Oil and Gas in Denmark

Exploration and Production

1990

MINISTRY OF ENERGY

Danish Energy Agency

The Danish Energy Agency is an institution under the Ministry of Energy. Other institutions are Risø Research Centre and the Mineral Resources Administration (Greenland), The Ministry further represents public interests in Dansk Olie og Naturgas A/S (D.O.N.G.).

The Agency was established by law i 1976. The Agency assists the Minister of Energy and other government authorities in energy matters. It is the responsibility of the Agency to follow and evaluate the Danish and international progress in the fields of energy production, supply and research.

The Agency in its executive capacity administers energy legislation for power and heating supply, alternative energy and production of oil and natural gas.

The Agency works closely with local, regional and departmental authorities, with energy distribution companies, licence holders and consumers. The Danish Energy Agency also participates in international energy co-operation.

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Foreword

The 1990 annual report by the Energy Agency concerning the exploration and production of oil and natural gas in Denmark is hereby submitted.

The report presents the Agency's five- and twenty-year oil and gas production forecasts, respectively, and furthermore includes the Danish oil and gas reserves assessment of January 1st, 1991.

In the light of the dramatic developments in the Persian Gulf area during 1990/1991 the Danish oil and gas production presented important domestic security of energy supply. Hence, the oil production alone provided 69 per cent of the domestic oil demand; in terms of self-sufficiency the combined oil and gas production corresponded to 85 per cent of the oil and gas consumption during 1990.

Expected rising oil and gas production in coming years will eventually exceed the domestic demand.

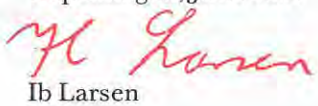
The seismic surveying activities were high during 1990. The exploratory drilling included two wells. Hydrocarbons were discovered in both wells, – the first discoveries since 1986 in Denmark.

Three new licence awards for the exploration and production of oil and gas were granted during 1990.

The field development activity was considerable during the year. In addition to the new field development at Kraka, Dagmar and Valdemar, extended development was implemented or initiated in all existing fields. Current work efforts primarily comprise the drilling and completion of horizontal producers and the extension of existing water flood projects.

In line with the expected higher oil production it has been decided to increase the capacity of the oil pipeline from the Danish fields to 10 million m^3 on an annual basis.

Copenhagen, June 1991



Ib Larsen
Director

Conversion Factors

Conversion Factors

1 m^3 Crude Oil = 0.857 ton ≃ 35.9 GJ

1 m^3 Motor Gasoline = 0.75 ton ≃ 43.8 GJ

1 m^3 Middle Distillate = 0.84 ton ≃ 42.7 GJ

1 m^3 Heavy Fuel Oil = 0.98 ton ≃ 40.4 GJ

1 Barrel = 0.159 m^3

1.000 Nm^3 Natural Gas = 37.239 scf ≃ 39.0 GJ

1.000 Sm^3 Natural Gas ≃ 1 t.o.e. (ton oil equivalent)

1 Nm^3 Natural Gas = 1.057 Sm^3

1 ton steam coal ≃ 25.2 GJ

1 ton coal (other) ≃ 26.2 GJ

Nm^3 (normal cubic metre) at 0°C, 101.325 kPa

Sm^3 (standard cubic metre) at 15°C, 101.325 kPa

scf (standard cubic foot), at 15,6°C, 101.56 kPa

Contents

In pursuance of the reorganisation within the Danish Energy Authorities during 1989 comprising a revised allocation of authority between the Ministry of Energy and the Energy Agency, the internal structure of the Agency has been under continuous revision with a view to meet the increased challenges within the field of energy during the coming years, i.a. including energy supply/ consumption and saving, co-production of energy for power and district heating, oil and gas exploration and production and international cooperation.

The present structure of the Energy Agency comprises 11 technical and administrative divisions, shown in Fig. 1.1.

Oil and gas exploration and production activities are handled by three divisions, i.e. division 3, 4 and 10. Their fields of responsibilities are summarized as follows:

The 3rd Division, Exploration and Production

Licensing and awarding strategies, licence rounds and concession supervision; reconnaissance work and exploration; hydrocarbon recovery, reservoir and geological evaluations; assessment of reserves, production forecasts, development plans and infra structure; oil and gas economics.

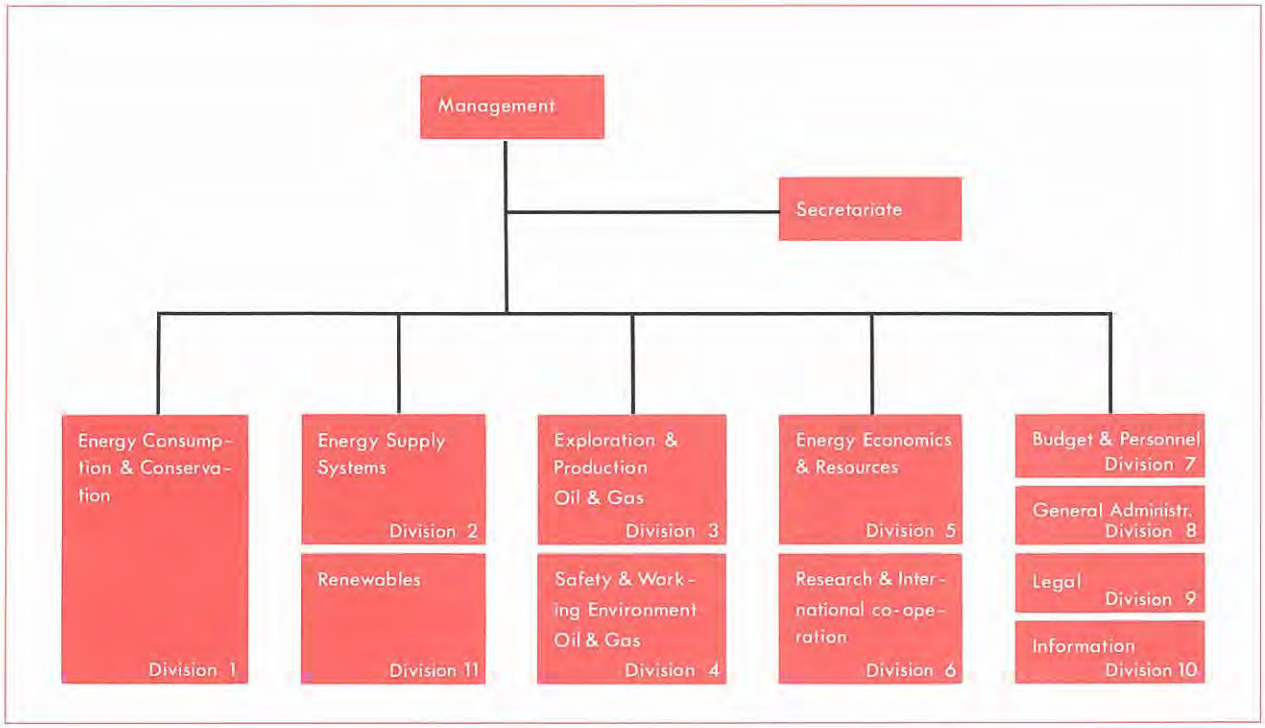
The 4th Division, Safety and Working Environment

Safety and working environment issues on marine installations, hereunder supervision of drilling equipment; approval of processing facilities and supervision regarding the Danish gas transmission system; regulatory activities, participates in the Action Committee and Coordination Committee.

The 10th Division, Research and Information

Extramural activities; coordination of educational and research activities.

Fig. 1.1 Organisation of the Danish Energy Agency



Two exploratory wells were spudded in 1990, i.e. well Alma-1 by the Danish Underground Consortium and well Amalie-1 by the Statoil Group. Both wells are located in the Central Graben area. Hydrocarbons were discovered in both wells. The hydrocarbon discoveries are the first in Denmark since 1986.

Three new licence awards for exploration and production of oil and gas were granted during 1990.

A list of the 18 groups that retained licences for exploration and production of oil and gas in Denmark at the expiry of 1990 is included in Appendix A. The geographical location of the individual licence areas is highlighted in the enclosed concession map (back cover).

Seismic Surveys

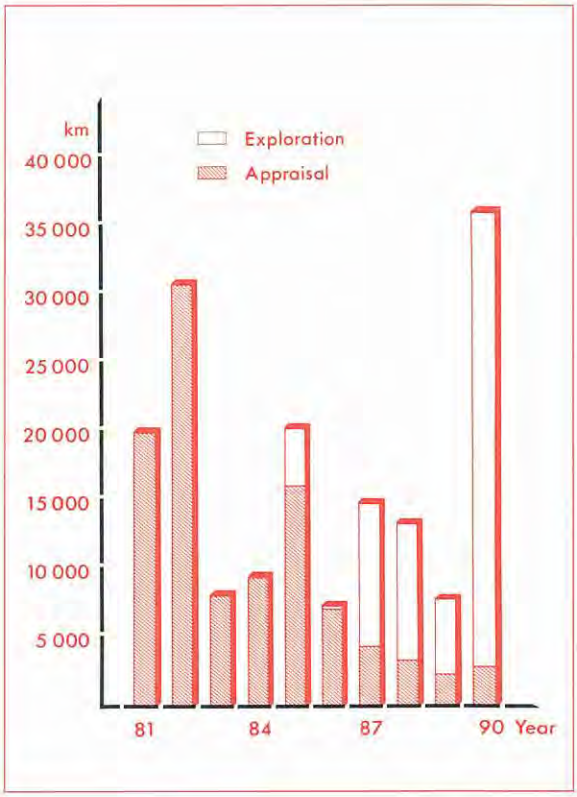
A total of 36,011 km of seismic surveying data was collected in Denmark during 1990, reflecting a considerable increase compared to 1989 (3,188 km). The higher activity level is principally due to the completion of a number of 3-D programmes, conducted by the Danish Underground Consortium during 1990 (32,974 km).

Furthermore, the seismic programmes under the Danish 3rd Round work commitments were basically completed during 1990, i.e. comprising a total of 2,252 km of 2-D acquisition. This work included the collection of 51 km of land data within the Central Jutland area by Dansk Operatørselskab on behalf of the Jordan Group and 785 km of marine data by Norwegian licence holders in areas straddling the Danish/Norwegian boundary in the North Sea.

The annual seismic surveying activity 1981-1990 is illustrated in Fig. 2.1; a compilation of the 1990 seismic surveys is included in Appendix C.

The Energy Agency issued a permit to Hoff International Offshore Service Team, Inc., with regard to the performance of a major geochemical prospecting campaign in Danish waters during 1990. The work is part of a global investigation with regard to the distribution of hydrocarbons in sea bottom sediments. The Danish programme comprises the collection of approximately 500 cores of sea bottom sediments. The work is expected to last two months.

Fig. 2.1 Annual Seismic Survey Activities 1981-1990



Following a request by the Ministry of Fisheries, The Energy Agency resumed the evaluation with regard to the effects of damage on the fish stock due to seismic aquisition technique in cooperation with the fisheries authorities.

Drilling Activities

A total of 15 production wells was drilled/spudded, allocated as follows:
Two wells were drilled in connection with the Dagmar Field development; four wells were spudded at the Dan Field; five wells at the Gorm Field; two wells at the Tyra Field and one well each at the Skjold Field and Valdemar Field, respectively. The production drilling activity was considerably improved as compared to 1989 (seven wells). This high level of activity is expected to be maintained during 1991. Annual production drilling activity for the period 1981-1990 is summarized in Fig. 2.3. Further information with regard to the production drilling is provided below.

Exploration

Two exploratory wells were drilled/spudded during 1990. These wells are highlighted below.

One well was furthermore drilled in connection with the evaluation of a projected gas storage located at Stenlille on western Zealand.

Exploratory Drilling

The following exploratory wells were drilled/spudded during 1990:

Alma-1 5505/17-10

Well Alma-1 is located within the DUC Contiguous Area approximately five km east of the Dan Field. The well was drilled between March and August, 1990 by Mærsk Olie og Gas AS as operator for the Danish Underground Consortium. Hydrocarbon presence was confirmed by production testing. An appraisal programme covering the Alma discovery, forwarded by the operator in February, 1991 is currently being evaluated by the Energy Agency.

Fig. 2.2 Exploratory and Appraisal Wells 1981-1990

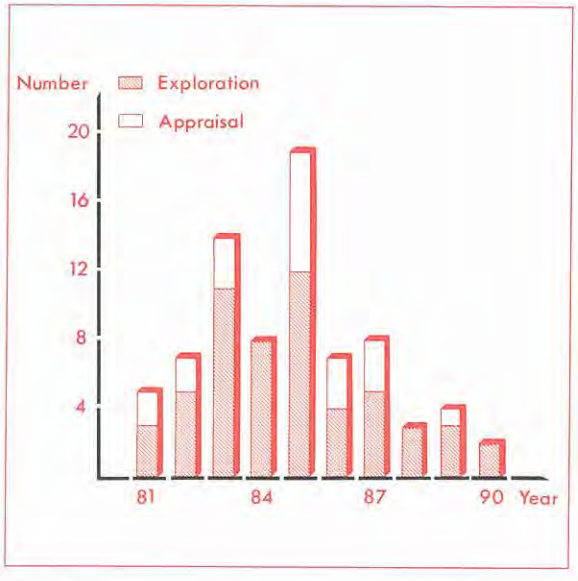
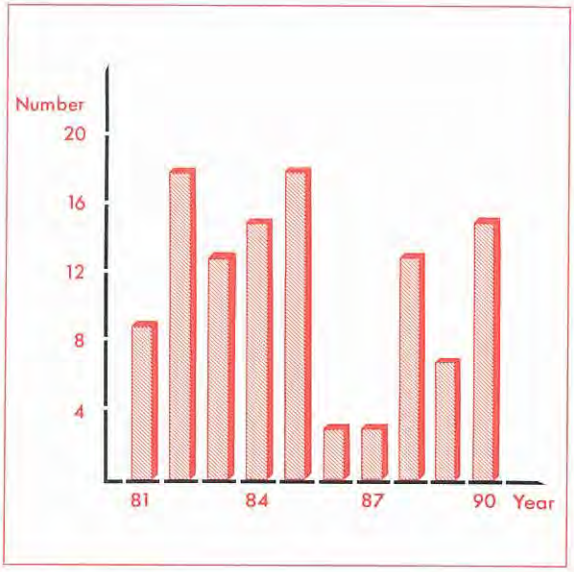


Fig. 2.3 Production Wells 1981-1990



Amalie-1 5604/26-2

Well Amalie-1 is located within the Statoil Group licence area under the Danish 2nd Round of 1986. The well, spudded in August, 1990 by the operator Statoil was still being drilled at the expiry of 1990. During testing of the well in 1991 the presence of hydrocarbons in several layers was confirmed.

Appraisal Activities

Current appraisal activity comprises the Ravn discovery, made by the Amoco Group in 1986 under the Danish 1st Round licence award of 1984.

Ravn 5504/1,2,5 and 6

The Amoco Group conducted the drilling of three wells within the licence area, i.e. well Ravn-1 in 1986, Ravn-2 in 1987 and well Falk-1 in 1989. Oil was discovered and produced on test from a Jurassic sandstone interval, penetrated by well Ravn-1. The original exploration licence was extended by two years, i.e. now expiring in 1992. The Amoco Group is still engaged in exploratory work within the licence area including continued evaluations of the Ravn discovery.

New Licence Awards

Three new licences with regard to exploration for oil and gas were awarded during 1990. The licence rights were granted after a short licence round.

Two licence areas, located in the Danish North Sea, were awarded to the Statoil Group, i.e. comprising the westernmost part of block 5604/18 and blocks 5604/23 and 24; both areas are adjacent to the Statoil Group's existing licence area, previously acquired under the Danish 2nd Round awards of 1986. The location of the new licence areas is shown in Fig. 2.4 and is furthermore highlighted in the enclosed concession map; the composition of the licence group is summarized in Appendix A.

Licence rights with regard to the northwestern part of block 5603/28 were furthermore granted the Mærsk Group. This award resulted from negotiations regarding the delineation of the Gert Field; the negotiations and pertaining licence award followed arbitration claims against the State submitted by A.P. Møller in 1988. After negotiations in 1990 A.P. Møller dropped its claims and the arbitration was abandoned.

Relinquishments

A number of licence areas awarded under the Danish 1st Round (1984) were relinquished during 1990

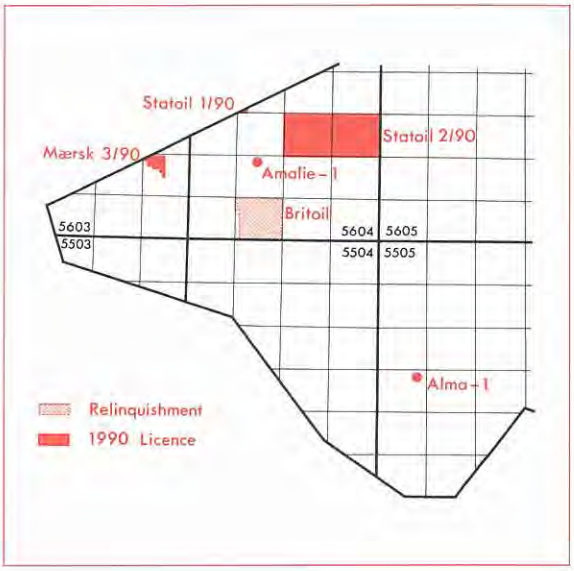
The Amoco Group relinquished its previous Kattegat licence, comprising blocks 5611/22 and 23. Well Terne-1 was drilled by Amoco within this licence area in 1985.

The Britoil Group gave back the licence area comprising most of block 5604/3 in the Central Graben area. Well Iris-1 was drilled by the Group within the licence in 1984.

Released Well Data

Generally, the data and information retrieved under the Danish Subsoil Act are protected by a five year confidentiality clause. With regard to licences that have expired or licence acreage that has been relinquished the confidentiality period is, however, limited to two years.

Fig. 2.4 Exploratory Wells, Relinquishments and New Licence Awards within the Central Graben, 1990.



During 1990 data concerning the following exploratory and appraisal wells were released:

Offshore:

Iris-1	5604/30-1	Britoil
Dyb Adda-1	5504/08-4	DUC
Vest Lulu-2	5604/21-4	DUC
Gert-2	5603/28-1	DUC
Elna-1	5604/19-1	DUC
Terne-1	5611/23-1	Amoco
John Flanke-1	5504/20-2	DUC
Lone-1	5603/27-3	DUC
Nord Jens-1	5504/07-5	DUC
Nord Jens-2	5504/07-6	DUC
Vest Lulu-3	5604/21-5	DUC
Kim-1	5603/30-1	DUC

Onshore:

Kværs-1	5409/02-1	DUC

Information with regard to released well data is provided by the Danish Geological Survey.

The Danish oil and gas production is sustained from five fields located within the DUC Contiguous Area of the southern Danish Central Graben. These fields are the Dan, the Gorm, the Skjold, the Rolf and the Tyra Fields. The licence rights are retained by A.P. Møller in cooperation with its partners Shell Olie- og Gasudvinding Danmark and Texaco Denmark, Inc. of the Danish Underground Consortium (DUC). The operator is Mærsk Olie og Gas AS, a subsidiary of the A.P. Møller Group.

Oil and Gas Production, 1990

The total oil and condensate production during 1990 amounted to 7.0 million m^3 or 6.0 million tons, i.e. reflecting an eight per cent increase compared to the 1989 production.

The 1990 gas production amounted to 5.1 billion normal cubic metres (Nm^3), a decline of 3.5 per cent compared to 1989. 3.3 billion Nm^3 were produced from the Tyra Field, the remaining consisting of associated gas produced in conjunction with the oil production. Of the totally produced gas 2.8 billion Nm^3 (54 per cent) were delivered to Dansk Naturgas A/S (sales gas); 2.1 billion Nm^3 (40 per cent) were reinjected at Gorm and Tyra; the remaining was consumed as fuel or flared offshore.

The total oil and gas production landed during 1990 corresponds to 8.9 million tons oil equivalent (t.o.e.), an increase of six per cent compared to 1989.

The 1990 domestic energy consumption amounted to 18.7 million t.o.e., whereof 10.0 million t.o.e. comprised oil and natural gas. Hence the rate of self-sufficiency increased to 85 per cent in 1990 from 78 per cent in 1989. Further, the rate of selfsufficiency with regard to oil increased from 60 per cent in 1989 to 69 per cent in 1990.

Fig. 3.1 Annual Oil Production 1981-1990

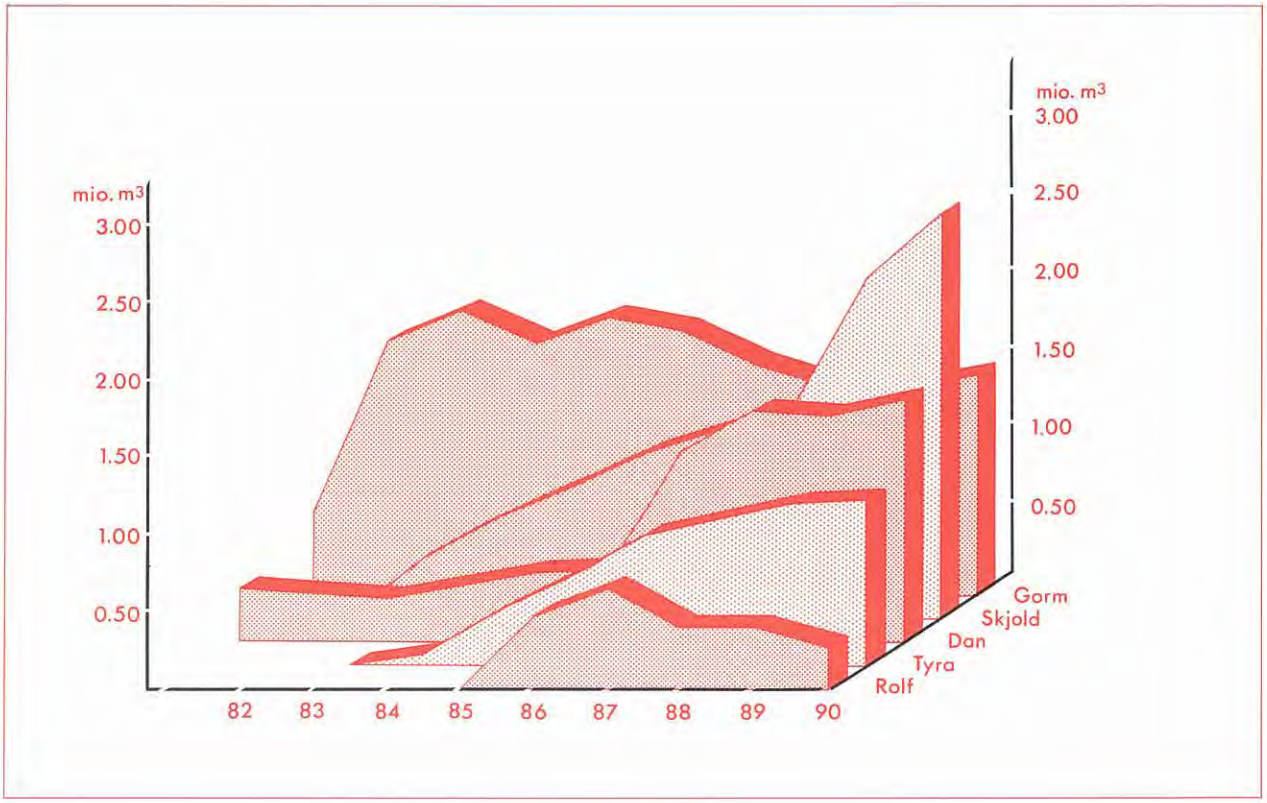
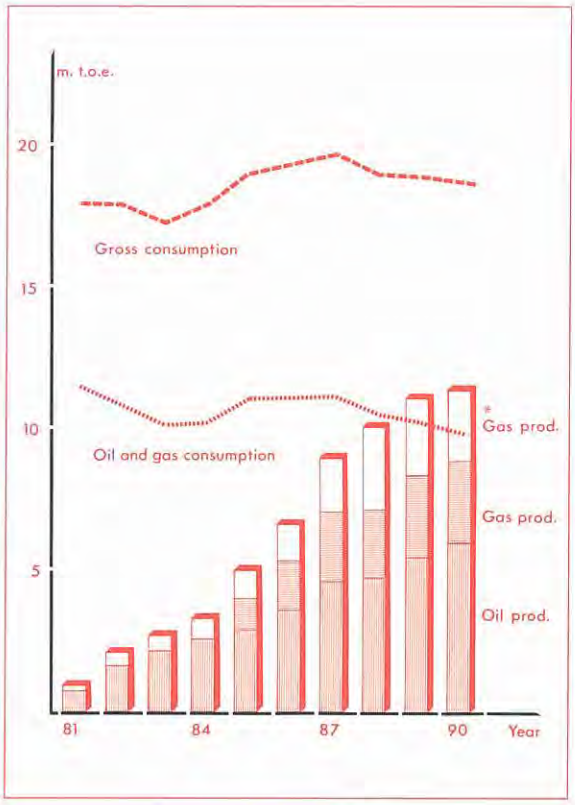


Fig. 3.2 Consumption and Production of Oil and Natural Gas 1981-1990



* Injection gas, shrinkage and flare gas.

The annual oil and gas production for the period 1972-1990 is summarized in Appendix D together with the monthly production during 1990 and the allocation with regard to the domestic energy consumption between 1972 and 1990.

Gas Flaring

In accordance with the currently applicable guidelines for the production of gas in Denmark, up to 0.35 million Nm^3 of gas may be flared on a daily basis. During 1990 the flared gas corresponded to 0.11 billion Nm^3; averaging 0.3 million Nm^3 per day. The flaring of gas is closely watched.

Gas shrinkage during 1990 amounted to 0.23 billion Nm^3.

Oil and Condensate Recovery

The development with regard to oil recovery procedures went according to plans submitted and approved during 1990 and the years immediately preceding 1990.

The Minister of Energy issued approval in principle of development of the Harald, Roar, Igor, North Arne (renamed Svend) and Adda Fields. The approval establishes the general framework and basic principles with regard to the phasing of this development and production, and furthermore addresses the infra-structuring of the collective project as well as existing installations and facilities.

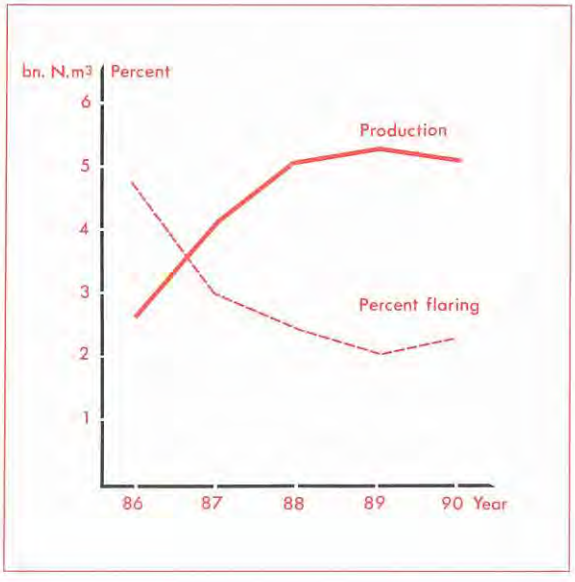
Improved recovery methods based on water and gas injection are of increasing importance.

The water injection project in the Gorm Field was extended. Experience and evaluations of this work will provide the basis for further decisions on water injection in the field.

Similarly, the water injection project in the Skjold Field was extended.

Other projects under improved oil (and condensate) recovery include the water injection pilot at the Dan Field. The gas recycling project at the Tyra Field continued during 1990. The DUC Concessionaires forwarded plans for an extension of the water injection pilot project at the Dan Field, comprising the completion of a horizontal oil producer with four attendant water injectors.

Fig. 3.3 Gas Flaring 1986-1990



In March 1991 the DUC Concessionaires forwarded a revised development plan for the Dan Field comprising a comprehensive water injection project.

The encouraging results of the implementation of horizontal well completions in Danish oil fields are continuously applied.

During 1990 the number of horizontal well completions at the Dan Field was increased, hence currently eight horizontal oil production wells exist in the Dan Field. In accordance with the approved plans, the number of horizontal well completions will be more than doubled within the next few years.

Two horizontal production wells were furthermore completed in the oil leg of the Tyra Field during 1990. The results of this project were highly successful and an application for the drilling of additionally three horizontal oil producers at Tyra was approved by the Energy Agency in February, 1991.

The oil recovery from two of the fields that were under development during 1990 is based on the application of horizontal well completions, i.e. comprising the Kraka and Valdemar Fields. The Kraka Field was placed on stream in March 1991 from two horizontal producers.

The development activity in Denmark was considerable during 1990. Hence, in addition to the new developments at the Kraka, Dagmar and Valdemar Fields, extended development either took place or was at an advanced stage of preparation at all the existing fields. In addition to the Kraka Field oil production will be implemented from the Dagmar Field during 1991.

With a view to bringing ashore the expected increased Danish oil production, it was decided to increase the oil pipeline transportation capacity by the installation of a booster station. This will raise the annual oil pipeline transportation capacity to approximately 10 million m^3. The booster station is expected to be in operation mid 1991.

Producing Fields

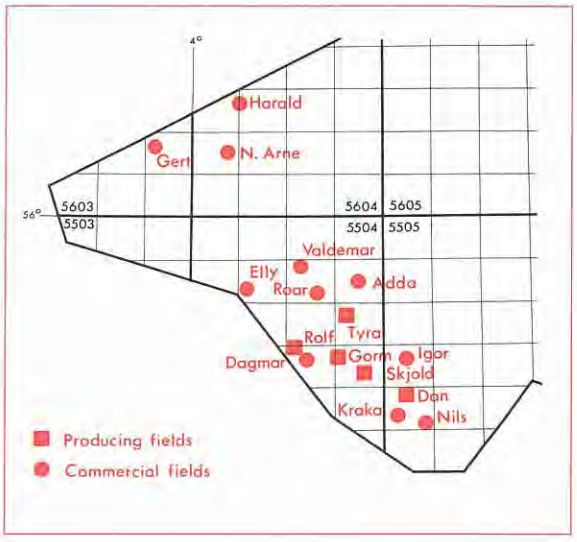
Relevant information with regard to the Danish producing fields is summarized in Appendix E.

The Dan Field

Dan is an oil field with a free gas cap. The oil production was initiated in 1972. Continuous development has taken place since that time.

The field consists of two independent reservoir blocks.

Fig. 3.4 Danish Oil and Gas Fields



Oil production took place from five wellhead platforms during 1990, i.e. the three originally six-slot platforms "A", "D" and "E" and the two originally 12-slot platforms "FA" and "FB". A number of additional well slots were later installed on platforms FA, FB and D, respectively. Subsequent to separation and treatment the oil and gas produced is exported ashore by pipeline via Gorm and Tyra, respectively.

Production

A first horizontal producer was completed at the Dan Field in 1987. The experience of this project provided the basis for the further development of the Dan Field, approved by the Minister of Energy in 1988. The plan comprises continued phased development of the field including a total of 18 horizontal production wells.

Phase one of this development included the installation of five horizontal producers and was completed during 1989.

Phases two and three include the drilling and completion of a further seven and six horizontal wells, respectively. Two of these wells were put on stream during 1990, hence eight horizontal wells are currently in production at the Dan Field.

The water injection pilot project initiated in 1988 has been continued. Based on the encouraging results of this project the DUC Concessionaires filed an application for a supplementary pilot project comprising one horizontal production well with four attendant water injectors.

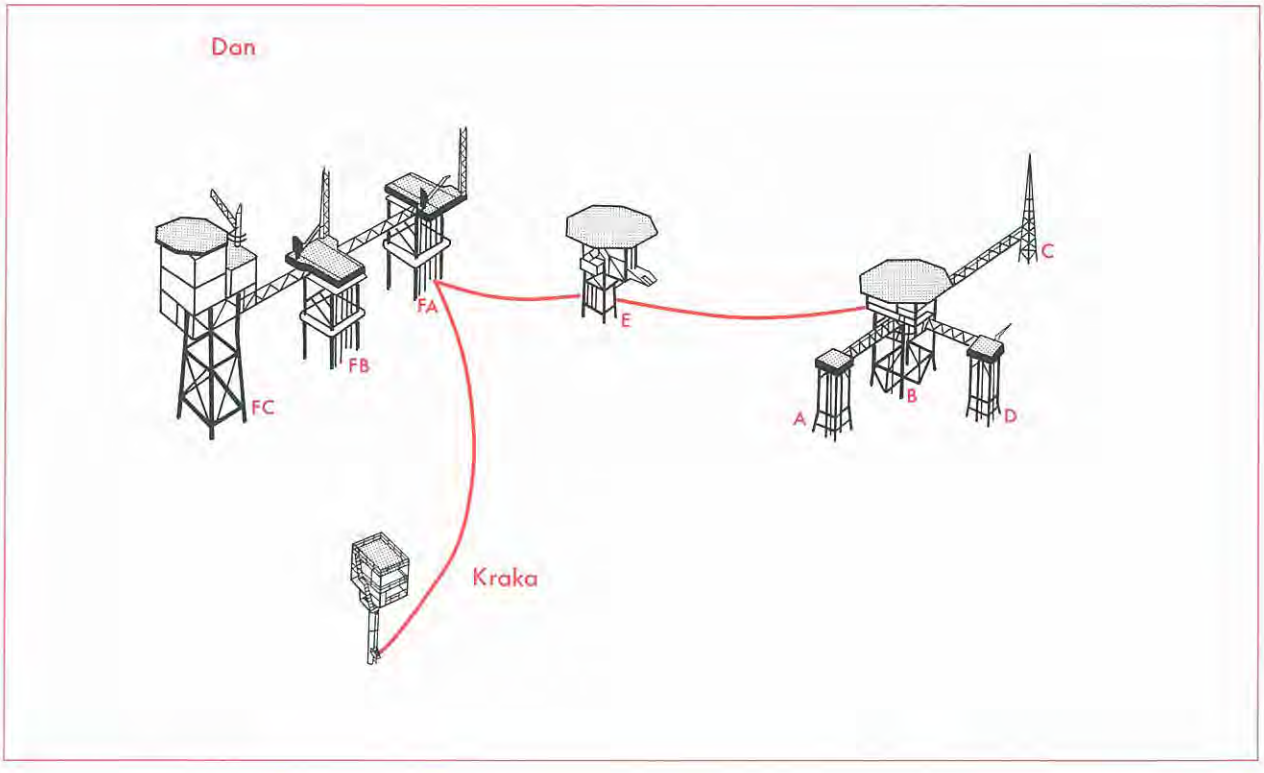
Due to the increased requirement for treatment of associated gas at the Dan Field facilities, an extension of the gas compression capacity is currently under implementation. The work was initiated in 1990 and is expected to be completed towards medio 1991.

In March 1991 the DUC Concessionaires filed an application with the Minister of Energy regarding a revised development plan for the Dan Field. The plan comprises an extension of phase three of the 1988 development plan and a full scale water injection project in the northern and southwestern flank areas of the field.

The plan implies comprehensive extensions of the installations and processing facilities at the Dan Field Complex.

The oil and gas production from the Dan Field comprised 1.58 million m^3 and 0.8 billion Nm^3, respectively, during 1990. The oil production reflects a 7.5 per cent increase compared to 1989.

Fig. 3.5 The Dan Field Complex



The Gorm Field

Gorm is an oil field located 27 km northwest of the Dan Field. Oil production was initiated in 1981.

The field consists of two independent reservoir blocks due to a major north-south striking fault, subdividing the field into an East and a West Block.

A water injection project was initiated at the Gorm Field in 1989. This project was continued and further developed during 1990.

The project development comprised drilling and completion of one water injector in each block; both injectors are located in the southern flank areas. Pertaining work comprised furthermore the drilling and completion of an additional producer in the East Block and the abandonment and redrilling of an old producer in the West Block.

The currently ongoing and continued phased development of the Gorm Field reveals a gradually increasing reservoir pressure maintenance through water injection. In addition gas is still injected in two wells, located on the crest of the West Block.

Injection water to Gorm was provided from a provisional water treatment plant located at the Skjold Field via a six inch flowline.

Following the commissioning of the Gorm F platform towards medio 1991 a water treatment plant will be permanently installed on Gorm F, hence replacing the current Skjold facility. Furthermore the processing facility on Gorm C will be relieved due to the installation of new processing facilities on Gorm F. The Gorm F facilities will be utilized for the treatment of i.a. the Skjold oil production.

A total of 1.44 million m^3 of oil was produced from the Gorm Field during 1990, an increase of approximately 10 per cent as compared to 1989.

The Skjold Field

Skjold is an oil field located 10 km east of the Gorm Field. Skjold is developed as a satellite to Gorm. The oil production from Skjold was initiated in 1982.

The current oil production is sustained by four production wells supported by four water injectors. One of the injection wells is a converted observation well, previously utilized for the registration of reservoir pressure and fluctuations in the free water level.

The ongoing field development of Skjold aims at the full implementation of water flooding of the reservoir. Further work comprises an increased number of producers within the crestal part of the structure, supplemented with a corresponding number of injectors located in the flank areas.

The oil production at Skjold is still sustained without water cut.

The converted jack-up drilling rig that has been utilized as a water treatment plant since 1986 will be replaced by the facilities installed on the new Gorm F platform. The Skjold oil production will also be processed on Gorm F, rather than as previously at the Gorm C platform.

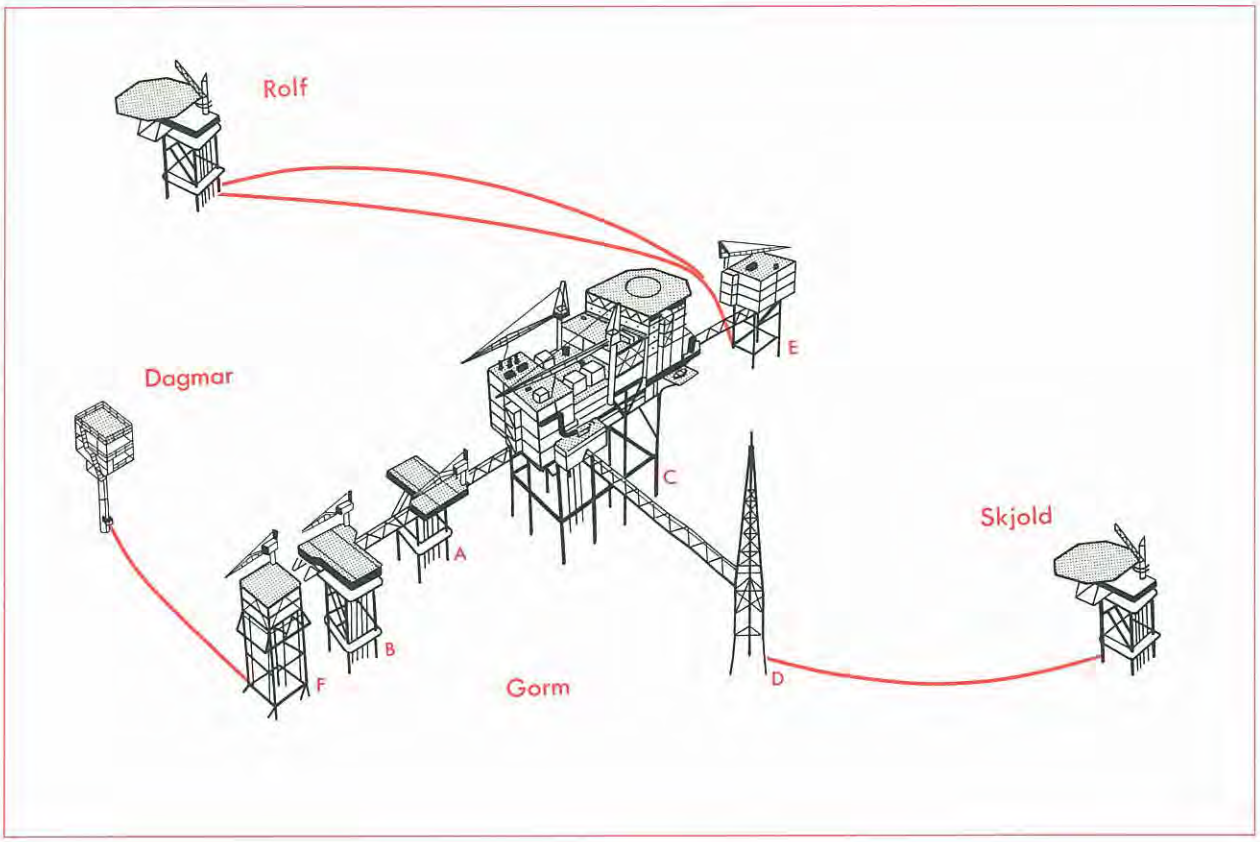
The total oil production from the Skjold Field amounted to 2.63 million m^3 in 1990, a 19 per cent increase compared to 1989.

The Tyra Field

The Tyra Field comprises a large free gas cap overlying a thin black oil zone. Production from Tyra was initiated in 1984. A gas recycling project with a view to increased condensate recovery was initiated in 1987.

The investigations with regard to the oil zone were continued during 1990. Hence two horizontal wells were drilled and completed in the oil

Fig. 3.6 The Gorm Complex



zone within the southwestern flank area. The current result of this project is very encouraging, providing credibility to previous expectations with regard to the feasibility of black oil recovery from the reservoir underlying the gas cap of Tyra through application of horizontal wells.

An intensified development plan for the oil zone at Tyra was approved by the Energy Agency in February, 1991. The plan includes drilling and completion of up to three additional horizontal production wells in the oil zone underlying the gas cap at Tyra. The results of this project are expected to provide the basis for an assessment of the feasibility of a further extension of the oil zone development in the Tyra Field. In connection with the horizontal drilling programme a further effort to increase the black oil recovery comprises the conversion of four existing gas producers located within the eastern field area to oil producers.

With a view to appraise the flank area of the Tyra Field a delineation well Tyra Southeast E-5x was spudded at the beginning of 1991. The well is located approximately eight km southeast of the Tyra East Complex. Preliminary well results indicate a larger areal extent of the hydrocarbon bearing flank than previously assessed.

During 1990 3.30 billion Nm^3 of gas was produced at Tyra providing 0.69 million m^3 of condensate, a decrease of the gas production by 6 per cent as compared to 1989. A total of 0.39 million m^3 of black oil was furthermore produced during 1990 bringing the cumulative oil production up to 1.15 million m^3.

The Rolf Field

Rolf is an oil field located 15 km west of the Gorm Field. The oil production at Rolf was initiated in 1986. Rolf has been developed as a satellite to Gorm. The oil is transported to Gorm C via pipeline.

Current oil production at Rolf is sustained from one crestally located producer.

Further development comprising drilling and completion of a second production well in the Rolf Field was approved by the Minister of Energy in February 1991. The approved work further comprises initial efforts to produce oil from the Zechstein carbonates underlying the chalk reservoir.

Since 1987 the oil production at Rolf has been accompanied by water, the water cut increased during 1990 to around 45 per cent. The position of the second producer has been selected in order to increase oil recovery, while presumably diminishing water production.

A total of 0.27 million m^3 of oil was produced from Rolf in 1990, a 31 per cent decline as compared to 1989.

Field Developments in Progress

The Dagmar Field

Dagmar is an oil accumulation located approximately 10 km west of the Gorm Field.

The discovery was made in 1983 and in March 1989 a development plan was approved by the Minister of Energy. In accordance with the plan phased development will be applied at Dagmar.

The Dagmar Field will be developed as a satellite to Gorm. Oil produced at Dagmar will be transported via an eight inch pipeline to the Gorm F platform for processing and further transport ashore.

The phase one development included the installation of an unmanned STAR platform (Ref. 1989 report) and the drilling of two producers during 1990. This is the first time a platform was installed by utilization of a drilling rig within the North Sea.

Oil production from the Dagmar Field is expected to be initiated towards mid 1991.

The reservoir fluid in the Dagmar Field contains hydrogen sulphide. Part of the gas produced will be utilized as fuel gas at Gorm F, the remainder will be flared.

Phase two of the development plan, expected for implementation during 1993, comprises the installation of sour gas treatment facilities at Gorm F for the Dagmar gas and furthermore an extension of the number of production wells.

The Kraka Field

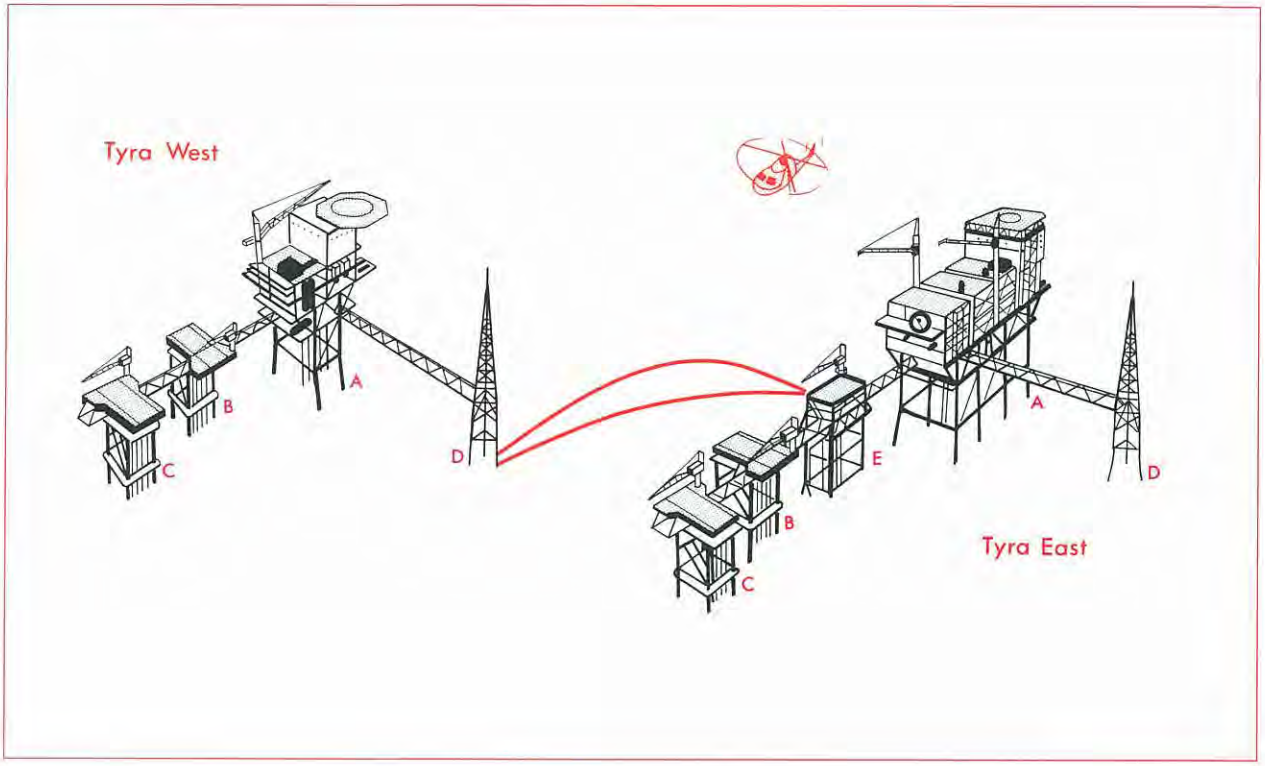
Kraka is an oil accumulation with a small free gas cap. The field is located approximately seven km southwest of the Dan Field.

The oil production was initiated in March 1991.

The Kraka discovery was made in 1966, a development plan was approved by the Minister of Energy in 1988. The plan includes phased development of Kraka as a satellite to the Dan Field.

Phase one was completed during 1990 and included the installation of a template and drilling, completion and production testing of two horizontal production wells. Furthermore a 10 inch pipeline was installed for the transportation of the Kraka oil and gas production to the Dan FC platform. Finally a STAR wellhead platform was installed over the template; hook-up and commissioning took place early 1991 allowing initiation of the oil production during March 1991.

Fig. 3.7 The Tyra Complex



Continued development at the Kraka Field is contingent on the results of an initial six month test production. If applicable, the phase two development comprises the drilling and completion of additionally two horizontal producers followed by a 12 months' test production period.

A final development plan will be considered subsequent to this extended test production period.

The Valdemar Field

Valdemar consists of a number of separate oil and gas zones. The field is located approximately 20 km northwest of the Tyra Field within the DUC Contiguous Area. Valdemar covers around 200 km^2, hence representing the largest Danish hydrocarbon accumulation so far discovered.

A number of discovery wells were drilled within the Valdemar Field area, i.e. comprising Bo-1 (1977), Boje-1 (1982) and North Jens-1 and 2 (1985/1986). A development plan was approved by the Minister of Energy in 1988. In accordance with this plan the Valdemar Field will be developed as a satellite to the Tyra Field under a phased development scenario.

The target area for the initial development is located in the vicinity of wells North Jens-1 and 2.

Phase one of the Valdemar development was initiated in 1989, i.e. including the installation of a template and the drilling of a horizontal well, Valdemar-1.

The pilot hole for the horizontal well Valdemar-2 was subsequently drilled closer to the exploratory wells North Jens-1 and 2. A production test conducted in the pilot hole provided promising results and well Valdemar-2 was subsequently suspended to allow a detailed evaluation of the drilling and test data prior to the implementation of the horizontal part of the well.

A revised development plan was approved by the Minister of Energy in July 1990 comprising a reduction of the number of production wells under phase one of the development plan to a total of three wells and furthermore a delay of the production start until 1st January, 1993. Furthermore the expiry date for the submittal of a plan for the further development of Valdemar will now be 1st January, 1994.

Drilling operations at well Valdemar-2 were resumed in August 1990 for the carrying out of the horizontal part of the well. Subsequent to completion of the well a thorough production test was carried out. The results of the testing supported the promising results previously encountered in the pilot hole.

The implementation of further development activity at Valdemar is contingent on the evaluation of the currently available results.

Future Field Developments

A review including pertinent data and information on previously approved field developments is enclosed in Appendix E of this report. Reference is also made to earlier issues of the annual report on the exploration and production of oil and gas in Denmark.

Commercially viable discoveries for which development plans are currently outstanding are described below.

The Elly Discovery

Elly is a gas discovery located 40 km northwest of the Tyra Field in block 5504/6, close to the Danish/German boundary.

The discovery was made in 1984 and was declared a commercially viable prospect in 1988.

Due to the geologically complex nature of the Elly prospect area the Minister of Energy granted an extension of the expiry date for the submittal of a development plan until 6th December, 1991.

The Gert Discovery

Gert is an oil discovery located 80 km north of the Tyra Field within blocks 5603/27 and 28. The field extends into the Norwegian sector where it has been designated "Mjølner".

The Gert discovery was made in 1984 and was declared a commercially viable prospect in 1987.

The expiry date for the submittal of a development plan will be 30th August, 1991. Hence the results of two delineation wells, terminated during 1990 (Gert-4 in Denmark, 2/12-2 in Norway), can be included in the study providing the basis for a development plan for the Gert/Mjølner area.

A review and assessment of the Danish oil and gas reserves is carried out annually by the Energy Agency.

The reserves assessment reflects those amounts of oil and gas that can be produced under the prevailing economic conditions by the utilization of known technology.

A minor decline in the oil reserves is observed in the revised assessment of 1st January, 1991, corresponding to two per cent compared with the 1990 figure. This is due to the fact that although a number of upward revisions, have been performed as a result of recent evaluations of the data basis underlying the calculations, these revisions did not fully compensate for the decline caused by the oil being produced. On the basis of the present reserves assessment it is estimated that in average the current level of oil production can be sustained for the next 20 years.

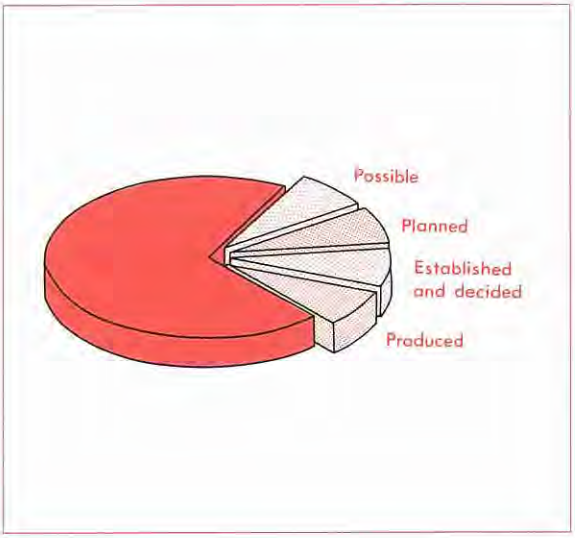
As in earlier assessments reserves were only allocated where presence of hydrocarbons has been conclusively established through drilling and testing.

Method and Definitions

The probabilistic calculation method used by the Energy Agency provides a single expectation value with regard to oil and gas reserves contained in a given field or prospect. The underlying calculations account for the uncertainties attributed to the various parameters entered into the calculations based on available geological, petrophysical and well test information, and besides the expectation value the result of the calculations also reflects low and high reserves values.

The range between the low and the high values thus becomes an expression of uncertainty attributed to the expectation value, i.e. a wide range between the low and high values reflects a high level of uncertainty in the expectation value. As data and information are gained for a given reservoir, this range narrows, hence providing an expectation value with a higher degree of confidence.

Fig. 4.1 Reserves Categories



The recovery in terms of the amounts of oil and gas that can be produced from a field during its lifetime is designated the ultimate recovery. The difference between ultimate recovery and the quantities of oil and gas produced at any given time hence constitutes the reserves, i.e. the amounts of oil and gas remaining to be produced. The reserves categories are illustrated in Fig. 4.1.

Reserves

The ongoing and planned oil and gas production was categorized as established, decided and planned recovery, respectively.

In addition, oil and gas reserves were assessed by the Energy Agency with regard to projects not yet supported by the operator's development plans.

These reserves were categorized as possible recovery.

The categories discussed above are defined in the following.

Established Recovery

Established recovery comprises oil and gas reserves that are recoverable from the currently existing wells and production facilities. In this context it is assumed that the required maintenance of the facilities is performed.

Reserves

Table 4.1 Reserves Assessment, 1st January, 1991

	Oil and Condensate, million m^3			
	Produced	Low	Exp.	High
Established and Decided Recovery				
Dan	11	23	30	40
Gorm	15	6	13	20
Skjold	10	11	20	33
Rolf	2	1	1	2
Tyra	5	5	7	9
Dagmar	–	1	2	3
Kraka	–	1	2	4
Valdemar	–	1	4	6
Adda	–	<1	1	2
North Arne (Svend)	–	4	7	10
Harald	–	4	5	7
Igor	–	<1	<1	<1
Nils	–	<1	<1	1
Roar	–	2	2	3
Sub total	*43*		*94*	
Januar 1990	36		100	
Planned Recovery				
Dan	–	3	4	5
Rolf	–	<1	1	2
Tyra	–	1	2	3
Dagmar	–	1	1	2
Kraka	–	1	2	2
Valdemar	–	5	10	16
Gert	–	3	6	9
Elly	–	<1	<1	1
Sub total			*26*	
January 1990			27	
Possible Recovery				
Producing Fields	–	26	35	46
Comm. Fields	–	2	6	11
Pot. Fields	–	9	18	28
Sub total			*59*	
January 1990			56	
Total	*43*		*179*	
January 1990	36		183	

	Gas, billion Nm^3			
	Produced	Low	Exp.	High
Established and Decided Recovery				
Dan	4	9	12	15
Gorm	<1	5	6	8
Skjold	1	1	2	2
Rolf	<1	<1	<1	<1
Tyra	11	25	35	43
Dagmar	–	<1	<1	1
Kraka	–	<1	1	2
Valdemar	–	1	1	2
Adda	–	1	1	2
North Arne (Svend)	–	1	2	3
Harald	–	20	25	31
Igor	–	1	2	3
Nils	–	<1	<1	<1
Roar	–	9	12	17
Sub total	*16*		*99*	
January 1990	13		108	
Planned Recovery				
Dan	–	1	1	2
Rolf	–	<1	<1	<1
Tyra	–	<1	<1	<1
Dagmar	–	<1	<1	<1
Kraka	–	1	1	1
Valdemar	–	2	4	5
Gert	–	<1	1	1
Elly	–	1	3	5
Sub total			*10*	
January 1990			19	
Possible Recovery				
Producing Fields	–	9	13	17
Comm. Fields	–	3	11	22
Pot. Fields	–	13	29	47
Sub total			*53*	
January 1990			49	
Total	*16*		*162*	
January 1990	13		176	

Decided Recovery

Reserves under decided recovery are calculated for hydrocarbon discoveries for which development plans have been approved by the Energy Authorities. Further reserves under this category apply to approved extensions and modifications of existing production facilities.

Planned Recovery

Reserves under planned recovery comprise the producible amounts of oil and gas that can be calculated for prospects described in development plans filed to the Ministry of Energy, however not yet approved. Further reserves under planned recovery include oil and gas reserves from prospects that have been declared commercial by the licence holders.

Possible Recovery

Possible recovery comprises oil and gas that can be produced by the utilization of known technologies and under compatible conditions with those in other parts of the North Sea. For example, possible recovery may be envisaged as a result of water flood programmes on a larger scale compared to the current plans, or to an extended application of horizontal drilling and completion.

Furthermore this category comprises reserves requiring more favourable oil pricing conditions, hereunder marginal fields.

The 1991 Reserves Assessment

The oil/condensate and gas reserves assessment by the Energy Agency as of 1st January, 1991 are summarized in Table 4.1 in line with the above category subdivision.

For comparison the 1990 reserves figures have been included.

As indicated in Table 4.1 the total Danish reserves potential is based on the expectation values. It is not considered realistic to assume that either the low or the high reserves figure will be applicable for all the fields and prospects in the assessment.

Fig. 4.2 Oil and Gas Reserves

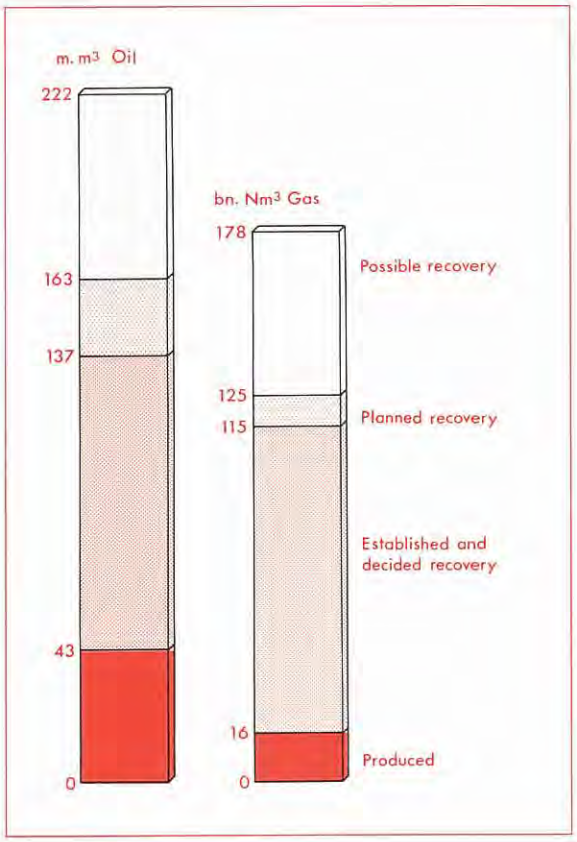


Fig. 4.2 reveals that the total expected recovery corresponds to between 163 and 222 million m^3 of oil and condensate and between 125 and 178 billion Nm^3 of gas. The gas production as shown in Fig. 4.2 represents net production, i.e. excluding reinjection gas. Needless to say that the uncertainty with regard to the commercial exploitation viability is increasing from planned to possible recovery.

A number of revisions in the reserves assessment were made compared to the assessment of last year. This is principally due to planned and/or approved developments at the Gorm, Rolf and Tyra Fields; furthermore new data and information were retrieved from the wells completed during 1990 in addition to the production experience gained during the report period.

Areas for which significant revisions were made are briefly described below.

Established and Decided Recovery

Extended development took place at the Gorm Field during 1990, comprising the installation of one producer and two water injectors. This carries an increase of the oil reserves of two million m^3.

The production experience gained at the Skjold Field indicates continued promising production behaviour. This circumstance justified an upward revision of the high value of the ultimate recovery by seven million m^3 of oil. This resulted in an increase of the expectation value of one million m^3.

A downward revision of the condensate reserves in the Tyra Field was performed, but compensated by an upward revision of the black oil reserves in relation to the encouraging results of the horizontal oil producers drilled at Tyra during 1990. Hence the ultimate oil and condensate reserves assessment for Tyra remains unchanged.

The Dagmar Field is expected to be put on stream towards medio 1991; production from the Kraka Field was initiated in March 1991.

The gas reserves in the Valdemar Field have been reduced in the light of the results of the production test conducted in the horizontal well Valdemar-2.

A review of the expected recovery drive mechanism of the gas accumulation of the Roar Field carried a downward correction of the Roar condensate reserves, corresponding to two million m^3.

Planned recovery

Extended development of the Rolf Field was approved by the Minister of Energy. In 1991 the project comprises, besides the drilling of a second oil producer, oil production from Zechstein carbonates underlying the chalk reservoir currently producing.

Approval was granted by the Minister of Energy in 1990 on extended development of the oil zone in the Tyra Field, comprising the drilling and completion of three additional horizontal oil production wells.

The oil reserves at Valdemar were upgraded by two million m^3 as a result of the production test in well Valdemar-2 during 1990. These results also carried a reduction of the gas reserves under planned recovery, corresponding to nine billion Nm^3.

Oil reserves for Gert were assessed at six million m^3, however the complex geological situation in the Gert area provides this oil reserves estimate with considerable uncertainty.

Possible Recovery

A number of possibilities were studied and evaluated by the Energy Agency with regard to possible additional oil and gas recovery under known technological conditions, and compatible with applications elsewhere in the North Sea area.

Based on reserves calculations combined with general assumptions concerning capital investments, operating costs and oil pricing development it is envisaged that additional oil reserves will be produced by implementation of extended water injection projects, especially in the Dan and Gorm Fields.

Furthermore, additional possible gas reserves were identified at the Tyra Field, comprising recovery by horizontal gas producers from the flank areas of the field.

An important contribution to the reserves under possible recovery is allocated to the Barremian limestone reservoirs at the Valdemar and Adda Fields. A further possibility comprises the reserves obtained through continued development of the Dagmar Field.

Finally, reserves in hydrocarbon prospects under evaluation and hydrocarbon accumulations declared not commercially viable were included under possible recovery. Although not considered producible under currently prevailing economic or technological conditions the reserves of the latter category, may become commercially viable in the future.

Enhanced Oil Recovery

The total reserves assessed in the above, i.e. under the established, decided, planned and possible recovery categories correspond to approximately 14 per cent of the identified Danish oil-in-place potential.

A number of problematic geological conditions are, however, attached to several Danish oil fields, hampering a ready recovery of oil, mainly due to capillary constraints within the reservoirs.

In the 1989 report a description was provided concerning the possibilities for enhanced oil recovery from these reservoirs, principally through the application of enhanced oil recovery procedures (EOR).

The EOR technology is continuously being developed, i.a. comprising injection of chemicals and gases into the reservoir with the purpose of reducing the surface tensions between reservoir rock and fluids or improving the displacement of oil in conjunction with water injection.

A meaningful reserves estimate under enhanced oil recovery is difficult to perform for the time being, although it is expected that the magnitude of such oil reserves could be considerable.

Speculative Reserves

Oil and gas reserves estimates allocated to exploratory leads and prospects within the Central Graben area, not yet substantiated by drilling, were discussed in the 1989 report.

Based on the reserves assessment the Energy Agency prepared forecasts for oil and gas production and the pertaining income/expenditure.

The current five-year forecast reveals the expectations as assessed by the Energy Agency together with an evaluation regarding energy self-sufficiency and the net currency expenditure for energy imports.

In addition a 20-year forecast for the oil and gas production has been prepared.

A description concerning the public economical implications of the five-year production forecast has furthermore been included.

Fig. 5.1 Energy Consumption and Production 1991-1995

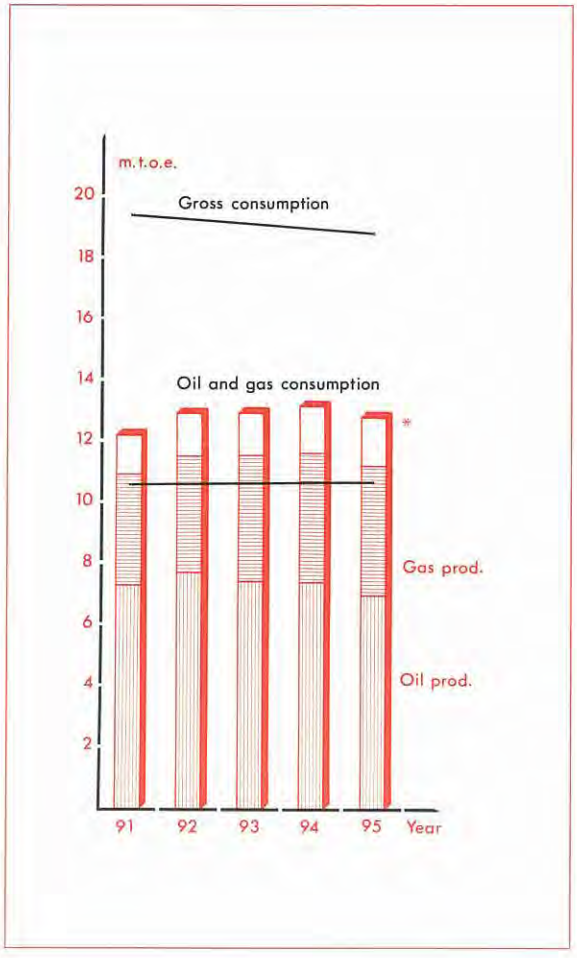


Table 5.1 Oil and Condensate Production Forecast, million m^3

	1991	1992	1993	1994	1995
Established and Decided Production					
Dan	1.8	2.4	2.4	2.2	1.9
Gorm	1.4	1.2	1.1	1.0	1.0
Skjold	2.9	2.5	2.2	1.9	1.5
Rolf	0.3	0.2	0.2	0.1	0.1
Tyra	1.3	1.2	0.9	0.5	0.5
Dagmar	0.3	0.5	0.4	0.4	0.3
Kraka	0.1	0.3	0.2	0.3	0.2
Valdemar	–	–	0.4	0.3	0.3
Roar	–	–	0.1	0.3	0.3
Nils	–	–	–	0.4	0.1
Sub Total	*8.1*	*8.3*	*7.9*	*7.4*	*6.2*
Planned Production	0.2	0.8	0.8	1.3	2.0
Expected Production	*8.3*	*9.0*	*8.7*	*8.7*	*8.2*
April 1990	7.8	7.4	7.0	7.1	

Five-year Production Forecast

The five-year production forecast uses the same systematics as applied to the reserves assessment, including the hydrocarbon recovery under the established, decided and planned categories.

The oil and condensate production forecast assumes the utilization of currently existing facilities and further planned extensions of these facilities.

Furthermore, it is assumed that the total production will not exceed the capacity of the currently existing transportation system.

The sales gas production forecast reveals the expected gas deliveries to Dansk Naturgas A/S.

This year's liquid hydrocarbon production forecast has been upgraded compared to the 1990 forecast; hence the current prediction reveals a production peak in 1992 followed by a decline.

Forecasts

The increase of oil production through the forecast period is due to intensified field developments as well as the extended capacities of the processing and transportation systems.

Fields carrying a significant revision in the oil production forecast are the following:

The Gorm Field, an increased oil production due to extended water injection.

The Skjold Field, an increased oil production due to continued development and encouraging production performance.

The Tyra Field, an increased oil production as a result of the encouraging results of the horizontally completed oil wells during 1990, besides the approved conversions of gas wells to oil producers within the eastern part of the field.

The Kraka Field was put in production in March 1991.

Oil production from the Valdemar Field is now expected to be initiated by 1st January, 1993.

As a result of these modifications the production forecast under the established and decided categories shows significant increments compared to the 1990 forecast, reflecting the intensified Danish field development activities.

Table 5.2 Sales Gas Production Forecast, billion Nm^3

	1991	1992	1993	1994	1995
Dan Centre	0.9	1.1	1.0	1.2	1.0
Gorm Centre	0.3	0.2	0.3	0.2	0.1
Tyra Centre	2.4	2.6	2.8	2.9	3.2
Expected Production	*3.6*	*3.9*	*4.1*	*4.3*	*4.3*
April 1990	3.6	3.7	3.9	4.0	

Table 5.3 Development Investments. DKK billion (1991)

	1991	1992	1993	1994	1995
Established and Decided Projects					
Dan	0.5	0.6	0.0	–	–
Gorm	0.0	–	–	–	–
Skjold	0.2	–	–	–	–
Rolf	0.2	–	–	–	–
Tyra	0.0	–	–	–	–
Dagmar	0.3	0.0	–	–	–
Kraka	0.3	0.1	0.1	0.2	–
Valdemar	0.1	0.3	–	–	–
Roar	0.0	0.2	0.5	–	–
Nils	–	–	0.3	–	–
Sub Total	*1.7*	*1.2*	*0.9*	*0.2*	*0.0*
Planned Projects	0.4	0.3	1.1	0.9	0.5
Expected Investments	*2.1*	*1.5*	*2.0*	*1.1*	*0.5*
April 1990	1.5	1.6	2.2	1.0	–

Table 5.4 Operating Costs. DKK billion (1991)

	1991	1992	1993	1994	1995
Established and Decided Projects					
Dan	0.3	0.3	0.3	0.3	0.3
Gorm	0.2	0.2	0.2	0.2	0.2
Skjold	0.2	0.2	0.2	0.2	0.2
Rolf	0.0	0.0	0.0	0.0	0.0
Tyra	0.3	0.3	0.3	0.3	0.3
Dagmar	0.0	0.0	0.1	0.1	0.1
Kraka	0.0	0.0	0.0	0.0	0.0
Valdemar	–	–	0.0	0.0	0.0
Roar	–	–	0.0	0.0	0.0
Nils	–	–	–	0.0	0.0
Sub Total	*1.1*	*1.1*	*1.3*	*1.3*	*1.3*
Planned Projects	0.0	0.0	0.0	0.0	0.1
Expected Costs	*1.1*	*1.1*	*1.3*	*1.3*	*1.3*
April 1990	1.2	1.2	1.3	1.3	–

Table 5.5 Oil Pipeline Transportation Costs. DKK billion (1991)

	1991	1992	1993	1994	1995
Sub Total	*0.8*	*0.9*	*0.9*	*0.9*	*0.8*
April 1990	0.8	0.8	0.8	0.8	–

A similar increase of the production under planned recovery is basically a result of further development work at Tyra, comprising three additional horizontal wells in the oil zone. In this category is also included production from planned development projects at Dan, Rolf, Dagmar and Valdemar.

The Agreement in Principle of 1989 between the Danish Underground Consortium and Dansk Naturgas A/S implies inherent improved sales gas disposal. The gas production is allocated to the three processing centres located at Dan, Gorm and Tyra, respectively (ref. Table 5.2).

The predicted capital and operating costs for the forecast period are highlighted in Tables 5.3 and 5.4.

In Table 5.5 the expected costs of transportation of oil from the Danish fields are presented for the next 5 years.

The expenditure forecast with regard to exploratory and appraisal activities was revised in line with the work commitments under the Danish 3rd Round, 1989 (ref. Table 5.6).

Table 5.6 Exploration and Appraisal Costs. DKK billion (1991)

	1991	1992	1993	1994	1995
Total	*0.8*	*0.4*	*0.3*	*0.3*	*0.2*
April 1990	0.2	0.4	0.3	0.1	–

Table 5.7 Rate of Self-Sufficiency and Net Currency Expenditure for Energy Imports 1991-1995

	1991	1992	1993	1994	1995
Production					
Crude Oil (million m^3)	8.3	9.0	8.7	8.7	8.2
Natural Gas (billion Nm^3)	3.6	3.9	4.1	4.3	4.3
Total Energy Consumption (PJ)	*807*	*801*	*794*	*788*	*784*
Rate of Self-Suffiency (%)					
A)	103	111	110	111	106
B)	56	61	61	62	60
C)	62	68	68	70	68
Net Currency Expenditure for Energy Imports					
Billion DKK	4.8	4.2	4.3	4.1	4.8
Crude Oil Price					
USD/barrel	21	23	25	27	28
DKK/USD	7.00	7.00	7.00	7.00	7.00

A: Oil and gas production vs. domestic oil and gas consumption
B: Oil and gas production vs. total domestic energy consumption
C: Total energy production vs. total domestic energy consumption

Self-Sufficiency and Net Currency Expenditure

Two basic assessments with regard to the rate of oil and gas self-sufficiency are made, reflecting the predicted hydrocarbon production as it relates to (A): the total domestic hydrocarbon consumption and (B): the total domestic energy consumption. A third assessment (C) shows the rate of self-sufficiency in terms of total domestic energy production, including alternative and recycled energy, and its proportion of the total domestic energy consumption.

The calculation of the net currency expenditure is based on an assumed escalation of the crude oil price.

The net currency expenditure is calculated in terms of its immediate effect on the energy products item of the Balance of Trade, including all forms of energy. Costs for imports in conjunction with field developments are not included in the calculation nor are transfers of revenues abroad. The proportion between energy production and consumption is illustrated in Fig. 5.1 in terms of t.o.e. for the sake of convenient comparison.

It can be noticed that the rate of self-sufficiency with regard to oil and gas exceeds 100 per cent during the forecast period; for oil alone the rate corresponds to nearly 90 per cent.

Twenty-year Production Forecast

The twenty-year forecast was prepared using the same systematics as applied in the five-year forecast, but does also include oil and gas production under the possible category.

Crude Oil and Natural Gas Production

Three scenarios regarding oil and condensate production were assessed: i.e. the established/decided, the planned and the possible scenarios. The production forecasts are shown in Fig. 5.2.

Fig. 5.2 Oil and Condensate Production 1991-2010

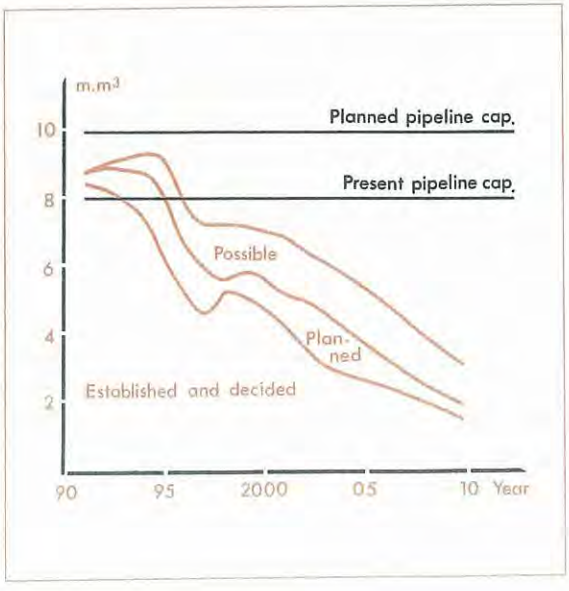
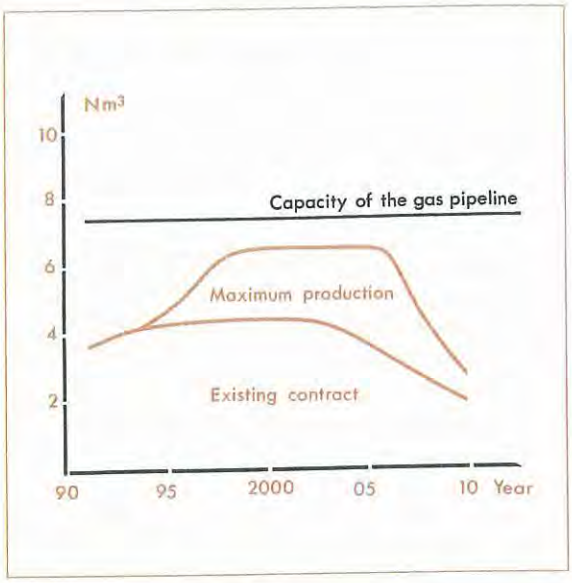


Fig. 5.3 Sales Gas Production 1991-2010



The production under the established/decided scenario reflects an even decline towards the turn of the century followed by a marked increase. The increase is primarily due to the implementation of the Harald Field development but also the developments at the North Arne (Svend), Igor and Adda Fields.

The planned scenario reflects extended development at the existing Dan, Rolf and Tyra Fields and furthermore includes the oil production from further development of the Dagmar, Kraka and Valdemar Fields, currently under development, as well as the production under the planned development in the Elly and Gert areas.

The possible production scenario further assumes extended phased development at the Dan, Gorm, Rolf, Dagmar and Adda Fields.

The oil and condensate production forecast in Fig. 5.2 reveals an annual possible plateau production of around nine million m^3 until 1997 declining to approximately four million m^3 in 2010.

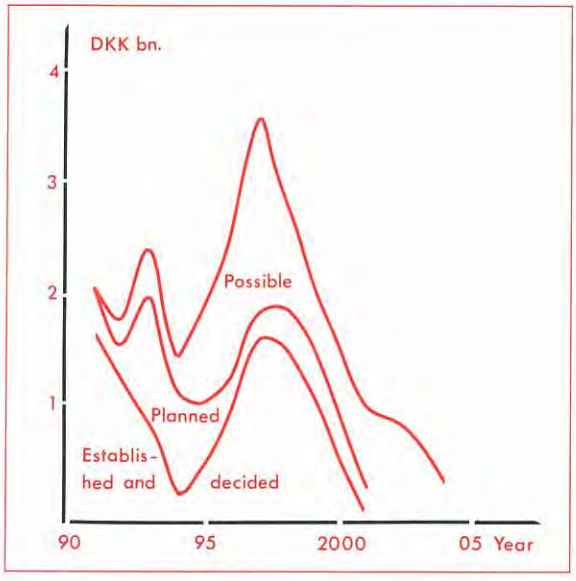
The forecasts are based on utilization of known technology and currently prevailing economic conditions. The application of EOR methods and additional projected field developments that may appear justified during the production period

could eventually increase and extend the plateau production well into the next century.

The perspectives of the natural gas production are illustrated in Fig. 5.3. In contrast to the oil production scenarios the gas production forecast is subject to existing and future disposal opportunities with underlying long-term contracts for gas deliveries.

Therefore, the maximum gas production under the forecast has been restricted to reflect the maximum capacity of the existing Danish gas transmission system; the corresponding minimum gas production forecast simply reflects the gas sales under the existing gas sales contracts between the Danish Underground Consortium and Dansk Naturgas A/S, comprising a total of 93 billion Nm^3. The maximum gas production to the end of the forecast period corresponds to 120 billion Nm^3, and further gas deliveries of 27 billion Nm^3 can be made within the forecast period.

Fig. 5.4 Rate of Investment 1991-2010

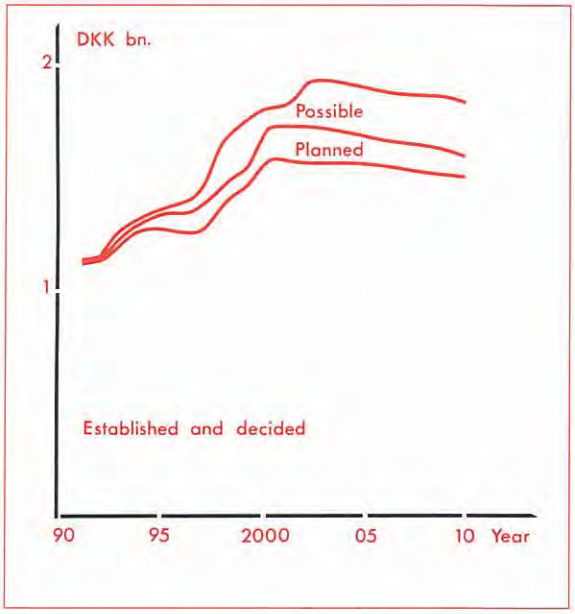


Capital Expenditure and Operating Costs

Figures 5.4 and 5.5 illustrate the rate of investment and operating costs pertaining to the production scenarios described above.

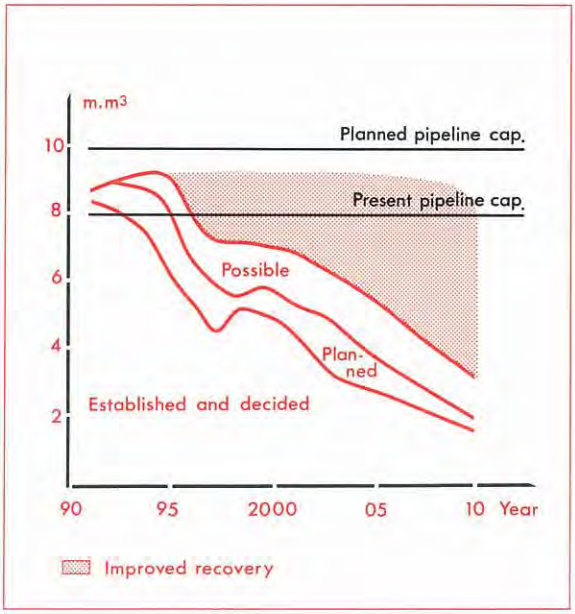
The phasing with regard to a number of the field developments is subject to considerable uncertainty. The pertaining rate of investment has therefore been averaged over the long term.

Fig. 5.5 Operating Costs 1991-2010



The high rate of investment under the category decided recovery as indicated at the end of this decade is related to the approved developments in the northern Central Graben area.

Fig. 5.6 Possible Oil Production Scenarios at Implementation of Enhanced Oil Recovery



The total capital expenditure of approved projects amounts to approximately DKK 10 billion; planned activities require investments corresponding to DKK 5 billion; a total investment of additionally DKK 9 billion was estimated in order to realize the recovery projects under the scenario for possible production.

The present production facilities required a total investment of approximately DKK 30 billion.

The rate of operating costs reflects a more uniform course than that assessed for the capital costs. In line with the forecast the operating costs will approach DKK 2 billion per year towards year 2000.

Improved Oil Recovery

The oil production scenario discussed above should not be regarded as the absolute upper limit of the Danish oil production potential.

Table 5.8 Predicted Value of Production, Capital Costs and Operating Costs 1991-1995, DKK billion (1991)

	1991	1992	1993	1994	1995
Oil Production (million m^3)	8.3	9.0	8.7	8.7	8.2
Natural Gas Production (billion Nm^3)	3.6	3.9	4.1	4.3	4.3
Crude Oil Price USD/bbl	21	23	25	27	28
Capital Costs:					
Exploration	0.8	0.4	0.3	0.3	0.2
Field Development	2.1	1.5	2.0	1.1	0.5
Natural Gas System	1.0	1.0	1.2	1.0	0.4
Operating Costs:					
Fields	1.1	1.2	1.2	1.3	1.3
Natural Gas System	0.9	0.9	0.9	0.9	0.9
Oil Pipeline	0.2	0.2	0.2	0.2	0.2

Table 5.9 State Revenues 1991-1995, DKK billion (1991)

	1991	1992	1993	1994	1995
Hydrocarbon Tax	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Corporate Tax	2.2 (1.8)	2.8 (2.2)	3.0 (2.0)	3.5 (2.2)	3.4 (2.0)
Royalty	0.8 (0.8)	1.0 (0.8)	1.0 (0.8)	1.1 (0.8)	1.1 (0.8)
Profit Element	0.3 (0.3)	0.4 (0.3)	0.4 (0.3)	0.4 (0.3)	0.4 (0.3)
Total	*3.3* (2.8)	*4.2* (3.3)	*4.5* (3.2)	*5.1* (3.3)	*5.5* (3.0)

Further improved oil recovery is contingent on the currently intensified efforts with regard to the development and implementation of new technologies. Furthermore the continuously gained production experience is expected to result in the implementation of new concepts of enhanced recovery, hence improving the production potential. Finally, the ongoing exploratory work is assumed to provide additional oil reserves, hence increasing the production potential.

A tentative forecast reflecting improved conditions in line with the above is indicated in Fig. 5.6 with regard to the known fields and discoveries.

State Revenues

The annual state revenue has been estimated on basis of the five-year production forecast by the Energy Agency. The underlying assumptions for the calculations are summarized in Table 5.8.

An escalation of the oil price has been assumed from USD 21/bbl in 1991 to USD 39/bbl in the year 2010.

The development of the oil price is, however, subject to considerable uncertainty. The calculations were therefore supplemented with a scenario assuming a constant oil price at USD 20/bbl (figures in brackets of Table 5.9).

Based on the above assumptions (Table 5.8) the state revenues were calculated for the period 1991-1995, shown in Table 5.9. The revenues were allocated to the year of income. With regard to the revenues resulting from the corporate tax it is emphasized that these revenues are subject to particular uncertainty, i.a. due to the fact that currency exchange rate fluctuations are not included in the calculations.

Earlier state revenues from the Danish oil and gas production are summarized under the section *Economics*.

The state revenues in the long term are illustrated in Fig. 5.7, assuming an escalating oil price from USD 20/bbl to USD 39/ bbl in year 2010, as well as the assumption of a constant oil price for the entire period at USD 20/bbl.

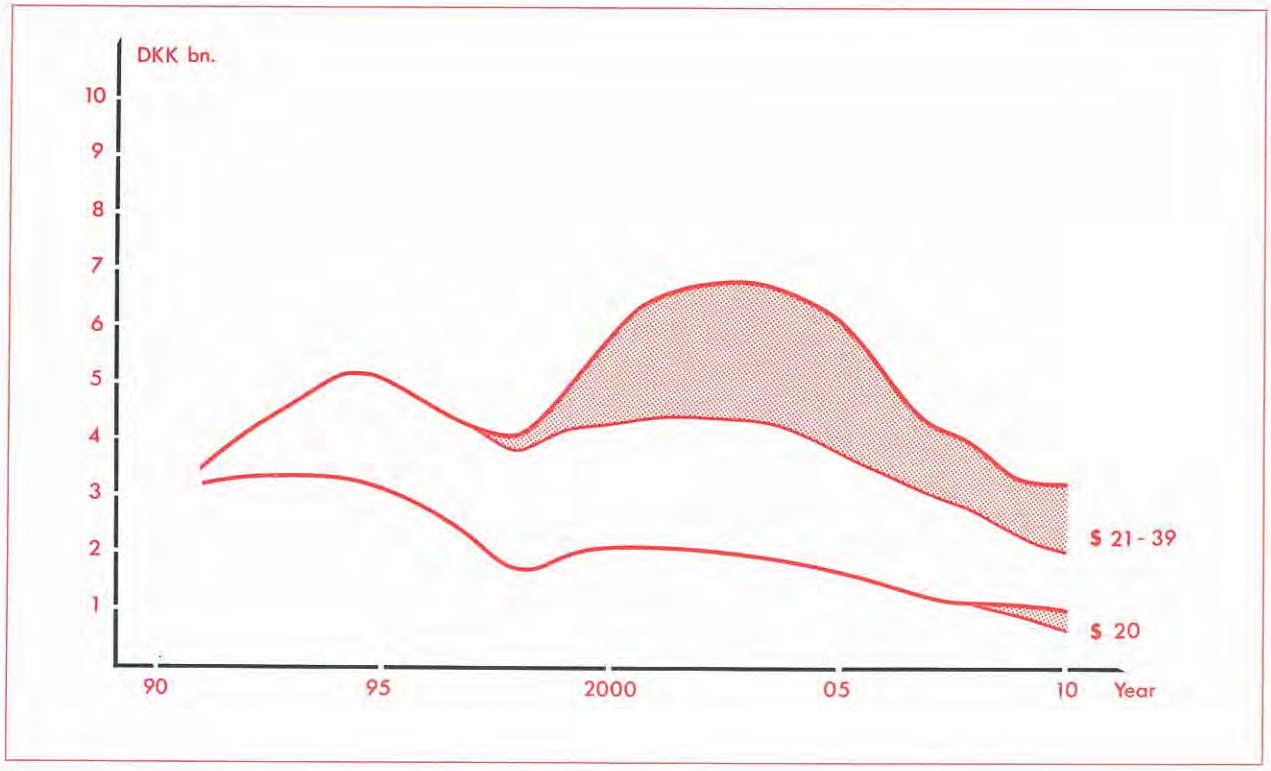
Discounting of the value of oil production was based on the 20-year production forecast including planned recovery. The disposal of the sales gas is based on the five-year production forecast and the deliveries under the Agreement in Principle of 1989 between the Danish Underground Consortium and Dansk Naturgas A/S.

It becomes apparent that the magnitude of direct state revenues resulting from the oil and gas production are primarily dependent on the future development of the crude oil price. It is furthermore indicated in Fig. 5.7 that hydrocarbon tax (highlighted area) is primarily only applicable at rising oil prices and is of subordinate relevance at relatively low oil prices.

Effects on the Balance of Payments

The effect of the Danish production of oil and natural gas on the Balance of Trade and the Balance of Payments, respectively, are summarized in Table 5.10.

Fig. 5.7 Taxes and Fees 1991-2010, DKK billion (1991)



The Balance of Payments is improved as a result of the Danish oil and gas production, partly due to export revenues and partly due to the savings of the foreign currency expenditure in connection with otherwise required energy imports. With this in mind the economic value of the production was calculated for the period 1988-1995. Subtraction of import costs related to investments and operations provides the effect on the balance of goods and services. Further subtraction of transfers of interest and returns abroad allows the effect on the Balance of Payments to be calculated.

The amounts shown in Table 5.10 do not reflect direct income from exports but rather provide an expression of the contribution to the Balance of Goods and Services and the Balance of Payments by the oil and gas production. This relationship is further illustrated in Fig. 5.8. It is emphasized that the underlying calculations are based on models with applied standard assumptions with regard to imports, etc., hence not based on actual accounting statements and figures. This does not change the circumstance, however, that Danish oil and gas production has a considerable beneficial effect on the Balance of Payments.

Fig. 5.8 Effects on the Balance of Payments 1987-1995, DKK billion (1991)

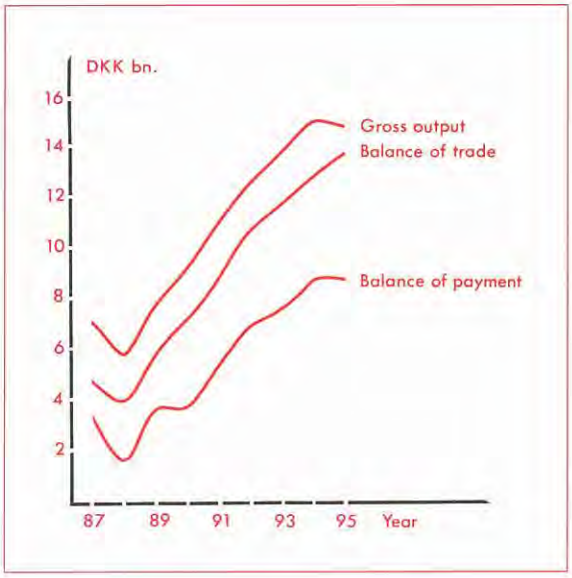


Table 5.10 Effects on the Balance of Payments, 1988-1995, DKK billion (1991)

	88	89	90	91	92	93	94	95
Gross Output Value	5.6	7.9	8.9	11.0	12.8	13.8	15.2	14.9
Import Content	1.8	1.8	1.8	2.2	1.8	2.1	2.2	1.1
Balance of Goods and Services	3.8	6.1	7.1	8.8	11.0	11.8	13.0	13.9
Transfer of Interests and Returns	2.6	3.1	4.1	4.5	5.1	5.3	5.5	6,5
Effects on Balance of Payments	1.1	3.0	2.9	4.3	5.9	6.4	7.4	7.3

The international crude oil price was during the early 1990 influenced by local capacity constraints as a result of a harsh winter in North America and technical production constraints. During spring 1990 the oil prices subsequently declined from approximately USD 20/bbl to USD 15/bbl at mid year.

The Gulf Crisis after August 1990 resulted in a considerable escalation of the oil prices, spot prices reaching as high as USD 40/bbl during brief periods. The oil prices remained at a high level during the remainder of 1990; the 1990 crude oil price averaged USD 23.71/bbl, an increase of 31 per cent compared to the average of 1989. Fig. 6.1 reveals the development of the oil price (Brent) through 1990.

The exchange rate of US dollar decreased during 1990 from DKK 7.32/USD to DKK 6.19/USD, a 16 per cent decline. The oppositely directed developments of the oil price and of the US dollar exchange rate, resulted in a moderately increased oil price in terms of Danish currency. Hence the average oil price for 1990 increased by 11 per cent to DKK 923/m^3 from DKK 834/m^3 in 1989.

The combined Danish oil and gas production landed during 1990 amounted to 8.9 million t.o.e.

Fig. 6.1 The Crude Oil Price (Brent) 1990

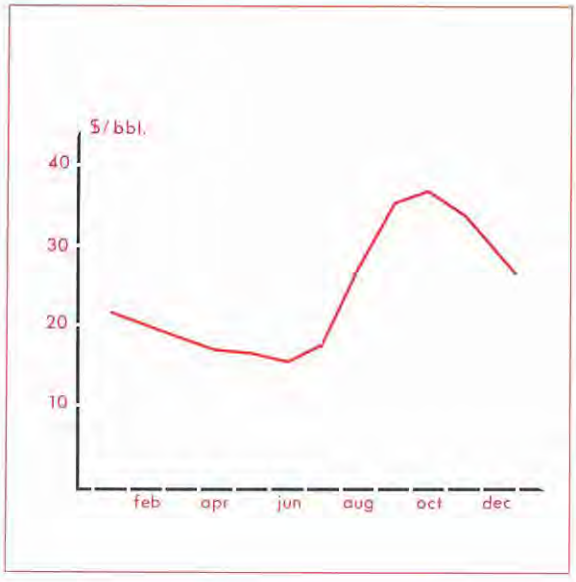


Table 6.1 Sales Value and Production of Oil and Gas

	1986	1987	1988	1989	1990*)
Sales Value (DKK million)					
Oil	3,270	4,270	3,500	5,360	6,400
Gas	2,440	1,660	1,355	1,410	1,610
Total	*5,710*	*5,930*	*4,855*	*6,770*	*8,010*
Production					
Oil, million m^3	4.29	5.41	5.57	6.47	7,00
Gas billion Nm^3	1.80	2.30	2.27	2.68	2.75
International Crude Oil Price (*Brent*)					
USD/bbl	14.45	18.38	14.94	18.11	23.70
DKK/USD	8.09	6.84	6.74	7.32	6.19
DKK per m^3	735	791	633	834	923

Nominal prices, *) Estimate

The rate of self-sufficiency corresponded to 69 per cent for oil, and 85 per cent for oil and natural gas combined, hence the domestic hydrocarbon production contributed considerably to a secure supply during the strained political situation in the Persian Gulf area.

The 1990 sales value amounted to DKK 8.0 billion, an increase of 18 per cent compared to 1989 (DKK 6.8 billion). The increase is due to the combined rising production and escalated oil price.

Exploratory, Development and Operating Expenditure

Table 6.2 summarizes the combined capital outlays for the activities in connection with exploration and production of oil and gas in Denmark. The compilation indicates a total 1990 expenditure of DKK 3.1 billion, a 22 per cent increase as compared to 1989. In addition DKK 0.7 billion were spent in connection with the transportation of the crude oil.

The transportation costs for the crude oil comprises operational costs, financing costs and depreciation on capital expenditure with regard to the pipeline and terminal facilities. In addition

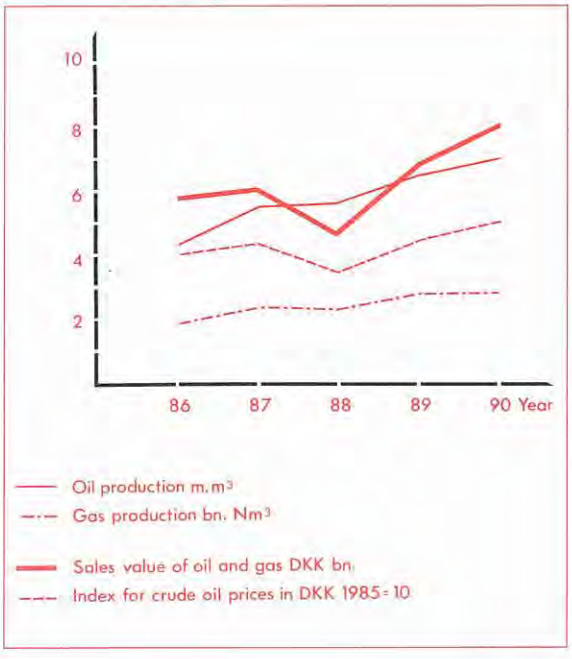
Table 6.2 Costs of Exploration, Development and Operations, DKK million

	1986	1987	1988	1989	1990*)
Exploration and Appraisal:					
DUC	309	234	110	73	240
Licence Groups 1st, 2nd and 3rd Rounds	304	505	449	170	150
Total	*613*	*739*	*559*	*243*	*390*
Development (DUC)	1,764	914	897	1,145	1,720
Operations (DUC)	981	1,023	1,000	1,094	1,025
Transportation Costs	617	632	604	727	725

Nominal prices, *) Estimate

the oil pipeline tariff includes a profit element corresponding to five per cent of the value of the transported crude oil. The oil pipeline and adjacent facilities are owned by Dansk Olierør A/S which transfers 90 per cent of the income under the profit element to the Treasury.

Fig. 6.2 Sales Value and Production of Oil and Gas 1986-1990



All costs incurred in connection with the operation of the oil pipeline are currently covered by the Danish Underground Consortium, sole producer of oil and gas in Denmark.

The rate of investment was considerable during 1990 reflecting the intensified project developments at the Dan, Gorm, Skjold and Tyra Fields, combined with the initiated developments at Dagmar, Kraka and Valdemar.

The development expenditure allocated to the various fields are summarized in Table 6.3, the 1990 entries being estimated. Non-allocated cost includes common field expenses, certain costs incurred in connection with accounting and costs carried by the individual participants of the DUC.

Table 6.3 Development Investments by the DUC, DKK million

	1986	1987	1988	1989	1990*)
Dan	1,303	641	223	362	300
Gorm	23	11	262	204	570
Skjold	44	62	236	44	105
Rolf	163	10	–	21	0
Tyra	134	188	107	85	120
Kraka	–	–	4	195	230
Dagmar	–	–	–	8	245
Valdemar	–	–	7	223	125
Not Allocated	99	2	58	3	25
Total	*1,766*	*914*	*897*	*1,145*	*1,720*

Nominal Prices *) Estimate

The total accumulated development investments of the DUC to the present amount to approximately DKK 30 billion (1991).

The results before tax of the DUC activities are shown in Table 6.4 for the period 1986-1989, the results for 1990 not yet being available. It should be noted that the transportation costs are included in the operation costs, the five per cent profit element however being excluded in the underlying calculations.

Table 6.4 Earnings by the DUC Companies 1986-1989, DKK million

	1986	1987	1988	1989*
Income	5,633	5,823	5,103	6,716
Op. Costs	1,706	1,663	1,569	1,654
Interests	529	492	628	680
Exchange Rate Adjustments	+1,385	+943	-324	+85
Gross Income	4,783	4,611	2,582	4,468
Depreciations	1,539	1,586	1,495	1,553
Earnings Before Taxes	*3,244*	*3,025*	*1,088*	*2,915*

Nominal prices *) Estimate

Direct state revenues resulting from the oil and gas production are summarized in Table 6.5 for the period 1986-1990 in 1991 prices.

As a statement of account with regard to 1990 is not yet available, the figures representing 1990 are uncertain and subject to adjustment. This is particularly evident for the estimated corporate tax in view of fluctuations in the currency exchange rates.

Table 6.5 State Revenues 1986-1990, DKK million (1991)

	1986	1987	1988	1989	1990*)
Hydrocarbon Tax	0	0	0	0	0
Corporate Tax	820	845	0	491	1,500
Royalty	531	505	398	553	656
Profit Element	139	199	144	245	270
I alt	*1,490*	*1,545*	*542*	*1,007*	*2,426*

*) Estimate

The annual entries are shown as assessed. Settlement of the corporate tax takes place ten months subsequent to the expiry of the year of income; the hydrocarbon tax is settled during the year of income; the royalty settlement six months after the expiry of the year of income. The profit element of the oil pipeline tariff is settled in monthly installments.

The total state revenues for the period 1972-1989 correspond to DKK 11.8 billion, in 1991 prices, which are allocated as follows:

- Corporate tax DKK 4.2 billion
- Hydrocarbon tax DKK 0.7 billion
- Royalty DKK 5.5 billion
- Profit element DKK 1.5 billion

The Energy Agency provides supervision concerning safety and working environment in connection with oil and gas exploration and production within the Danish offshore area. With regard to permanent installations, the Energy Agency provides supervision for both safety and working environment; for mobile offshore facilities the supervision concerning safety is shared between the Energy Agency and the Danish Board of Shipping and Navigation.

The supervision by the Energy Agency is based on internal control systems established by operators of permanent offshore installations. These systems serve to safeguard that activities are conducted in accordance with the requirements under the current legislation and under the pertaining documentation to Danish authorities. In order to ensure the implementation of the internal control systems introduced by the operators and their contractors the Agency carries out audits on a regular basis. During 1990 the supervision by the Energy Agency in particular focused on the utilization of temporary equipment on permanent installations.

New Regulations

Technical Guidelines for Marine Installations

During 1990 the Coordination Committee finalized the preparation of a draft regarding guidelines for the certification of new drilling facilities. The guidelines are effective from 1st May, 1991.

Working Environment

The regulatory work concerning safety and health on marine installations was continued during 1990 in pursuance of the Act on Certain Marine Installations of 1981 in cooperation with the Coordination Committee.

The Coordination Committee finalized the preparation of orders with regard to noise limitation on permanent marine installations and furthermore the use of chemicals and materials on marine installations.

The orders have been effective since the beginning of 1991.

Control Regulations

The Energy Agency finalized the preparations of Guidelines on control for mobile marine installations during 1990. The Guidelines are an extension in pursuance of section 14(4) of the Energy Minister's Order No. 711 of 16th November, 1987 on safety etc., on marine installations (the Safety Order).

In contrast to the requirement on permanent marine installations for the operator's own internal control system, the above guidelines valid for mobile marine installations will secure the availability of documentation onboard that safety, health and environmental conditions with regard to design, construction and operation are in accordance with current legislation and standards. Such documentation can include certificates by internationally recognized certification companies but also procedure descriptions, e.g. with regard to maintenance and work routines.

Both for permanent and for mobile marine installations the responsibility for the availability and function of the control system rests with the operator.

The work regarding the preparation of guidelines for control of permanent marine installations was completed during 1990. The guidelines comprise the operator's internal control concerning engineering, construction and installation of permanent marine installations.

Safety and Working Environment

The following jack-up drilling rigs were used in connection with operations within the Danish North Sea sector during 1990:

- Neddrill Trigon, Mærsk Endeavour, Mærsk Giant, West Sigma and the Shelf Driller.

Furthermore two additional vessels were utilized in connection with the following installations:

- The pipelaying barge "Stena Apache" from Stena Offshore Ltd., Aberdeen, was used for

the installation of pipelines Kraka Dan FA, Skjold-Gorm F and Dagmar-Gorm F. The work included the application of a new technology, i.e. comprising the welding together of the pipeline onshore and the spooling up of the pipeline on a reel placed on the barge prior to the work at sea.

– The crane barge "Hermod" from HeereMac, Holland, for the installation of the Kraka wellhead platform and of the Gorm F jacket.

The most important areas of supervision by the Energy Agency in connection with these activities concerning safety and working environment comprised noise, chemicals, ventilation, accommodation and drilling equipment, the latter being applicable for the drilling rigs, and the basic technical equipment and accommodation with regard to the pipelaying and crane barge. The supervisory activities were intensified by the Energy Agency with respect to procedures and certifications of importance for safety and health (control procedures).

The Board of Shipping and Navigation provided supervision concerning the maritime aspects of the above vessels (construction, life-saving appliances, fire-fighting equipment, etc.). Complaints of importance were forwarded by the Board regarding fire-fighting equipment and life-saving appliances.

Piper Alpha

On 6th July, 1988 the British production platform Piper Alpha was destroyed by an explosion, causing the death of 167 persons. The disaster gave rise to a major debate with regard to the safety particularly of British oil and gas installations in the North Sea.

A public investigation committee was assigned the task of inquiring into the causes of the disaster under the chairmanship and coordination of Lord Cullen. The Cullen Commission submitted its final report in November 1990.

In the report the Commission directs severe criticism of the lack of satisfactory safety conditions on British marine oil and gas installations, both towards the UK Department of Energy and towards the operator of the Piper Field, Occidental Petroleum Corporation. A number of recommendations are forwarded with a view to a revision of the present safety policy, hereunder intensified government supervision. The Energy Agency is studying and evaluating the Cullen Commission report in cooperation with Danish maritime authorities to assess whether the recommendations of the Cullen Commission give reason to revisions of currently implemented safety regulations and procedures on Danish marine oil and gas installations.

The Stenlille Gas Storage

Based on the Agreement in Principle of May 1989 between the Danish Underground Consortium and Dansk Naturgas A/S the offtake of sales gas is now estimated to reach 4.3 billion Nm^3 per year in 1994.

In consequence of the increasing gas sales Dansk Naturgas A/S filed an application with the Minister of Energy in December 1990 to establish a gas storage at Stenlille, located in western Zealand. The maximum working volume is planned at 300 million Nm^3 by the year 2000. The current plan includes implementation of the gas storage in 1994 with a working volume of approx. 150 million Nm^3.

The effective Danish gas storage capacity retained by Dansk Naturgas A/S will in 1994 amount to an estimated 450 million Nm^3.

Europipe

In 1990 the Energy Agency received information by Den Norske Stats Oljeselskap (Statoil) on the plans of a new gas pipeline, Europipe, tying the Norwegian gas fields to the gas transmission system of northern Germany. The pipeline, with a diameter of 40 inches, will intersect the Danish part of the North Sea east of the established Danish oil and gas installations. Completion of the Europipe project is expected during 1996.

Statistics of Accidents and Injuries

The registration of a work accident to the Energy Agency requires that the accident results in the

absence of working capacity corresponding to a minimum of one full day in addition to the day of the incident.

A total of 23 work accidents were reported in offshore activities during 1990, 11 on mobile and 12 on permanent installations, respectively. No fatal accidents or serious personal injury were reported. In terms of accidents versus man hours worked the reported accident rate corresponds to 7.9 accidents per million work hours for the permanent installations and 9.9 accidents per million work hours for the mobile facilities. The development in accident frequency for the permanent and mobile installations through the years is summarized in Tables 7.1 and 7.2, respectively.

Table 7.1 Accident Frequency, Permanent Marine Installations

	1984	1985	1986	1987	1988	1989	1990
Accidents per million Man Hours	36	34	40	40	10	3.4	7.9

The accident frequency, with regard to both permanent and mobile marine installations, is considerably lower than for corresponding activities onshore.

Table 7.2 Accident Frequency, Mobile Marine Installations

	1988	1989	1990
Accidents pr. million Man Hours	31.0	12.7	9.9

Concession Agreements

The concession agreements of the Danish 1st, 2nd and 3rd licence rounds include research and development funds commitments by the licensees with regard to activities within the fields of oil and gas exploration, production and development.

Research and development pertaining to these funds were initiated in 1984. At the expiry of 1990 projects were completed, corresponding to approximately DKK 50 million, and projects corresponding to approximately DKK 20 million were in progress.

The funds were primarily used for research and development focusing on:

- improved knowledge concerning the geological and geophysical processes at depths governing the generation and accumulation of oil and gas.
- reduction of development costs and the development of installation procedures and platform designs for utilization in marginal fields, and under extreme environment, such as arctic areas etc.
- limitation and prevention of environmental damage.

The Energy Research Programme, 1991

The Energy Agency is responsible for the evaluation of project applications with regard to the public funding of Danish oil and gas R&D activities.

A total of 36 applications were received at the expiry of the application period on 1st August, 1990. The amount of applications covers R&D activities corresponding to a total budget of DKK 104 million. The Danish Petroleum Committee recommended financial support to 14 projects.

EEC Research and Development Programmes

The Energy Agency is a member of the advisory committee under the Directorate General XVII of the Commission of the European Communities concerning the THERMIE programme for the promotion of European energy technology. The programme covers the period 1990-1994 and has a total budget corresponding to DKK 5.6 billion. The programme plays an important role for the implementation of the common policy of the Community, in particular with regard to the establishment of the Inner Market. Denmark's share of the total budget is nearly 10 per cent, which is considered indeed satisfactory. However, under the first THERMIE programme no oil and gas R&D projects was awarded to Denmark.

The Energy Agency is furthermore a member of the advisory committee under the Directorate General XII of the Commission of the European Communities with regard to the JOULE programme for research and development of non-nuclear energy. The total financial support under the JOULE programme amounted to DKK 950 million during 1990, whereof Danish contributions corresponded to DKK 36 million. Five Danish oil and gas projects participated in the programme, i.e. comprising exploration and production technology as well as recycling of hydrocarbons.

Table 8.1 EEC Funding of Danish Research Programmes (JOULE)

Project	EEC Funding (DKK, million)	Institution
1. Techniques of Prospecting and Exploration	3.5	Technical University of Denmark
2. Production Techniques	1.5	University of Århus
3. Production Techniques	1.0	Danish Geological Survey
4. Production Techniques	1.6	University of Copenhagen
5. Chemical Transformation of Hydrocarbons	1.9	Haldor Topsøe A/S

Appendices

Concessionaires in Denmark

(31st december, 1990)

Group	Share
Dansk Undergrunds Consortium (DUC):	
Block 5603/27 and 28, 5604/21, 22 and 25, 5504/5, 6, 7, 8, 10, 11, 12, 14, 15 and 16, 5505/13, 17 and 18	
A.P. Møller (concessionaires)	39.00%
Shell Olie- og Gasudvinding Danmark	46.00%
Texaco Denmark Inc.	15.00%
Mærsk Olie og Gas AS is operator	
1st Round:	
Licence 2/84, Block 5504/1, 2, 5 and 6	
Amoco Denmark Exploration Co. (operator)	66,67%
FLS-Energy A/S	10.00%
DOPAS	23,33%
2rd Round:	
Licence 1/86, Block 5503/4, 5604/29, 5507/18, 21 and 22	
Agip Danmark Olie- og Gasefterforskning ApS (operator)	40.00%
Fina Exploration Denmark S.A.	28.80%
ÖMV Erdöl-Aufsuchungsges. m.b.H.	11.20%
DOPAS	20.00%
Licence 2/86, Block 5414/7 and 11	
Amoco Denmark Exploration Co. (operator)	75.00%
FLS-Energy A/S	5.00%
DOPAS	20.00%
Licence 3/86, 4/86, 5/86, Block 5603/28 and 31, 5604/25, 5503/3 and 4, 5514/29 and 30, 5414/1 and 2	
Norsk Hydro Udforskning a.s. (operator)	19.50%
Enterprise Petroleum Ltd.	19.50%
Gas Council (Exploration) Ltd.	13.70%
Amerada Hess (Denmark) A/S	9.80%
Dansk Oliesøgning K/S	7.50%
Korn- and Foderstof Kompagniet A/S	2.50%
DENERCO K/S	7.50%
DOPAS	20.00%
DANOP is operator in licence 4/86,	

Group	Share
Licence 7/86, Block 5604/22 and 26	
Statoil Efterforskning og Produktion A/S (operator)	26.50%
BHP Petroleum Inc.	21.00%
Total Marine Danmark	12.00%
LD Energi A/S	7,50%
EAC Energy A/S	4.00%
DENERCO K/S	9.00%
DOPAS	20.00%
DANOP will be operator in a development phase	
3rd Round:	
Licence 1/89, 2/89, Block 5603/26, 5504/6 and 10	
Amoco Denmark Exploration Co. (operator)	70.00%
FLS-Energy A/S	5.00%
DENERCO K/S	5.00%
DOPAS	20.00%
Licence 3/89, 4/89, Block 5606/13, 14,15,17 and 18, 5514/30 and 31, 5414/2, 3, 5, 6, 10, 11, 14 and 15	
Amoco Denmark Exploration Co. (operator)	80.00%
FLS-Energy A/S	5.00%
DENERCO K/S	5.00%
DOPAS	10.00%
Licence 5/89, Block 5503/8 and 5504/5	
Elwerath Erdgas und Erdöl GmbH	14.17%
Brigitta Erdgas und Erdöl GmbH	15.15%
C. Deilmann AG	6.60%
Deutsche Schachtbau- und Tiefbohrgesellschaft GmbH	7.58%
RWE-DEA AG	5.15%
Elf Aquitaine Deutschland GmbH	8.70%
Wintershall AG	7.58%
Preussag AG	7.58%
DENERCO K/S	7.50%
DOPAS	20.00%
BEB is operator, Danop is co-operator	

Appendix A

Group	Share
Licence 6/89, Block 5409/2 and 3, 5509/29 and 30	
Cluff Oil plc. (operator)	63.00%
Zenith Resources Ltd.	27.00%
DOPAS	10.00%
DANOP will be operator in a development phase	
Licence 7/89, 8/89, Block 5504/2, 5604/25, 29 and 30, 5603/32	
Norsk Hydro Udforskning (operator)	21.75%
Du Pont E & P No. 6 B.V.	29.00%
Gas Council Ltd.	18.13%
Danoil Exploration A/S	1.81%
Korn- and Foderstof Kompagniet A/S	1.81%
DENERCO K/S	7.50%
DOPAS	20.00%
Danop is operator in licence 8/89	
Licence 9/89, Block 5509/5, 6, 9 and 10	
Jordan Dansk Corporation	25.00%
G.B.T. Northern Corporation	60.00%
DENERCO K/S	5.00%
DOPAS	10.00%
Danop is operator	
Licence 10/89, Block 5603/27 and 31	
A.P. Møller	26.66%
Shell Olie- og Gasudvinding Danmark	26.66%
Texaco Denmark Inc.	26.66%
DOPAS	20.00%
Mærsk Olie og Gas AS is operator	
Licence 11/89, Block 5504/3 and 4	
RWE-DEA AG	36.25%
Wintershall AG	36.25%
DENERCO K/S	7.50%
DOPAS	20.00%
Danop is operator	
Licence 12/89, Block 5414/8	
RWE-DEA AG	42.50%
Wintershall AG	42.50%
DENERCO K/S	5.00%
DOPAS	10.00%
Danop is operator	

Group	Share
Licences awarded in 1990:	
Licence 1/90, Block 5604/18	
Statoil Efterforskning og Produktion A/S (operator)	33.54%
Total Marine Danmark	15.19%
LD Energi A/S	9.49%
EAC Energy A/S	5.06%
DENERCO K/S	11.39%
DOPAS	25.32%
DANOP is co-operator	
Licence 2/90, Block 5604/23 and 24	
Statoil Efterforskning og Produktion A/S (operator)	40.42%
Total Marine Danmark	18.31%
LD Energi A/S	11.44%
EAC Energy A/S	6.10%
DENERCO K/S	13.73%
DOPAS	10.00%
DANOP is operator	
Licence 3/90, Block 5603/28	
A.P. Møller	31.20%
Shell Olie- og Gasudvinding Danmark	36.80%
Texaco Denmark Inc.	12.00%
DOPAS	20.00%
Mærsk Olie og Gas AS is operator	

Exploration and Appraisal Wells, 1985-1990

Well name Number	Operator Rig	Lat.North Long.East	Total depth Formation	Spud Compl.
Dyb Adda-1	Chevron	55°48″13′	3192 meter	1985-01-01
5504/08-4	Dan Earl	04°58″24′	Ø.Jura	1985-02-17
Vest Lulu-2	Chevron	56°19″48′	4017 meter	1985-02-21
5604/21-4	Dan Earl	04°12″13′	L.Trias	1985-04-23
Gert-2	Chevron	56°11″50′	5032 meter	1985-02-27
5603/28-1	Mærsk Endeavour	03°46″50′	Carbon ?	1985-07-29
Elna-1	Chevron	56°26″55′	3097 meter	1985-05-01
5604/19-1	Dan Earl	04°31″43′	N.Perm	1985-06-14
Ugle-1	BP	55°43″15′	3057 meter	1985-05-07
5505/09-2	Transocean 7	05°12″10′	Palæozoikum	1985-06-24
Thisted-4	Amoco	57°01″19′	3418 meter	1985-05-19
5708/31-2	Kenting 31	08°42″07′	Perm	1985-07-18
Terne-1	Amoco	56°20″39′	3361 meter	1985-05-29
5611/23-1	Dyvi Epsilon	11°30″20′	Præ-/kambr.	1985-08-16
John Flanke-1	Chevron	55°24″28′	2417 meter	1985-06-20
5504/20-2	Dan Earl	04°50″10′	Trias	1985-07-19
Lone-1	Chevron	56°08″35′	3923 meter	1985-06-30
5603/27-3	Mærsk Endeavour	03°31″58′	Trias/Perm	1985-09-03
Kværs-1	Mærsk Olie og Gas	54°56″28′	2691 meter	1985-07-27
5409/02-1	Kenting 31	09°28″49′	N.Perm	1985-09-09
Nord Jens-1	Chevron	55°49″59′	3983 meter	1985-08-07
5504/07-5	Mærsk Endeavour	04°33″35′	Ø.Jura	1985-11-12
Sæby-1	Dopas	57°21″24′	1854 meter	1985-08-07
5710/22-1	Boldon-41	10°23″44′	Palæozoikum	1985-08-28
Kegnæs-1	Texaco	54°50″51′	2591 meter	1985-08-21
5410/05-1	Dyvi Epsilon	10°05″15′	Ø.Perm	1985-10-05
Skive-2	BP	56°35″37′	1456 meter	1985-09-02
5609/13-1	Boldon-41	09°00″21′	Ø.Trias	1985-09-25
Vest Lulu-3	Chevron	56°20″58′	3822 meter	1985-09-12
5604/21-5	Mærsk Endeavour	04°12″34′	Trias	1985-12-11
Kim-1	Chevron	56°07″02′	4441 meter	1985-10-03
5603/30-1	Glomar Labrador 1	03°29″53′	N.Perm ?	1985-12-31
Nord Jens-2	Chevron	55°49″59′	2350 meter	1985-11-16
5504/07-6	Mærsk Endeavour	04°33″36′	N.Kridt	1985-12-28
Lulu-2	Mærsk Olie og Gas	56°19″06′		1985-12-15
5604/22-2	Mærsk Endeavour	04°17″31′		1986-03-18
Diamant-1	Phillips	56°00″23′	4242 meter	1986-01-10
5603/32-2	Glomar Labrador 1	03°53″44′	N.Perm	1986-03-18
Øst Rosa-3	Mærsk Olie og Gas	55°35″36′		1986-01-20
5504/15-5	Dyvi Epsilon	04°36″31′		1986-03-10
Ravn-1	Amoco	55°52″35′	5013 meter	1986-03-24
5504/01-2	Dyvi Epsilon	04°13″52′	Perm	1986-07-17
Øst Rosa Fl.-1	Mærsk Olie og Gas	55°33″51′		1986-03-24
5504/15-6	Mærsk Endeavour	04°37″50′		1986-04-30
Midt Rosa Fl.-1	Mærsk Olie og Gas	55°35″27′		1986-05-04
5504/15-7	Mærsk Endeavour	04°31″33′		1986-06-11
Vest Lulu-4	Mærsk Olie og Gas	56°19″05′		1986-07-27
5604/21-6	Mærsk Endeavour	04°10″16′		1986-09-12
Gwen-2	Mærsk Olie og Gas	56°06″52′		1986-09-30
5604/29-3	Mærsk Endeavour	04°04″10′		1986-12-15
Mejrup-1	Phillips	56°22″39′	2532 meter	1987-03-22
5608/19-1	Kenting 36	08°40″36′	Trias	1987-04-29
Felicia-1	Statoil	57°26″18′	5321 meter	1987-07-03
5708/18-1	Mærsk Guardian	08°18″41′	Perm	1987-12-03
Gert-3	Mærsk Olie og Gas	56°12″43′		1987-07-21
5603/28-2	Mærsk Endeavour	03°45″49′		1987-10-28
Stenlille-2	Danop	55°32″17′		1987-07-27
5511/15-2	Kenting 36	11°36″18′		1987-08-28
Ibenholt-1	Phillips	56°23″26′	2599 meter	1987-08-11
5605/20-1	Dyvi Sigma	05°58″29′	Prækambrium	1987-09-24
Dyb Gorm-1	Mærsk Olie og Gas	55°34″04′		1987-08-18
5504/16-5	Zapata Scotian	04°45″50′		1987-12-04
Stenlille-3	Danop	55°32″17′		1987-08-30
5511/15-3	Kenting 36	11°36″18′		1987-09-16
Ravn-2	Amoco	55°50″35′	4507 meter	1987-09-16
5504/05-1	Dan Earl	04°13″41′	Trias	1987-11-17
Tostrup-11	Danop	56°37″55′		1987-10-10
5609/10-11	Kenting 36	09°25″24′		1987-11-07
Elly-2	Mærsk Olie og Gas	55°47″19′		1987-11-15
5504/06-2	Neddrill Trigon	04°19″05′		1988-05-31
Jeppe-1	Norsk Hydro	56°11″04′	5050 meter	1987-12-10
5603/28-3	Mærsk Guardian	03°54″36′	Perm	1988-03-02
Borg-1	Danop	55°02″57′	3074 meter	1988-04-18
5508/32-2	Kenting 34	08°48″23′	Palæozoikum	1988-05-29
Gulnare-1	Statoil	56°10″13′	4735 meter	1988-06-02
5604/26-1	Mærsk Endeavour	04°26″41′	Jura	1988-09-19
Stenlille-4	Danop	55°31″06′		1988-07-19
5511/15-4	Kenting 36	11°35″14′		1988-08-09
Stenlille-5	Danop	55°32″08′		1988-08-14
5511/15-5	Kenting 36	11°37″33′		1988-09-03
Stenlille-6	Danop	55°33″29′		1988-09-07
5511/15-6	Kenting 36	11°39″09′		1988-09-27
Tordenskjold-1	Danop	55°56″19′	3703 meter	1988-12-14
5503/03-2	Neddrill Trigon	03°32″31′	N.Perm	1989-02-04
Pernille-1	Norsk Hydro	55°00″54′	3588 meter	1989-04-07
5514/30-1	Glomar Moray Firth	14°18″43′	Palæozoikum	1989-06-06
Stina-1	Amoco	54°47″20′	2482 meter	1989-06-12
5414/7-1	Glomar Moray Firth	14°37″44′	Palæozoikum	1989-07-11
Falk-1	Amoco	55°50″01′	4200 meter	1989-07-23
5504/6-3	Glomar Moray Firth	04°18″50′	Trias	1989-09-05
Gert-4	Mærsk Olie og Gas	56°13″18′		1989-11-02
5603/27-4	Mærsk Endeavour	03°43″48′		1990-05-16
Alma-1	Mærsk Olie og Gas	55°28″58′		1990-03-18
5505/17-10	Mærsk Giant	05°12″33′		1990-08-16
Amalie-1	Statoil	56°14″39′		1990-08-01
5604/26-2	Neddrill Trigon	04°22″02′		1991-
Stenlille-7	Danop	55°32″18′		1990-09-10
5511/15-7	Kenting 31	11°36″27′		1990-12-17

Appendix C

Exploratory Surveys, 1990

Survey	Operator Contractor	Type	Initiated Terminated	Area	Acquisition
Seismic Surveys					
AM90B	Amoco Denmark Teledyne Exploration	Offshore 2D	1990-08-23 1990-08-28	Bornholm	491 km
AM90C	Amoco Denmark Teledyne Exploration	Offshore 2D	1990-09-11 1990-09-12	Central Graben Elly	132 km
AM90C	Amoco Denmark Teledyne Exploration	Offshore 2D	1990-09-12 1990-09-16	Central Graben	370 km
AM90C	Amoco Denmark Teledyne Exploration	Offshore 3D	1990-09-30 1990-11-02	Central Graben Elly	656 km
AM90C	Amoco Norway Teledyne Exploration	Offshore 2D	1990-10-16 1990-10-16	Central Graben	7 km
DK90C	Mærsk Olie og Gas AS CGG	Offshore 3D	1990-04-05 1990-10-19	Central Graben	1,493 km
DK90C	Mærsk Olie og Gas AS CGG	Offshore 3D	1990-04-09 1990-05-31	Central Graben Elly	7,574 km
DK90C	Mærsk Olie og Gas AS CGG	Offshore 3D	1990-06-02 1990-10-17	Central Graben Rita	11,359 km
DK90C	Mærsk Olie og Gas AS CGG	Offshore 3D	1990-09-30	Central Graben Kraka	11,114 km
DN90D	Danop/Jordan Prakla-Seismos AG	Onshore	1990-06-11 1990-07-08	Jutland Give	51 km
DN90N	Danop/Statoil Western Geophysical	Offshore	1990-08-10 1990-08-23	North Sea Frida	628 km
DN90C	Danop/RWE-DEA Simon-Horizon Ltd.	Offshore	1990-08-27 1990-09-03	Central Graben Gefion	611 km
DN90B	Danop/RWE-DEA A/S Geoteam	Offshore	1990-09-17 1990-09-19	Baltic Sea Bornholm	263 km
NH90C	Norsk Hydro Geco	Offshore 2D	1990-02-13 1990-04-03	Central Graben Feda, Arne	484 km
NS90C*	Norske Shell Geco	Offshore 3D	1990-09-22 1990-11-13	Central Graben	778 km

* Spec. seismik

Danish Oil Production 1972-1990, million m^3

Year	Dan	Gorm	Skjold	Tyra	Rolf	*Total*
1972	0.11					*0.11*
1973	0.15					*0.15*
1974	0.10					*0.10*
1975	0.19					*0.19*
1976	0.23					*0.23*
1977	0.58					*0.58*
1978	0.49					*0.49*
1979	0.49					*0.49*
1980	0.34					*0.34*
1981	0.34	0.53				*0.87*
1982	0.31	1.64	0.02			*1.97*
1983	0.27	1.84	0.40			*2.51*
1984	0.36	1.62	0.65	0.07		*2.70*
1985	0.45	1.80	0.85	0.35		*3.45*
1986	0.47	1.72	1,07	0.57	0.47	*4.30*
1987	1.23	1.50	1.21	0.84	0.65	*5.41*
1988	1.50	1.35	1.37	0.95	0.40	*5.57*
1989	1.47	1.35	2.21	1.05	0.39	*6.47*
1990	1.58	1.44	2.63	1.08	0.27	*7.00*
Total	*10.66*	*14.79*	*10.41*	*4.91*	*2.16*	*42.93*

Danish Gas Production 1972-1990, billion Nm^3

Year	Dan	Gorm	Skjold	Tyra	Rolf	*Total**	Sold
1972	0.02					*0.02*	
1973	0.03					*0.03*	
1974	0.03					*0.03*	
1975	0.06					*0.06*	
1976	0.07					*0.07*	
1977	0.17					*0.17*	
1978	0.16					*0.16*	
1979	0.16					*0.16*	
1980	0.07					*0.07*	
1981	0.08	0.08				*0.16*	
1982	0.08	0.27	0.00			*0.35*	
1983	0.08	0.43	0.04			*0.55*	
1984	0.13	0.51	0.06	0.26		*0.96*	0.22
1985	0.21	0.64	0.07	1.11		*2.03*	1.04
1986	0.24	0.78	0.10	1.63	0.02	*2.77*	1.80
1987	0.44	0.88	0.10	2.65	0.03	*4.10*	2.30
1988	0.60	0.98	0.11	3,36	0.02	*5.07*	2.27
1989	0.71	0.89	0.19	3,52	0.02	*5.33*	2.68
1990	0.80	0.81	0.22	3.30	0.01	*5.14*	2.75
Total	*4.14*	*6,27*	*0.89*	*15.83*	*0.10*	*27.23*	*13.06*

* *Reinjected Gas Included*

Appendix D

Monthly Oil and Condensate Production 1990, thousands m^3

	Jan	Feb	Marts	April	May	June	July	Aug	Sep	Oct	Nov	Dec	*1990*
Dan	141	125	136	132	134	135	135	123	127	132	127	134	*1580*
Gorm	109	102	106	128	122	121	125	121	126	129	123	126	*1439*
Skjold	180	186	184	211	232	232	241	220	225	240	234	244	*2630*
Tyra	99	87	98	62	74	73	60	73	96	116	117	126	*1080*
Rolf	27	24	21	27	27	25	18	18	11	25	25	25	*271*
Total	*556*	*524*	*544*	*560*	*588*	*586*	*578*	*555*	*586*	*641*	*626*	*655*	*6999*

Monthly Gas Production 1990, million Nm^3

	Jan	Feb	Marts	April	May	June	July	Aug	Sep	Oct	Nov	Dec	*1990*
Dan	74	65	73	71	68	69	70	61	62	65	62	65	*804*
Gorm	83	74	58	67	73	63	68	61	62	68	63	64	*805*
Skjold	15	15	16	17	19	19	20	18	19	20	20	20	*220*
Tyra	356	298	346	201	254	246	155	185	243	322	321	367	*3296*
Rolf	1	1	1	1	1	1	1	1	<1	1	1	1	*11*
Total	*529*	*454*	*494*	*358*	*416*	*399*	*314*	*326*	*386*	*476*	*467*	*518*	*5137*

Domestic Energy Consumption 1972-1990. Distributed on Fuels, Energy Production and Rate of Self-sufficiency, million t.o.e.

	Oil	Gas	Coal	Alternative Energy	*Total*	Energy Production	Self-sufficiency %
1972	17.7	-	1.2	0.2	*19.1*	0.3	2
1973*)	17.4	-	1.9	0.2	*19.5*	0.3	2
1974*)	15.9	-	1.7	0.2	*17.8*	0.3	2
1975	15.2	-	2.1	0.3	*17.6*	0.4	2
1976	15.9	-	2.8	0.3	*19.0*	0.5	2
1977	16.0	-	3.2	0.3	*19.5*	0.8	4
1978	16.0	-	4.0	0.3	*20.3*	0.7	4
1979	15.9	-	4.7	0.4	*21.0*	0.8	4
1980	13.1	-	5.8	0.4	*19.3*	0.7	4
1981	11.6	0.0	6.0	0.5	*18.0*	1.3	7
1982	10.9	0.0	6.2	0.5	*17.6*	2.3	13
1983	10.2	0.0	6.6	0.6	*17.4*	2.9	16
1984	10.1	0.2	7.1	0.6	*18.0*	3.3	18
1985	10.5	0.6	7.3	0.7	*19.1*	4.7	25
1986	10.2	1.2	7.4	0.9	*19.6*	6.3	32
1987	9.6	1.5	7.7	1.0	*19.8*	7.9	39
1988	8.9	1.6	7.6	1.0	*19.2*	8.1	41
1989	8.6	1.8	7.5	1.1	*18.9*	9.3	49
1990*)	8.2	1.8	7.5	1.2	*18.7*	10.6	52

Climatic correction has not been applied.
The survey indicates gross energy consumption i.e. including shrinkage. *) Estimate.

Domestic Energy Consumption 1972-1990. Distributed on Utilization, million t.o.e.

	Residential	Process	Transport	El Appliances	Non-energy	*Total*
1972	7.3	4.9	3.3	2.6	1.0	*19.1*
1973*)	7.5	5.2	3.3	2.6	0.9	*19.5*
1974*)	6.3	4.9	3.1	2.6	0.9	*17.8*
1975	6.3	4.6	3.2	2.6	0.9	*17.6*
1976	6.9	5.0	3.3	2.9	0.9	*19.0*
1977	7.0	5.2	3.3	3.1	0.9	*19.5*
1978	7.0	5.5	3.6	3.3	0.9	*20.3*
1979	7.4	5.8	3.6	3.3	0.9	*21.0*
1980	6.3	5.5	3.4	3.3	0.8	*19.3*
1981	5.7	5.0	3.2	3.4	0.7	*18.0*
1982	5.6	4.7	3.3	3.3	0.7	*17.6*
1983	5.3	4.6	3.4	3.3	0.8	*17.4*
1984	5.3	4.9	3.6	3.4	0.8	*18.0*
1985	6.1	5.0	3.6	3.5	0.9	*19.1*
1986	5.8	5.2	3.9	3.7	0.9	*19.6*
1987	6.0	5.2	4.0	3.8	1.0	*19.8*
1988	5.3	5.1	3.9	3.9	1.0	*19.2*
1989	4.9	5.2	4.0	3.9	1.0	*18.9*
1990*)	4.8	5.2	4.1	3.8	0.9	*18.7*

Including Shrinkage, climatic correction has not been applied. *) Estimate

Appendix E

Field name	**Dan**
Prospect:	Abby
Location:	Block 5505/17
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1971
Year on stream:	1972
Producing wells:	49
Injection wells:	1
Water depth:	40 m (131 ft)
Acreage:	30 km^2 (7,400 acres)
Reservoir depth:	1,850 m (6,070 ft)
Reservoir rock:	Chalk (Danian/Maastrichtian)

Reserves Expectation

Oil:	34 million m^3 (214 MMbbls)
Gas:	13 billion Nm^3 (484 BSCF)

Cumulative Production

Oil:	10.66 million m^3 (67 MMbbls)
Gas:	4.14 billion Nm^3 (154 BSCF)

Review of Geology

Dan is an anticlinal structure induced through salt tectonics of the Zechstein/Triassic. The chalk reservoir has an adequate porosity, although strongly reduced permeability. A major northeast-southwest fault divides the field into two independent reservoirs.

Production Facilities

The field installation comprises five wellhead platforms (A, D, E, FA and FB), two processing/accommodation platforms (B and FC) and one gas flare stack (C).

Processing of the produced oil and gas mainly takes place at Dan FC, the older processing facilities at Dan B are only used for temporary, individual well production testing. Final processing of the produced oil is performed at Dan FC prior to export ashore via the booster platform Gorm E. The gas is pre-processed at Dan FC and further transported to Tyra East for final processing and export ashore. Water treatment and pumping facilities for water injection were also installed at Dan FC. The accommodation capacity at the Dan Field corresponds to 91 persons.

Field name:	**Gorm**
Prospect:	Vern
Location:	Blocks 5504/15 and 16
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1971
Year on stream:	1981
Producing wells:	22
Gas injection wells:	2
Water injection wells:	5
Water depth:	39 m (128 ft)
Acreage:	12 km^2 (3,000 acres)
Reservoir depth:	2,200 m (7,218 ft)
Reservoir rock:	Chalk (Danian/Maastrichtian)

Reserves Expectation

Oil:	13 million m^3 (82 MMbbls)
Gas:	6 billion Nm^3 (223 BSCF)

Cumulative production

Oil:	14.79 million m^3 (93 MMbbls)
Gas:	6.26 billion Nm^3 (233 BSCF)
Injection gas:	5.99 billion Nm^3 (223 BSCF)
Net gas:	0.27 billion Nm^3 (10 BSCF)

Review of Geology

Gorm is an anticlinal structure due to Zechstein salt tectonics. A major fault extending north-south divides the field into two individual reservoirs. The western reservoir block is considerably fractured.

Production Facilities

The Gorm Field consists of two wellhead platforms (A and B), one processing/accommodation platform (C), one gas flare stack (D) and one riser/booster platform (E). A new processing platform (F) will be established in 1991.

Final processing of oil and gas takes place at Gorm C prior to export ashore via Gorm E (oil) and Tyra East (gas). The gas reinjection facilities are installed at Gorm C. Total accommodation facilities correspond to 98 persons.

Field name:	**Skjold**
Prospect:	Ruth
Location:	Block 5504/16
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977
Year on stream:	1982
Producing wells:	3
Water injection wells:	4
Observation well:	0
Water depth:	40 m (131 ft)
Acreage:	10 km^2 (2,500 acres)
Reservoir depth:	1,600 m (5,250 ft)
Reservoir rock:	Chalk (Danian/Maastrichtian)

Reserves Expectation

Oil:	20 million m^3 (126 MMbbls)
Gas:	2 billion Nm^3 (75 BSCF)

Cumulative Production

Oil:	10.43 million m^3 (66 MMbbls)
Gas:	0.89 billion Nm^3 (33 BSCF)

Review of Geology

The Skjold Field is an anticlinal structure induced through Zechstein salt tectonics. The structure is heavily fractured which has resulted in favourable reservoir conductivity, in particular within the crestal part of the structure.

Production Facilities

The Skjold Field comprises a satellite development to the Gorm Field, including one unmanned wellhead platform. The produced oil and gas are transported by pipeline to Gorm C for processing and export ashore.

Temporary water treatment and injection facilities have been installed on a modified jack-up drilling rig attendant to the Skjold platform.

The production from Skjold will from mid 1991 be processed in separate facilities on Gorm F, which furthermore will house permanent water treatment and injektion facilities replacing the temporary installations at the Skjold platform.

Field name:	**Tyra**
Prospect:	Cora
Location:	Blocks 5504/11 and 12
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Year on stream:	1984
Producing wells:	31
Gas injection wells:	8
Water depth:	37-40 m (121-131 ft)
Acreage:	52 km^2 (12,800 acres)
Reservoir depth:	2,000 m (6,562 ft)
Reservoir rock:	Chalk (Danian/Maastrichtian)

Appendix E

Reserves Expectation

Oil:	5 million m^3 (31 MMbbls)
Condensate:	4 million m^3 (25 MMbbls)
Gas:	35 billion Nm^3 (1.3 TSCF)

Cumulative Production

Oil	1.15 million m^3 (7.2 MMbbls)
Condensate:	3.76 million m^3 (23.7 MMbbls)
Gas:	15.83 billion Nm^3 (590 BSCF)
Injection gas:	4.91 billion Nm^3 (183 BSCF)
Net gas:	10.92 billion Nm^3 (407 BSCF)

Review of Geology

The Tyra Field is an anticlinal structure, probably related to tectonic inversion or salt tectonics or both. A marked permeability barrier separates the Danian and the Maastrichtian chalk reservoir rocks.

Production Facilities

The production facilities include two major production complexes, Tyra West and Tyra East, each consisting of two wellhead platforms, one processing/accommodation platform, and one gas flare stack; a riser platform was installed at Tyra East housing the gas export outlet into the main gas pipeline.

Final processing of gas and stabilization of black oil/condensate take place at Tyra East. The stabilized hydrocarbon liquids are transported to Gorm E for export ashore. Gas recycling facilities have been installed at Tyra West for enhanced condensate recovery. The total accommodation facilities at the Tyra Field hold 176 persons (96 at Tyra East and 80 at Tyra West).

Field name:	**Rolf**
Prospect:	Middle Rosa
Location:	Blocks 5504/14 and 15
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1981
Year on stream:	1986
Producing well:	1
Observation well:	1
Water depth:	34 m (112 ft)
Acreage:	5 km^2 (1200 acres)
Reservoir depth:	1,800 m (5,900 ft)
Reservoir rock:	1) Chalk (Danian/Maastrichtian) 2) Carbonates (Zechstein)

Reserves Expectation

Oil:	2 million m^3 (13 MMbbls)
Gas:	‹1 billion Nm^3 (‹37 BSCF)

Cumulative Production

Oil:	2.16 million m^3 (14 MMbbls)
Gas:	0.10 billion Nm^3 (4 BSCF)

Review of Geology

Rolf is an anticlinal structure created through Zechstein salt tectonics. The chalk reservoir is heavily fractured resulting in favourable reservoir conductivity (compare Skjold). The underlying Zechstein reservoir shows similar characteristics.

Production Facilities

The Rolf Field is a satellite development to the Gorm Field with an unmanned wellhead platform. The produced oil and gas are transported to the Gorm C platform via pipeline. From mid 1991 the Rolf production may be rerouted to the new facilities on Gorm F for processing.

Field Developments in Progress

Field name:	**Dagmar**
Prospect:	East Rosa
Location:	Block 5504/15
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1983
Year on stream:	1991 (planned)
Producing wells:	2
Water depth:	34 m (112 ft)
Acreage:	9 km^2 (2.200 acres)
Reservoir depth:	1.400 m (4.600 ft)
Reservoir rock:	1) Chalk (Danian/ Maastrichtian) 2) Carbonates (Zechstein)

Reserves Expectation

Oil:	3 million m^3 (19 MMbbls)
Gas:	‹1 billion Nm^3 (‹37 BSCF)

Review of Geology

The Dagmar field is an anticlinal structure, induced through Zechstein salt tectonics. The structure is heavily fractured, resulting in favourable reservoir conductivity. The reservoir fluid contains hydrogen sulphide.

Production Facilities

The Dagmar field will be developed as a satellite to Gorm including one unmanned production platform of the STAR type. The produced oil and gas will be transported to a new platform Gorm F for separate processing and export ashore.

Field name:	**Kraka**
Prospect:	Anne
Location:	Block 5505/17
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1966
Year on stream:	March 1991
Producing wells:	2
Water depth:	45 m (148 ft)
Acreage:	50 km^2 (12,500 acres)
Reservoir depth:	1,800 m (5,900 ft)
Reservoir rock:	Chalk (Danian/Maastrichtian)

Reserves Expectation

Oil:	4 million m^3 (25 MMbbls)
Gas:	2 billion Nm^3 (75 MSCF)

Review of Geology

Kraka is an anticlinal structure induced through Zechstein salt tectonics, which to a certain degree has caused fracturing in the chalk. The chalk reservoir has adequate porosity, although reduced permeability. The thin oil pay zone is further characterized by high water saturations.

Production Facilities

Kraka is a satellite development to Dan FC, including an unmanned production platform of the STAR type. The produced oil and gas is transported to Dan FC for processing and export ashore.

Appendix E

Field name:	**Valdemar**
Prospects:	Bo, Boje, North Jens
Location:	Block 5504/7 and 11
Concessionaires:	A.P. Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977 (Bo), 1982 (Boje) and 1985 (North Jens)
Year on stream:	1993 (planned)
Producing wells:	3
Water depth:	38 m (125 ft)
Upper Cretaceous reservoir:	
Acreage:	16 km^2 (4,000 acres)
Reservoir depth:	2,000 m (6,560 ft)
Reservoir rock:	Chalk
Lower Cretaceous reservoir:	
Acreage:	200 km^2 (50,000 acres)
Reservoir depth:	2,600 m (8,530 ft)
Reservoir rock:	Limestone

Reserves Expectation

Oil:	14 million m^3 (88 MMbbls)
Gas:	5 billion Nm^3 (186 BSCF)

Review of Geology

Valdemar comprises several separate reservoirs, i.e. oil and gas reservoirs in chalk of Danian/Maastrichtian and Campanian age and oil reservoirs in limestone of Aptian/Barremian age (Tuxen formation). The properties of the Upper Chalk reservoirs are comparable to other Danish fields as Gorm and Tyra, while the Aptian/Barremian limestones possess very difficult production properties. Some fracturing has been indicated in certain areas of the limestone reservoir, which improves the productivity.

Production Facilities

Valdemar will be developed as a satellite to Tyra, including an unmanned production platform of the STAR type. The produced oil and gas will be transported to Tyra East for processing and export ashore.

New Field Developments

Field name:	**Roar**
Prospect:	Bent
Location:	Block 5505/7
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Development plan approved:	1990
Year on stream:	1993 (planned)

Field name:	**Nils**
Location:	Block 5505/17
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1979
Development plan approved:	1988
Year on stream:	1994 (planned)

Field name:	**Harald**
Prospects:	Lulu/West Lulu
Location:	Block 5604/21 and 22
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1980 (Lulu) and 1983 (West Lulu)
Development plan approved:	1990
Year on stream:	1998 (planned)

Field name:	**North Arne (Svend)**
Prospects:	North Arne/Otto
Location:	5604/25
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1975 (North Arne) and 1982 (Otto)
Development plan approved:	1990
Year on stream:	2000 (planned)

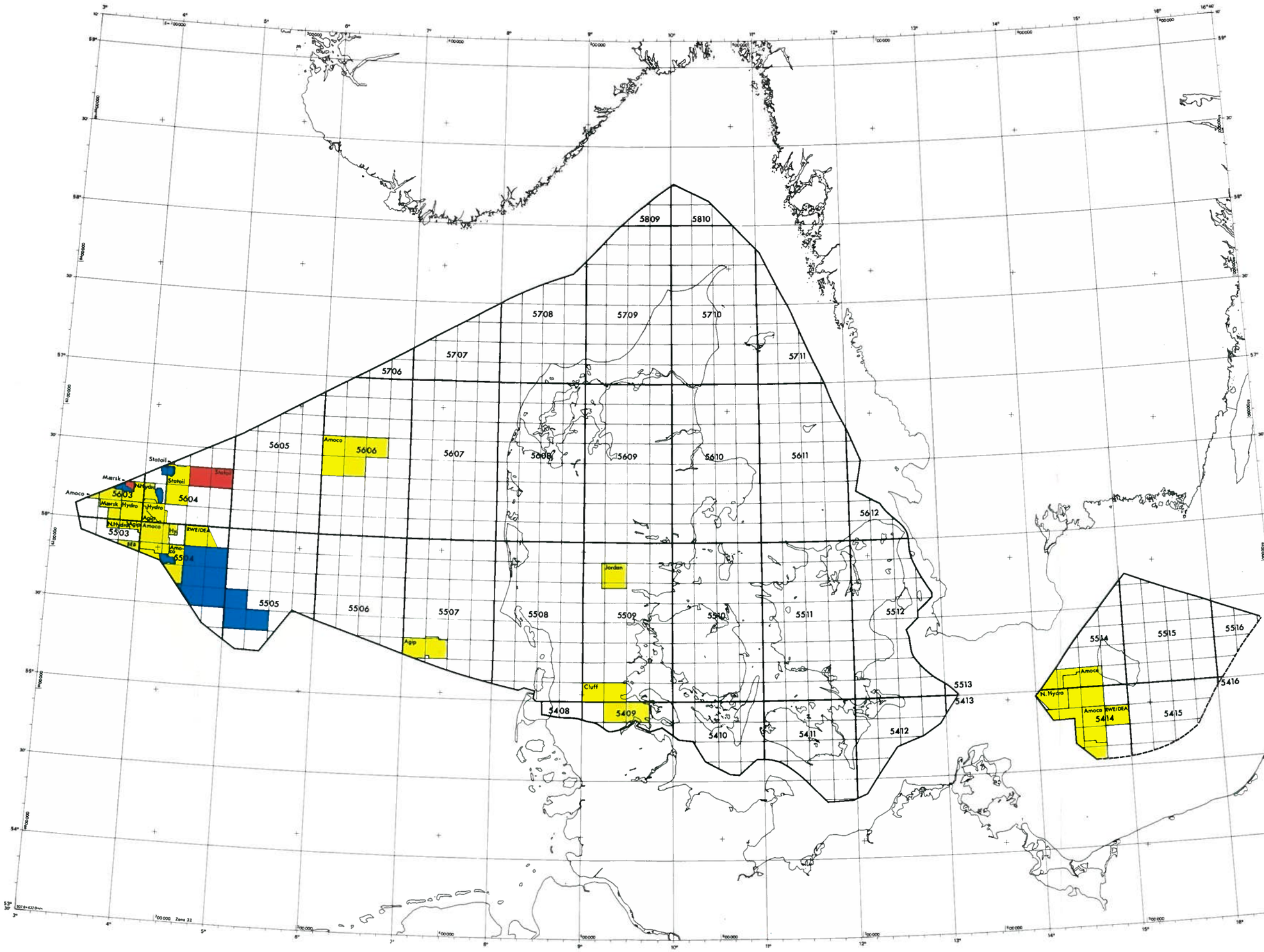
Field name:	**Adda**
Location:	Block 5504/8
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1977
Development plan approved:	1990
Year on stream:	1999 (planned)

Field name:	**Igor**
Location:	Block 5505/13
Concessionaires:	A.P.Møller
Operator:	Mærsk Olie & Gas AS
Discovered:	1968
Development plan approved:	1990
Year on stream:	1999 (planned)

Prospect and Field Designations

Prospect Name	Field Name
Abby	Dan
Vern	Gorm
Cora	Tyra
Ruth	Skjold
Middle Rosa	Rolf
Bent	Roar
Anne	Kraka
Lulu/West Lulu	Harald
East Rosa	Dagmar
Bo/Boje/North Jens	Valdemar
North Arne/Otto	Svend

The Danish Licence Area January,1 1991



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