factor will depend on a number of things including the stage reached in investigation, since investigation of various potentials normally proceeds through various stages. (Fig 11B). The first phase is a period wherein many holes are drilled through the strata without any discoveries made. The exploration risk is appraised as larger in this stage. The second phase begins after a find has been made and favourable search areas determined. This phase includes discovery of larger andsmaller fields. Few dry holes are drilled so that search risk is considered low. The third stage is characterized by finds of smaller, marginal fields. Search risk in this phase is also considered low. The final phase is characterized by failure to make further

commercial finds. The potential is exhausted and search risk again is large.

FIGURE 11B Phases in investigation of various Geological potentials.



Phase I Investigation with high geological risk

Phase II Period of discovery of large and small fields with low geological risk

Phase III Finds of small and marginal fields with low geological risk

Phase IV Investigatory potential exhausted with high geological risk

12 DRILLING WELLS IN THE NORWEGIAN NORTH SEA SECTOR.

The first "Norwegian" drilling well was started 19 July 1966 with Esso Exploration Norway Inc. as operator. Since then, 169 drilling wells have been started as of 1/1/77.

Information from 141 of these wells is used herein in some statistics that can cast light on the activity that has taken place.

In total there have been drilled 443,419 m. in these wells. The length in each well is measured from the average sea level to the bottom of the well.

80 days have on average been spent on each well, but average actual drilling has taken 24 days on average.

Average cost per drilling well is Kr. 19,759,000 (1975 Kroner).

If it is attempted to describe extent of oil activity by number of drilling rigs active each month within a quarter, this may be done by use of a histogram showing "rig months" per quarter from the start of activity until 1976. (Fig. 12 A) .

It is shown that there was greatest activity hitherto in the 1st quarter of 1974. Thereafter comes the 3rd quarter of 1972.

The highest activity by years has been in 1972, 1974, and 1975. (Table XI)

see page 92 for figure 12A and Table XI

FIG. 12A

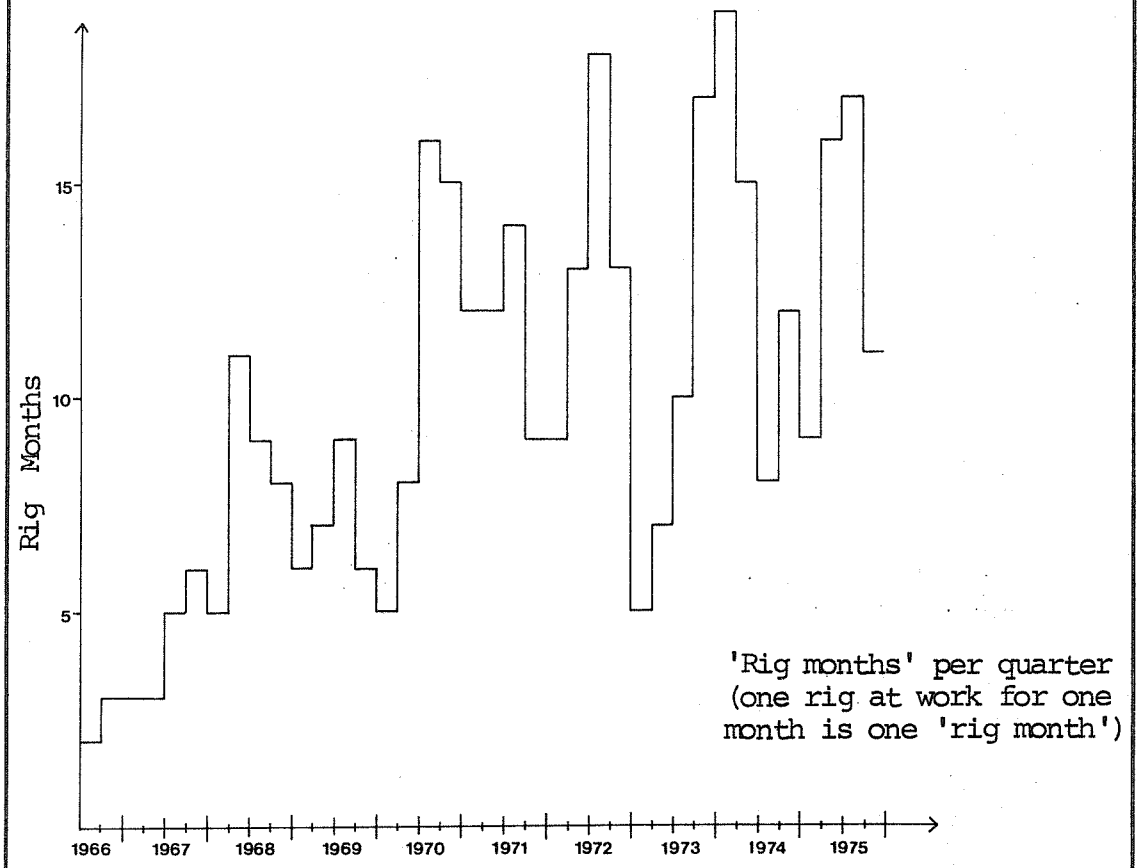


Table XI Rig Months per Quarter 1966-1975

Year	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Total
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	11	53
Total/quarter	73	92	108	100	

In order to show the seasonal fluctuations, Table XII has been prepared which indicates drill starts per calendar month. The average drilling cost per meter is also shown for each of the 12 months. This shows January to be the least favorable month. It has the fewest wells started and the highest cost per meter. February and March also have low activity, but a significantly lower cost per meter with March actually being the most seasonable month of the year costwise. The greatest number of drilling starts were in July and August. (Costs in 1975 Kroner). No adjustment has been made for increased costs due to increased water depth or depth of drilling.

TABLE XII Drilling Starts per Calendar Month

Month	Drilling Starts	Average Cost per 'month well meter'
Jan	4	8.977
Feb	5	5.237
Mar.	6	4.927
April	15	5.428
May	13	6.897
Jun	10	7.326
Jul	22	5.691
Aug	21	6.187
Sept	14	6.337
Oct	14	7.142
Nov	8	6.091
Dec	9	6.501

TABLE XIII Number Wells per Drilling Rig

Drilling Rig	No.Wells
Orion	7
Sedneth 1	3
Ocean Viking	29
Zapata Nordic	5
Ocean Tide	5
Ocean Traveler	9
Neptune 7	13
Maersk Explorer	5
Zapata Explorer	13
Drillship	1
Waage Drill 1	1
Sedco 135 F	2
Gulftide	3
Endeavour	2
Transworld Rig 61	2
Deep Sea Driller	7
Glomar Grand Isle	11
Drillmaster	4
Ross Rig	3
Odin Drill	1
Polyglomar Driller	2
Saipem 11	1
Ocean Voyager	2
Norskald	8
Dyvi Alpha	1
Deep Sea Saga	1

DRILLING RIGS.

During the period covered by the statistics there have been 26 different rigs active on the Norwegian Shelf. The "Ocean Viking" has drilled the most wells most closely followed by "Neptun 7" and "Zapata Explorer" (Table XIII, page 93).

RECORDS.

The deepest well drilled hitherto is 30/10-5 for which the operator was Esso Exploration and Production Norway Inc. and drilling halted in April 1975 at 5185 m. The well was started 25/9/74 and sea depth was 106 m. The drilling well undertaken at greatest sea depth so far is 35/3-1 with Saga Petroleum as operator, sea depth 304 m, and drilling depth 4475 m. Drilling began 19/7/76 and was halted 27/10/76.

PART IV - SUMMARIES

A. STAFF, 1976

Aga, Lasse, konsulent
Al-Kasim, Farouk, avdelingssjef
Andersen, Per Arild, kontorfullmektig
Andreassen, Randi, tegneleder
Andresen, Rolf Gunnar, overingeniør
Askvik, Nic B, førstekonsulent
Austenå, Kari, bibliotekar
Berg, Morten Arnold, konsulent
Berge, Hanne G, kontorassistent
Bergsager, Egil, seksjonssjef
Beskow, Bengt, geofysiker
Borvik, Brit, førstekontorfullmektig
Bratbak, Bjørn, kontorsjef
Buvik, Alex, avdelingsingeniør
Byberg, Arne Ingvald, regnskapsfører
Bye, Svein, seksjonssjef
Corneliussen, Njål, avdelingsingeniør
Danielsen, Harald Bergmann, overingeniør
Døskeland, Inge, overingeniør
Daae, Svein, førstekontorfullmektig/ materialforvalter
Edland, Sidsel, kontorassistent
Eide, Helene, laborant
Eide, Lars Olaf, avdelingsingeniør
Eikje, Steinar, bibliotekassistent
Ellingsen, Anne-Grete, ingeniør
Engås, Asbjørn Inge, avdelingsingenør
Fraser, Torunn, førstekontorfullmektig/resep-sjonsdame
Friestad, Elin, kontorassistent
Frodesen, Svein, geolog
Fritzen, Astri, ingeniør
Frøberg, Thorbjørn, ingeniør
Frøyland, Bjørn, overingeniør
Gram, John Carsten, avdelingsingeniør
Grinde, Ingolf, overingeniør
Gundersen, Petter, avdelingsingeniør
Hadland, Martha Charlotte, førstekontorfullmektig
Hagemann, Fredrik, direktør
Handeland, Ole Henry, overingeniør
Hansen, Anne Margrethe, kontorfullmektig
Hauge, Morten, avdelingsingeniør
Heiberg, Sigurd, overingeniør
Helgevold, Anne, avdelingsingeniør
Helgøy, Terje Sigurd, avdelingsingeniør
Helland, Sigmund, overingeniør
Hervik, Tove, kontorassistent
Hetland, Tor Helge, konsulent
Hoelstad, Reidun, kontorfullmektig
Houge-Thiis, Thomas, førstesekretær
Høyen, Jan, geofysiker
Haavik, Ole Andreas, overingeniør
Ihle, Inger, kontorassistent
Jensen, Anne Lise, kontorassistent
Jensen, Inger Margrethe, laboratorieassistent
Johannessen, Roald, kontorassistent
Johnsen, Svein, avdelingsingeniør
Jørgensen, Flemming Højgård, geolog
Jørgensen, Stein Jørgen, kontorassistent
Kalseth, Karl Otto, bibliotekar
Karlsen, Kristen, seksjonssjef
Kleppe, Liv, tegner
Kolderup, Sverre, overingeniør
Kollbotn, Lars, avdelingsingeniør
Kristoffersen, Kjell Audun, tegneassistent
Kvant, Bjørg, laborant
Kvant, Bjørn, arkivleder
Larsen, Arild, tegner
Larsen, Arne, betjent
Leidland, Johannes Skadberg, overingeniør
Lund, Tor Bjørnulf, overingeniør
Lunde, Otto, avdelingsingeniør
Lye, Hans, overingeniør
Matre Thowsen, Anne Gerd, ingeniør EDB-operatør
Meier-Hansen, Dag, avdelingssjef
Meling, Brit Eli, kontorfullmektig
Melsom, Per Edgar, avdelingsingeniør
Meltveit, Brynhild, personalsekretær
Moe, Aase, avdelingsingeniør
Moe, Arne, overingeniør
Myhre, Aud, førstelaborant
Myhre, Hjørdis Siri, ingeniør
Myhre, Lars Anders, geolog
Myrland, Rolf, overingeniør
Myrvang, Per, overingeniør
Mæland, Kjersti Gro, ingeniør
Mørland, Jens Anders, førstekonsulent
Navrestad, Torstein, geofysiker
Nese, Kyrre, overingeniør
Nilsen, Hans R, geolog
Nilsson, Kjell Leif, overingeniør
Njå, Steinar, overingeniør
Nyvik, Reidar, avdelingsingeniør
Næss, Ole Edvard, geofysiker
Ognedal, Magne, seksjonssjef
Ohm, Anders, avdelingsingeniør
Olsen, Randi Christine, ingeniør
Osmundsen, Per, arkivleder
Ottosen, Tor Inge, hustrykker
Reed, Rolf Arne, bibliotekar
Reigstad, Rigmor, førstekontorfullmektig
Riise, Roald Gunnar, avdelingsingeniør
Ringstrøm, Bjørn, avdelingsingeniør
Risanger, Inger Jorun, kontorfullmektig
Risnes, Bjørn, konsulent
Rosland, Torill, tegneleder
Røe, Signe-Line, geolog
Rønnevik, Hans Chr, førstegeolog
Røraas, Grethe, kontorassistent
Røsseth, Asbjørn, organisasjonskonsulent
Sande, Torvald, spesialist i risikoanalyse
Schanche, Grete, sivilingeniør
Scull, Berton James, geologisk rådgiver

/continued

Setsaas, Erik, førstekonsulent
Skagestad, Erling, overingeniør
Skinlo, Arne Jon, avdelingsingeniør
Skjæveland, Svein Magne, overingeniør
Skjølingstad, Laurits, overingeniør
Skontorp, Odd, avdelingsingeniør
Skrove, Vigdis, tegneassistent
Solberg, Marie Langseth, kontorassistent
Snarvold, Halvor, geolog
Solheim, Bjarne Halvor, avdelingsingeniør
Stangenes, John Olav, førstegeofysiker
Stavland, Arne, førstekonsulent
Steenstrup, Fiona Elspeth, kontorfullmektig
Strøm, Rune Helge, avdelingsingeniør
Svanøe, Per Endre, overingeniør
Svensen, Dag, ingeniør
Sægrov, Edith Thysse, kasserer
Sæverud, Gunnar, avdelingsingeniør
Talleraas, Erik Olav, geolog
Tappel, Inge M, ingeniør
Thime, Aud, kontorassistent
Thomsen, Bjarne, lagerassistent
Thormodsen, Astrid, kontorassistent
Tjønneland, Kåre Asbjørn, konsulent
Torkelsen, Liv Irene, kontorassistent
Totland, Jan Reidar, kontorassistent
Tronslin, Peter Jacob, førstekonsulent
Tunheim, Hallvard, avdelingsingeniør
Tønnessen, Helene, kontorfullmektig
Ulleberg, Kaare, førstegeolog
Vemmestad, John, avdelingsingeniør
Vogt, Nils, avdelingssjef
Wedvik, Lise, kontorassistent
Wermundsen, Arne B, lagerformann
Wersland, Gro, kontorassistent
Williams, Alan John, rådgiver i reservoar teknologi
Wyller Christensen, Arne, overingeniør
Ynnesdal, Harald, seksjonssjef
Zetterstrøm, Harry, avdelingsingeniør
Øie, Judith Marie, kontorassistent
Øvrebø, Ove Kristian, førstegeofysiker
Aagedal, Jarl A, seksjonssjef
Aamodt, Finn Roar, geolog
Åm, Knut, seksjonssjef
Aarseth, Ivar, overingeniør
Åsbø, Jens, avdelingsingeniør

IV B LISTING OF GROUPS/COMMITTEES/WORKING GROUPS WITH REPRESENTATION FROM THE PETROLEUM DIRECTORATE IN 1976.

Committee/Working Group Name	Date appointed	Represented by
Project Committe for Development of Oil Protective Equipment	Letter from Ministry for Environmental Affairs 20/9/76	Senior Engineer Steinar Njå.
Committee for Study of Application of Work Environment Law in connection with exploration and production from petroleum deposits on the Continental Shelf	Royal Resulution of 14/11/75	Director Dag Meier-Hansen
Negotiating Committee for negotiations with USSR regarding Continental Shelf Border in Barents Sea.	Royal Resolution of 15/11/74	Head of Section Egil Bergsager
Negotiating Committee for negotiations with Great Britain on unitization of Frigg Field	Royal Resolution of 11/1/74	Director Nils Vogt.
Committee for negotiations with Great Britain on unitization of Statfjord Field	Royal Resolution of 2/5/75	Director Nils Vogt.
Committee on financing of wave test installation, Trondheim	Watercourse and Harbor Laboratory, Norwegian Shipping Research Institute 21/5/74	Director Nils Vogt
Working Group for preparation of regulations for crewing of Norwegian mobile platforms.	-	Senior Engineer Bjørn Frøyland
Committee for coordination of radio position-establishment systems on the Norwegian Continental Shelf and adjacent waters.	Royal Resolution of 5/3/76	Senior Engineer Ivar Aarseth.
Committee for initiation and coordination of studies pertinent to petroleum activity north of 62°N	Government Resolution of 11/11/76	Head of Section Knut Åm.

/continued

Committee/Working Group Name	Date appointed	Represented by
Working Group of Svalbard's Advisory Expert agency for treatment of matters concerning reports on and area concessions for oil	Letter of Ministry of Industry 12/5/76	Senior Engineer Arne Moe Senior Geologist Hans C. Rønnevik
Working Group on safety and preparedness on Continental Shelf.	Letter of Ministry of Industry 29/12/76	Head Section Knut Åm. Civil Engineer Torvald Sande
Committee on preparation of proposals for training of the various types of drilling platform personnel (Leiro Committee)	Ministry for Education and Ecclesiastical Affairs	Senior Engineer Bjørn Frøyland
Board of Institute for Continental Shelf Researches	NTNF - 8/6/73	Director General Fredrik Hagemann
Polar Council	Ministry of Justice 1973	Director General Fredrik Hagemann
Council of Water Course and Harbor Laboratory	1974	Director General Fredrik Hagemann
Working groups for standarization of safety regulations in North Sea area.	Established by decision of London Conference of North Sea Nations March 1973	
Working Group I		Legal Counsellor Arne Stavland
Working Group II		Director Nils Vogt Director Dag Meier-Hansen Legal counsellor Arne Stavland
Working Group III		Director Dag Meier-Hansen Head of Section Svein Bye.
Oil Protection Council	Pursuant to Law on Protection against Oil Damages. Royal Resolution of 20/11-75	Director Dag Meier-Hansen

/continued

Committee/Working Group Name	Date appointed	Represented by
Council on Crewing of Drilling platforms	Ministry of Trade and Shipping	Head of Section Harald Ynnesdal Legal Councellor Arne Stavland
Inter-Ministry working Group on oil protection preparedness	Ministry for Environmental Affairs 1975	Senior Engineer Steinar Njå. Legal Councellor Arne Stavland
Committee on regulations for calculation and dimensioning of fixed bearing constructions on Norwegian Continental Shelf	Organizational Meeting 12/6/75	Head of Section Kristen Karlsen Senior Engineer Per Myrvang Legal Councellor Arne Stavland
Committee for evaluation of which preparedness measures etc. desireable of improvement in connection with petroleum activity on Norwegian Continental Shelf	Letter of Ministry of Industry 13/2/76	Head of Section Magne Ognedal
Ekofisk Teeside Pipeline Commission	Pursuant to Agreement approved by Royal Resolution of 6/4/73. Storting Prop. 110 (1972-73)	Head of Section Kristen Karlsen
Ekofisk-Emden Pipeline Commission	Pursuant to Agreement by Royal Resolution of 8/3/74. Storting Prop. 88 (1973-74)	Director Dag Meier-Hansen
Stratigraphic Nomeclature Committee for the North Sea	November 1974	Geological advisor G.J.Scull Senior Engineer Rolf Myrland
Committee on Compensation for Fishermen	Pursuant to Royal Resolution of 23/6/76 Named 20/9/76	Head of Section H. Ynnesdal
Appealbody on Compensation for fishermen	Pursuant to §6 of provisions	Head/Section Kristen Karlsen
Social Consequences of oil activity in Rogaland. Part project: Employment in North Sea.	Letter of Ministry for Social Affairs 28/9/76	Head of Section Svein Bye

/continued

Committee/Working Group Name	Date appointed	Represented by
ACOT	Letter from Det Norske Veritas 21/1/75	Director Dag Meier-Hansen
Expert sub-committee of NTNF Continental Shelf Committee. ("Continental Shelf Investigation").	4/4/74	Head of Section Egil Bergsager

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IVC PETROLEUM DIRECTORATE PUBLICATIONS

Name	Year	Price
Environmental Conditions of the Norwegian Continental Shelf.	1975	kr. 35,00
Well Data Summary Sheets Volume 1. (Wells completed prior September 1970).	1976	kr. 55,00 (kr. 25,00) ★
Well Data Summary Sheets Volume 2. (Wells completed between October 1970-December 1971).	1976	kr. 55,00 (kr. 25,00) ★
Oljedirektoratet, Paper No 1, Lithology. Well No 8/3-1.	1975	kr. 100 (kr. 25,00) ★
Oljedirektoratet, Paper No 2, Lithology. Well No 25/11-1.	1976	kr. 100,00 (kr. 25,00) ★
Oljedirektoratet, Paper No 3, Lithology. Well No 16/2-1.	1977	kr. 100,00 (kr. 25,00) ★
Oljedirektoratet, Paper No 4, Lithology Well No 16/11-1.	1977	kr. 100,00 (kr. 25,00) ★
Oljedirektoratet, Paper No 5, Lithology Well No 9/8-1, due - feb - 1977.		kr. 100.00 kr. +25.00★
Oljedirektoratet, Paper No 6, Lithology Well No 16/7-1, due - mar./april 1977.		
Oljedirektoratet, Paper No 7, Lithology Wells No 2/8-1 + No 2/11-1, prob.due- april 1977.		kr. 250.00 kr. +25.00★

★ Student Discount

PLEASE NOTE: IN THE ORIGINAL REPORT AN A1 SIZE MAP OF THE NORWEGIAN CONTINENTAL SHELF SHOWING ALLOCATION OF BLOCKS WAS ATTACHED. UNFORTUNATELY WE ARE NOT ABLE TO REPRODUCE THIS.