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GEO ENeRGY

Promoting *R&D capability* in the service of European Industry

Offshore NW Europe Production Outlook - *a major opportunity*

This issue of Geo Energy focuses on a study conducted by ENeRG on behalf of the European Commission which considers North Sea oil and gas production outlook to 2020. The NW European Continental Shelf (NWECS) is the most important world-wide offshore area and is the showcase for the many innovative European technologies which have been developed to work in this difficult environment. For instance, some of the most advanced wells have been employed in this area and recovery rates are amongst the highest in the world.

The study, which examines different scenarios, concludes that an active R&D policy is essential if Europe is to continue to enjoy the benefits of industrial competitiveness, additional employment, increased exports and greater energy self-sufficiency. The study also highlights the growing importance of environmental concerns and, in particular, the need to reduce carbon dioxide emissions. Picking up on this topic the lead article describes an initiative in the Norwegian North Sea Sleipner field where a million tons of CO_2 per year is now being stored in subsurface sand reservoirs.

The technology feature in this issue looks at a new method of data acquisition and pre-processing in the field. The product, called SEISBIT®, was supported by the EC's THERMIE programme and is a prime example of how support for RD&D is maintaining Europe's global position in the hydrocarbons industry.

REDUCING CARBON DIOXIDE EMISSIONS

- the European Upstream Oil Industry is taking the initiative

Global warming, considered to be resulting from man's release of greenhouse gases such as CO_2 and methane to the atmosphere, remains high on the international political agenda. Global targets for stabilisation and reduction of CO_2 emissions are being negotiated. At the international climate conference in Kyoto, Japan, the European Union was pushing strongly in favour of global reductions, particularly by the industrialised countries.

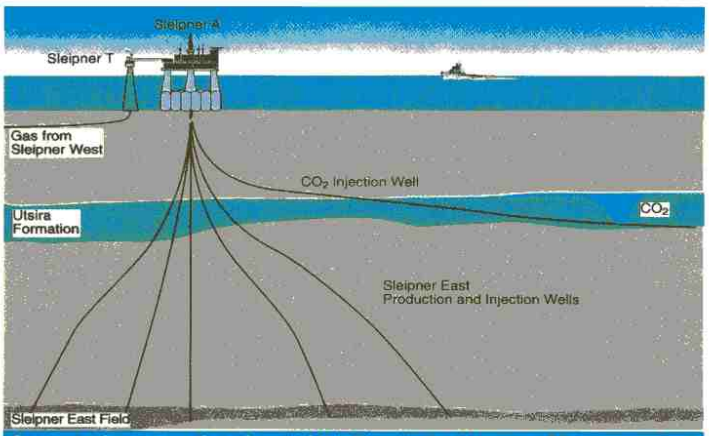
In the Norwegian North Sea Sleipner field, a million tons of CO_2 per year is now being stored in subsurface sand reservoirs.

The Sleipner Initiative

The Sleipner Field located in the Norwegian sector of the North Sea, close to the median line to the U.K. was put on stream last year. The field is operated by Statoil with Exxon, Norsk Hydro, Elf, and Total as licence partners. Sleipner is a major gas and condensate field, supplying gas to the European continent. The gas has a natural content of up to 9% CO_2. Rather than releasing this to the atmosphere, CO_2 is removed from the export gas, and stored at a depth of about 1 kilometer in a thick sandstone layer, well above the hydrocarbon reservoirs. Through a purposely drilled horizontal well, some 1 million tons of CO_2 is annually being injected into the shallow sand. This amounts to a 3% reduction in Norwegian CO_2 emissions.

Technology Advances

The Sleipner CO_2 project contains a number of technological 'firsts'. Never before has such large quantities of CO_2 been handled, compressed and injected at an offshore facility. Separation of CO_2 from the hydrocarbon gas takes place through the use of an activated amine process developed by Elf. The use of a long horizontal well ensures that deposition takes place well away from the gas production wells. Monitoring of the injected CO_2 will most likely be made by acquisition of seismic data at 2-3 year intervals, by drilling a horizontal observation well, or possibly by a combination of both methods.



Conceptual cross-section of part of the Sleipner field showing CO_2 injection well and predicted extend of CO_2 'cloud' after 20 years. *Figure courtesy of Statoil*

International R&D Cooperation

In late November of 1997, the International Energy Agency, through its Greenhouse R&D Programme, organised a workshop for a wide range of international partipants; oil companies, power utilities, gas suppliers, research organisations and the European Commission. The purpose of this international gathering was to define research needed for a better understanding of the scientific problems associated with CO_2 storage. An other purpose was to work on design options for monitoring CO_2 injection, not only during the Sleipner field life of 20-25 years, but also hundreds of years into the future. Statoil and the Sleipner partners will make all information easily available for industry and research participants.

At the workshop the industrial participants indicated support of several million ECU for research into CO_2 storage. A technical description is currently being made, comprising such R&D topics as; geological models, geochemical

(continued on page 2)

North Sea Oil and Gas Production Outlook - *A major challenge*

(continued from page 2)

Probable technological scenario

A more optimistic scenario is possible, if an aggressive RTD policy is quickly implemented in order to increase the ultimate recovery of producing fields, and allow the development of most of the undeveloped fields (currently more than 400 in the North Sea), and new discoveries. In such a "technological scenario" (the "probable" case in the study), the main figures, compared to the trend scenario, are:

- Additional reserves of oil: +22Bb
- Additional reserves of gas: +17 Bboe
- Equivalent present value: +500 BECU (approx.)
- Additional oil production in 2010: +3.4 million b/d
- Additional gas production in 2010: +1.8million boe/d

In other words, the production decline could be delayed by 10 years. (Figures 2a and b).

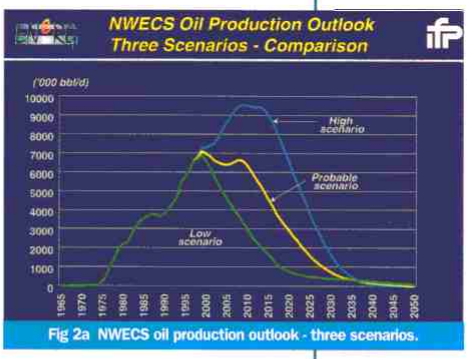


Fig 2a NWECS oil production outlook - three scenarios.

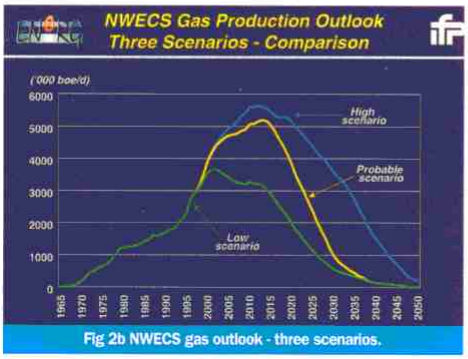


Fig 2b NWECS gas outlook - three scenarios.

In this scenario, expenditures would quickly stabilise at 30 BECU before slowly falling to 28 BECU in 2010, with a cumulative additional of 110 BECU over the period 1997-2010. The overall direct and indirect employment would increase to 380,000, 130,000 more than in the trend scenario (Figs 3a and 3b).

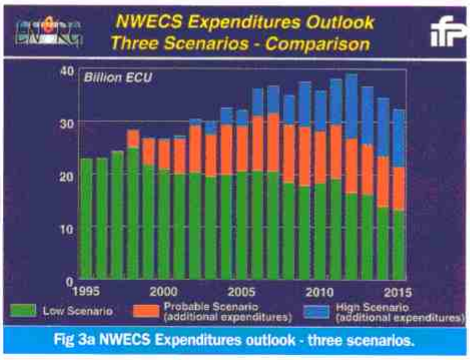


Fig 3a NWECS Expenditures outlook - three scenarios.

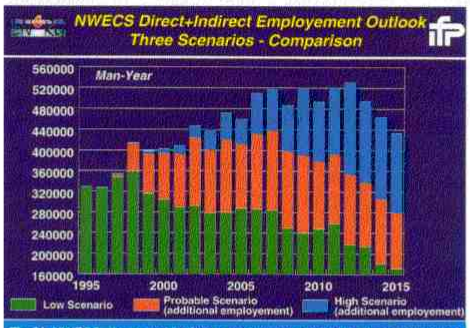


Fig 3b NWECS direct and indirect employment outlook - three scenarios

The S&S industry

In the technological scenario, the North Sea would undoubtedly remain a splendid showcase of the European industry, allowing the S&S industry to jump to a new step in its development.

Nowadays, according to another ENeRG study*, the European S&S industry in the upstream sector amounts to 28 BECU, or 30% of a world-wide market of 95 BECU. About half of this amount comes from the North Sea, the other half coming from foreign markets and onshore Europe.

According to EUROGIF**, the European S&S industry represents about 750,000 people, direct and indirect, or approximately a turnover of 40,000 ECU per job.

Assuming that the European S&S industry keeps its 70% share of the North Sea market, its turnover in 2010 would remain about 20 BECU per year in the probable technological scenario, while less than 14 BECU in the trend scenario.

Globally, in the probable technological scenario option, it would be reasonable to make the assumption that the European S&S industry - taking advantage of this high technology North Sea example - would increase its world-wide market share at 1% per year, for instance up to 40% in 2010. In the last 20 years, the European S&S industry did just that.

Now, the world-wide market will be increasing. Taking into account the assumed rate of increase in the world of oil and gas consumption (about 33% from now until 2010), it could increase by 25% in the same period and reach 120 BECU in 2010.

The above ambitious objective for the European S&S industry would represent a world-wide turnover in 2010 of around 48 BECU of which 20 BECU would come from the North Sea and 28 BECU would be from other areas, mainly the export value of the industry. On the same basis of 40,000 ECU per job, this leads to a potential of about 1.3 million jobs, direct and indirect, close to double the current figure.

Ideal technological scenario

A third scenario, named the high or ideal technological case, has also been studied. It relies on the sine qua non hypothesis of a very strong action for promoting the overall available technologies, currently or in the future, and moreover of a favourable economic and taxation environment.

The British experience during the period 1985-1995, as it is described for a recent study conducted by the Oxford Institute for Energy Studies***, proves that technological innovation and favourable fiscal conditions may have together a huge impact on the production level. In such an ideal technological scenario the main figures compared to the trend scenario are:

- additional reserves of oil +53 Bb
- additional reserves of gas +38 Bboe
- equivalent present value + 1,200 BECU (approx)
- additional oil production in 2010 +6.5 million b/d
- additional gas production in 2010 +2.3 million boe/d
- additional employment (direct and indirect) +240,000

Conclusion

The main arguments, which militate in favour of an active policy of research-development and innovation for the European S&S industry, are industrial competitiveness, potentiality of additional employment, increased exports and, obviously greater energy self-sufficiency.

With recent changes in the structure of the industry and of its innovation supply chain, the challenge for developing and introducing new technologies falls more and more upon firms within the S & S sector.

Furthermore, with the expansion of environmental concerns, there is a huge potential for developing and commercialising cleaner and more efficient technologies, especially in the field of exploration and hydrocarbon transportation.

The current phase for preparing the EC's Fifth Framework Programme offers an exceptional opportunity for the Commission and for the Parliament to contribute to reinforcing the position of a strategic high-tech sector, with a lot of SMEs.

Thus, in the Fifth Framework Programme, a priority which has not been conferred in the previous Programme (limited to 5% of the funds assigned to energy), should be given to this area of activities.

** A Global View of the European Oil and Gas Supply Industry. EC contract STR-0449-95-NL conducted by TNO.*

*** EUROGIF: European Oil and Gas Innovation Forum, an organisation representing more than 2,600 European S&S firms.*

**** Tax or Technology? The Revival of UK North Sea Oil Production - Oxford Institute for Energy Studies - SP8 - October 1997*

SEISBIT® - cutting costs in vertical seismic profiles

Vertical seismic profiles (VSPs) are an effective tool for surveying the area surrounding a well. However, high costs and serious operating risks may arise from conventional surveying techniques where the drilling process is interrupted and a geophone is conveyed downhole. Passive listening at the surface, using the noise produced by the bit during drilling as a seismic source for producing reciprocal VSPs, helps to overcome these difficulties.

SEISBIT® - developed by AGIP and OGS with financial support from the THERMIE programme - allows data acquisition and pre-processing to be undertaken in the field. The dataset is then transmitted via a modem to headquarters, thus reducing the need for in-field analysts and consequently cutting costs. The data is automatically acquired after laying out one or more lines of receivers and several pilot sensors designed to record on-site noise and the signal produced by the bit without the filtering effect of the ground.

The SEISBIT® pre-processing system is based on the identification of a pilot signal which represents the signal emitted by the bit, correlation of that signal with those measured at the geophones, and the subsequent summing of the correlations relating to a given depth level.

The SEISBIT® system has three components which assist with assessing the drilling results.

1. Check Shot. This involves the identification of travel times of direct compressional arrival from the bit to a receiver close to the well head. This information allows recognition of the bit position in time on a reference seismic section.

2. Sonic Calibration. An intermediate synthetic seismogram may be produced which can accurately identify the horizons drilled and seismically characterise them.

3. Reverse VSP. Seismic traces can be produced as a reverse VSP, making use of the entire recorded wave field. This use for real-time prediction of horizons below the bit would appear to be the most interesting aspect of the SEISBIT® technology.

Following a testing and validation period, SEISBIT® services are now operational, primarily in Southern Italy.

Further technological development and research is now being undertaken to:

- improve the use of the system around wells drilled with PDC bits;
- define, by tomography and SEISBIT® data, the velocity fields in the area of the well;
- perform 3D reverse VSPs;
- integrate SEISBIT® data and other information to provide an active geophysical monitoring of the proceeding well, in order to guide its trajectory on the desired target.

SEISBIT® services are operated by OGS and Discovery Geophysical Services SpA, an SME partly owned by OGS.

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INNOVATIVE OIL AND GAS TECHNOLOGIES - New Publications

JOULE-THERMIE

With the support of the EC's THERMIE programme, four new flag brochures concerning innovative technologies in the oil and gas industry have recently been published.

Brochure 202 describes Subsea Well Testing System (SWTS), a multiphase metering system designed to replace the line and riser presently used to connect multiwell subsea manifolds to the surface facilities. Sponsored by Tecnomare SpA, Italy, the project employed extensive field testing which will provide the information to design, fabricate and install a SWTS unit for real subsea application.

A new Underwater Electrical Telemanipulation System, designed to add a tactile sense to remote manipulation is described in Brochure 203. As the role of ROVs (Remotely Operated Vehicles) grows increasingly prominent in the oil and gas industry, the need to improve systems has also grown. This project, sponsored by Tecnomare SpA, Italy, developed a unique telemanipulation system, allowing the operator to "feel" the amount of force the manipulator is applying to a particular task.

Brochure 206 details MAESTRO, an integrated system which combines state-of-the-art data collection, operational computer modelling and satellite communications to provide a marine information system to support offshore oil and gas operations. By providing up-to-the-minute marine and environmental data and forecasts, MAESTRO will help minimise environmental risks, improve operational economics and increase safety standards. Depending on the nature of activities being undertaken, MAESTRO can increase the effectiveness of offshore operations by as much as 20%.

Brochure 217 describes a project undertaken by Stolt Comex Seaway Ltd and BJ Pipelines and Process Services, both Aberdeen, UK which aimed to minimise production downtime during subsea maintenance. In response to demand from pipeline operators, the Autonomous Isolation Plug (AIP) was developed. The AIP is a significant breakthrough for pipeline maintenance because it allows work to be carried out without the need for depressurisation and purging of the pipeline.

These brochures can be obtained free of charge by faxing or e-mailing your request to Lisa Rattray at CMPT.

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