Norwegian Deepwater Program

2010 Annual Report

January 31st 2011
History

Two projects 1996-1997

Chairman
1996-2002 (Statoil)
2002-2003 (BP)
2003-2011 (Shell)

Project Management
Seabed - Statoil (Norsk Hydro)
Metocean – Statoil (Shell)
Environmental Shell (Statoil, BP)
Subsea – Statoil
Riser & Mooring – Statoil (BP)

Five projects 1997-2010
What is NDP
- It is an organisation of the deep water licences awarded in 15th round (1996) in the Norwegian Sea. Later extended to include 16th, 17th, 18th, 19th and 20th round deepwater licences. About MNOK 350 in projects investment since start. 2010 budget estimated close to MNOK 20. (100% from Licences)

Objectives:
- To join forces and carry out cost effective preparations for safe and efficient drilling and field development

The programme phases

Current members
- Statoil - PL218, PL283, PL327, PL328, PL524
- Shell - PL326, PL392, PL538
- Chevron – PL527
- Petro Canada – PL528
- ENI – PL529
- Total – one license fee
Who are we?

Steering Committee

- **Chairman - Helge Skjæveland (Shell)**  helge.skjaveland@shell.com
- **Knut Chr. Grindstad (Statoil)**  KCG@statoil.com
- **Arild Sigurdsen (Chevron)**  asig@chevron.com
- **Erik Bjornbom (ENI)**  Erik.Bjornbom@eninorge.com
- **To be nominated Nina Gravdal (Petro Canada)**  ngravdal@suncor.com

Project Managers

(each project have representatives from license partners)

- **Metocean – Einar Nygaard (Statoil)**  enyg@statoil.com
- **Seabed - Thomas Reichel (Statoil)**  THOREI@statoil.com
- **Subsea - Keijo J. Kinnari (Statoil)**  KJKI@statoil.com
- **Riser & Mooring - Kjetil Skaugset (Statoil)**  KJSKA@statoil.com
- **Environmental – Gina Ytteborg (Shell)**  Gina.Ytteborg@shell.com
NDP Technical Committees Members

**Statoil:** Thomas Reichel (Seabed Project), Einar Nygaard (Metocean Project), Lars Petter Myhre (Environmental Project), Keijo J. Kinnari (Subsea Project), Jarl Øystein Tengesdal (Subsea Project), Kjetil Skaugset (Riser & Mooring Project)

**Shell:** Jostein Haga (Seabed Project), Hans Jørgen Sætre (Metocean Project), Gina Ytteborg (Environmental Project), Ulfert Klomp (Subsea Project), Lisa Paulson (Subsea Project), Lars-Petter Solie (Riser & Mooring Project)

**ConocoPhillips:** Arne Solberg (Seabed Project), Dave Peters (Metocean Project), Rosamund Durie (Environmental Project)

**ENI:** Stephen Tarran (Seabed Project), Robert Johnson (Metocean Project), Erik Bjørnbom (Environmental Project), Laura Bracco (Environmental Project), Robert Johnson (Riser & Mooring Project)
NDP Technical Committees Members

- **RWE Dea**: Harald Brunstad (Seabed Project), John Clark (Seabed Project)

- **Chevron**: Owen Oakley (Riser & Mooring Project)

- **Petoro**: Constantine Makrygiannis (Riser & Mooring Project), Constantine Makrygiannis (Subsea Project)

- **Total**: Hédi Dendani (Seabed Project), Edmond Coche (Metocean Project), Laurence Pinturier (Environmental Project), Paul Wiet (Riser & Mooring Project), Alexandre Goldszal, (Subsea Project), Thierry Palermo (Subsea Project)

- **GDF SUEZ**: Wim Lekens (Seabed Project), Bjørg Solheim (Seabed Project), Eva Fagernes (Metocean Project), Eva Fagernes (Environmental Project), David Grabowski (Subsea Project), Geir Pettersen (Riser & Mooring Project)

- **Ptil**: Gerhard Ersdal (Metocean Project)

- **ExxonMobil**: Guanggiang Yang (Riser & Mooring Project)
Funding licences 2010

- Statoil PL 218, 283, 327, 328, 524
- Shell PL 326, 392, 538
- Chevron PL 527
- ENI PL 529
- Petro Canada PL 528
- Total pay one license fee
A flexible, easy-to-run organization

Joint Licenses Steering Committee
(Operators)
Chairman: Shell

- Project Technical Committee
  - Seabed Project Statoil
  - Metocean Project Statoil
  - Subsea Project Statoil
  - Environmental Project Shell
  - Riser & Mooring Project Statoil
NDP Cost Summary by Year

### Annual cost, all projects 1996 - 2010

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<tbody>
<tr>
<td>Cost</td>
<td>16,602</td>
<td>55,553</td>
<td>52,887</td>
<td>30,099</td>
<td>8,188</td>
<td>20,674</td>
<td>24,750</td>
<td>37,228</td>
<td>19,172</td>
<td>12,085</td>
<td>19,192</td>
<td>20,000</td>
<td>16,822</td>
<td>11,868</td>
<td>13,047</td>
<td>358,176</td>
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<tr>
<td>%</td>
<td>5%</td>
<td>16%</td>
<td>15%</td>
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<td>100%</td>
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## NDP Cost Summary by Project

### Total, all projects 1996 - 2010

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Seabed</td>
<td>128,200</td>
<td>36%</td>
</tr>
<tr>
<td>Metocean</td>
<td>45,261</td>
<td>13%</td>
</tr>
<tr>
<td>Subsea</td>
<td>67,700</td>
<td>19%</td>
</tr>
<tr>
<td>R &amp; M</td>
<td>95,425</td>
<td>27%</td>
</tr>
<tr>
<td>Environm.</td>
<td>19,930</td>
<td>6%</td>
</tr>
<tr>
<td>Acc.</td>
<td>1,660</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>358,176</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

### NDP Cost Breakdown

- **Seabed**: 128,200
- **Metocean**: 45,261
- **Subsea**: 67,700
- **R & M**: 95,425
- **Environm.**: 19,930
- **Acc.**: 1,660

**Total**: 358,176
The Seabed project 1/3

Aims:

• To improve the regional and local understanding of hazards, the geotechnical challenges and other related processes and features on the seabed and in shallow sediments.

Program 2010:

• The main activity this year was the Finneidfjord-Vesterålen project (in cooperation of NGI, NGU & UiB). The project tries to correlate and interpret the relation of sediment properties and subseabed geohazard features (glide planes/shallow gas) between the Finneidfjord Field Laboratory (Sheltered Fjord Setting) and the offshore Vesterålen margin setting (offshore deepwater area).

• A second project was the GANS project (Gashydrates along the Norwegian and Svalbard Margin) which has terminated in 2010 after 4 years. Many interesting results will be presented in a final report available early 2011.

• A third activity was supporting a general geotechnical investigation on temperature effects on deepwater clay sediments, reporting will be expected in 2011.
The Seabed project 2/3

Finneidfjord-Vesterålen Project

Acquired OBS-data at Finneidfjord (left)

Data example of a Topas Line within the Fjord (below)

Acquired data at Vesterålen (Lofoten)
The Seabed project 3/3

Technical Committee managed by Statoil

- Statoil: Thomas Reichel
- Shell: Jostein Haga
- ConocoPhillips: Arne Solberg, Chris Perry
- ENI: Stephen Tarran
- RWE Dea: Harald Brunstad and John Clark
- Total: Hédi Dendani
- GDF SUEZ - Wim Lekens - Bjørg Solheim
Metocean Project 1/4

Aims:

To establish data bases of metocean conditions for use in operations and design of deep water installations by acquisition of ocean current data (short and long term), modelling and establishment of hindcasts for currents and waves, analysis of remote sensing data and research on ocean dynamics in order to understand the deepwater currents.
Metocean Project 2/4

Specific work in 2010:

- Finalised New Wave and Wind Hindcast model - NORA10 – with Norwegian Meteorological Institute
- LoVeCur. Comparison of different current hindcast models in the Lofoten Vesterålen area.
- Current measurements in the Northern Norwegian Sea (areas with sand waves.

Benefits to licenses

- *New wave and wind hindcast model (NORA10)*: The database, which is obtained via a web portal, contains wave and wind data in 10 km resolution from West of Ireland to the Arctic for the period 1957 to 2009. Data can be used for planning purposes of both exploration and field development. Preliminary analysis indicate that the data base has very high quality.
Metocean Project 3/4

Benefits to licenses (cont.)

• **Lofoten Vesterålen Current hindcast (LoVeCur):** Comparison of six different hindcast models with measurements from the Lofoten Vesterålen area. All current hindcast are completed. The comparison study will be completed in 1Q 2011.

• **Current measurement in the Northern Norwegian Sea:** Current measurements are performed by IMR in the Northern Norwegian Sea (in area with sand waves in deep water).

• **Support UoB in Svinøy data collection:** NDP supports the long term current measurements at Svinøy. The 15 years long continuous time series has been used to evaluate uncertainties in extreme current based on short duration time series.
Metocean Project 4/4

Technical Committee managed by Statoil

- Statoil: Einar Nygaard (Chairman from 2010)
- Shell: Hans Jørgen Sætre
- ConocoPhillips: Dave Peters
- Eni: Robert Johnson
- GDF Suez: Eva Fagernes
- Exxon: Eugene Berek
- Total: Edmond Coche
- Ptil: Gerhard Ersdal (observer)
The Environmental project 1/2

Aims:
- To reduce environmental risks related to exploration drilling and field development in deep water areas through:
  - Multidisciplinary approach to identify and close gap of knowledge.
  - Study deep sea fauna and improve taxonomical expertise.
  - Establishment of sound environmental monitoring.
  - Study possible effects of particulates on sponges.
  - Improve knowledge and methods for oil spill response on deep water

Program 2010:
- The environmental project has not run any projects in 2010 due to resource restrictions. Focus has been to develop a relevant program for 2011 to follow up the Macondo incident and new deepw. areas on NCS.
- The exchange of knowledge about deep water taxonomy was supported in 2010, but will not be part of the 2011 program.

Benefits to licenses
- Important part of getting permission to explore and develop licenses having thorough understanding of not harming marine life.
The Environmental project 2/2

Technical Committee managed by Shell

- Shell: Gina Ytteborg
- Statoil: Lars Petter Myhre
- Total: Laurence Pinturier
- ENI: Erik Bjørnbom
- ConocoPhillips: Rosamund Durie
- PetroCanada: Urban Williams
- Chevron: Gunnar Lille (based in California)
The Subsea project 1/3

Subsea Project Aims:
To develop low cost subsea technology concepts, methods and procedures for installation and operation of subsea systems in deep waters as well as making suppliers and contractors aware of the challenges for future field developments in deep water areas in the Norwegian Sea.

Test objective:
Risk assessment of hydrate plug formation for improved design and operational strategy with the overall objective to assess the criticality of hydrate formation in different subsea production system areas in order to determine its impact on functional requirements, physical design and operational procedures.

Test program
The work has had continued focus on hydrate plugging caused by pulsating flow which is often encountered at real field conditions due to thermal/pressure changes and riser movements.

Main findings
Results show that shutdown periods can be extended beyond cooldown time even in cases where the fluid system is subject to pulsating flow. This adds confidence to extended no touch time in certain areas of the production system.
The Subsea project 2/3

Benefits to licenses

• Criticality of hydrate plugging in templates and similar system elements can be related to the critical threshold water level concept, i.e. no plugging below a given water content

• The results provide important design and operational guidelines.
  - Reduced chemical usage
  - More time available for corrective operational measures rather than focusing on hydrate control measures
  - Improved design
  - Safer operation
The Subsea project 3/3

Technical Committee managed by Statoil

- Statoil: Keijo J. Kinnari
- Shell: Ulfert Klomp, Lisa Paulson
- Total: Biljana Djoric, Thierry Palermo
- Gaz de France: David Grabowski
- Petoro: Constatine Makrygiannis
The Riser and Mooring Project 1/3

Aims:
To identify cost-efficient riser and mooring configurations by focusing on critical elements and building on world-wide expertise and experiences with the focus on:
- Development of new riser solutions for deepwater and harsh environments
- Development of new devices for suppression of vortex induced vibrations
- Fundamentals for design of deep water riser and mooring systems

Program 2010:
The work this year is focusing on:
- New steel riser solutions for harsh environment and deep water
- Suppression of vortex induced vibrations (High Re-number Fairing study)
- Contact between marine risers
The Riser and Mooring Project 2/3

Benefits to licenses

- **New steel riser solutions for harsh environment and deep water:**
  - Develop new riser configurations suitable for high motion vessels (FPSO, Buoy)
  - Increase flexibility of steel risers (improved fatigue life, more robust compared to traditional SCR solutions)
  - Enable steel risers on marginal field developments and increase flexibility of floater concepts

- **Fairing study:**
  - Increased ability to perform drilling operations
  - Increased fatigue life and reduced environmental loads on risers on permanent installations
  - Increased level of safety in operating conditions
  - VIV suppression devices can be a technology enabler for a field development

- **Contact between marine risers:**
  - Better prediction of the behaviour of interaction between marine risers
  - Review feasibility of allowing marine riser contact during operation
Technical Committee managed by Statoil

- Statoil: Kjetil Skaugset
- Shell: Lars-Petter Solie
- ENI: Robert Johnson
- Total: Paul Wiet
- Chevron: Owen Oakley
- ExxonMobil: Guanggiang Yang
- GDF SUEZ: Tom Steinskog
- Petoro: Constantine Makrygiannis
NDP is a Success!

• A cost efficient way of working
  - Significant savings in co-ordinated and shared operations
  - Avoided duplication of work
  - Cheap administration, less than 1%

• It has been an open and sharing way of work
  - High degree of openness and experience transfer
  - Good personal relations and co-operation with external institutions
  - Increased co-operation between external institutions

• We have learned a lot!
  - Increased competence and knowledge base
  - Improved communication between involved companies
  - Personal relations and increased network

• The licensees got results
  - Very useful data base for further work
  - Reduced work load and costs for each license