A Comparison between the DONG Energy Reserves/Resource Classification System and the UNFC-2009 System

UNFC, London, 7th February 2011
(Previously given at IQPC, London, 7th October 2010)
Prepared by J. Christensen & J. Reffstrup, DONG Energy
- Introduction – DONG Energy
- Classification Systems/Procedures
- Example
- Close out
Exploration & Production explores for and produces oil and gas. The activities are focused in the waters around Denmark, Norway, the UK (West of Shetland area), the Faroe Islands and Greenland.

**End 2009**

OIL AND GAS PRODUCTION  
24 mio. boe

OIL AND GAS RESERVES (2P)  
364 mio. boe

EBITDA  
DKK 3.4 billion

40%
Generation produces power and heat from efficient, flexible power stations and renewable energy sources.

Generation is a market leader in the construction and operation of offshore wind farms and clean coal technology.

End 2009

<table>
<thead>
<tr>
<th></th>
<th>POWER GENERATION</th>
<th>HEAT GENERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWh</td>
<td>18,074</td>
<td>46,686</td>
</tr>
<tr>
<td>TJ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EBITDA
DKK 0.9 billion
10%
Energy Markets

Energy Markets optimises DONG Energy’s energy portfolio, forming the link between the Group’s procurement and sale of energy. Energy Markets sells gas and power to wholesale customers and trades on energy exchanges.

End 2009

GAS SALES
102,436 GWh

POWER SALES
10,723 GWh

EBITDA
DKK 2.0 billion

24%
Sales & Distribution sells gas, power and related products to private customers, companies and public institutions in Denmark, Sweden and the Netherlands. Sales & Distribution operates the gas distribution network and power grids, gas storage facility and oil pipeline owned by DONG Energy in Denmark.

### End 2009

**GAS SALES**
- 21,756 GWh

**POWER SALES**
- 8,529 GWh

**GAS DISTRIBUTION**
- 9,966 GWh

**POWER DISTRIBUTION**
- 9,156 GWh

**EBITDA**
- DKK 2.2 billion (26%)

**EBITDA**
- DKK 2.2 billion (26%)
The activities of this business area focus on oil and gas exploration and extraction in Denmark, Norway, the UK (West of Shetland area), the Faroe Islands and Greenland.

This business area includes a stake in Gassled, which comprises the entire gas pipeline network from the Norwegian fields to continental Europe and the UK.

At the end of 2008, DONG Energy was participating in 62 exploration and appraisal licences and 13 production licences.

The growth strategy for this business area is based on continuous oil and gas exploration. DONG Energy therefore participates actively in licensing rounds within this area of activity.
DONG Energy fields in production – Denmark and Norway

Projection: Mercator (world) [not to scale]

**Fields in Production**

<table>
<thead>
<tr>
<th>Name</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siri / Stine</td>
<td>DONG E&amp;P (50%)</td>
</tr>
<tr>
<td>Nini</td>
<td>DONG E&amp;P (40%)</td>
</tr>
<tr>
<td>Nini East</td>
<td>DONG E&amp;P (40%)</td>
</tr>
<tr>
<td>Cecilie</td>
<td>DONG E&amp;P (22%)</td>
</tr>
<tr>
<td>Syd Arne</td>
<td>Hess (34.4%)</td>
</tr>
<tr>
<td>Lulita</td>
<td>Maersk (43.6%)</td>
</tr>
<tr>
<td>Ula</td>
<td>BP (15%)</td>
</tr>
<tr>
<td>Gyda</td>
<td>Talisman (34%)</td>
</tr>
<tr>
<td>Tambar</td>
<td>BP (43.2%)</td>
</tr>
<tr>
<td>Alve</td>
<td>Statoil (15%)</td>
</tr>
<tr>
<td>Ormen Lange</td>
<td>Norske Shell (10.3%)</td>
</tr>
</tbody>
</table>

**Pipeline Details**

- **Gas Pipeline**
  - From Siri/Stine to Nybro: 260 km
  - From Syd Arne to Nybro: 235 km
  - From Dan to Fredericia: 330 km
  - From Dan to Nybro: 360 km

- **Oil Pipeline**
  - From Gyda to Teesside
  - From Tambar to Dutch shelf
  - From Alve to Den Helder
  - From Ormen Lange to Norwegian shelf

- **Multi Phase Pipeline**
  - From Ormen Lange to Danish shelf

- **Gas Condensate**
  - From Alve to Den Helder

- **Other Pipelines**
  - From Gorm to Tyra
  - From Stine Segment-1 to Stine Segment-2

- **Operators**
  - DONG E&P
  - BP
  - Maersk
  - Talisman
  - Statoil
  - Norske Shell
- Introduction – DONG Energy
- Classification Systems/Procedures
- Example
- Close out
Most E&P projects are Category A project according to the DONG E&P Project Model i.e. Capex > 500 mill DKK

- It is mandatory that 'A' projects pass through all decision gates
- For each phase/gate a list of mandatory deliverables are defined by the Project Model
DONG Energy Project Model
DONG E&P Capital Value Process (CVP)

- The CVP is DONG E&P's decision-making process for investment projects
- Project Work Processes are aligned with the requirements of the CVP process
DONG Decision Gates for Approving Resources/Reserves

Class 6 Prospective Resources → Class 5 Technical Contingent Resources → Class 4 Commercial Contingent Resources → Class 3 Reserves

DG2
- Preliminary Evaluation NPV > 0 for base case
- Development < 8 years

Discovery Well

Full Evaluation NPV > 0 for 2P Reserves and NPV => 0 for 1 P Reserves Development < 5 Years

After DG3 before DG4

Increasing Maturity
The E&P Field Development Model

Value Chain

Explore → Appraisal Exploration → Appraisal Development → Develop → Produce

Project Responsible

Exploration → Country → TOP/PS&E → Country

Gatekeeper

TOP → TOP → TOP → TOP → Country

Project Model

Business Planning → Feasibility → Concept Selection → Preparation for Execution → Execution → Operation

Resource Classes

Class 6 Prospective Resources → Class 5 (5a, 5b) Technical Contingent Resources → Class 4 Commercial Contingent Resources → Class 3 Reserves → Class 2 Reserves → Class 0+1 Reserves

Discovery well → NPV > 0 for base case Dev. < 8 years → PDO started → PDO agreed with partners → Budget Approval → Wells on Production

Class 2 Reserves

Class 3 Reserves

Class 4 Commercial Contingent Resources

Class 5 (5a, 5b) Technical Contingent Resources

Class 6 Prospective Resources

Class 0+1 Reserves
DONG Energy Procedure of Resources and Reserves Classification
We apply SPE PRMS
UNFC 2009 Classification

- **Sales Production**
  - $E_1$
  - $E_2$
  - $E_3$
  - $F_1$
  - $F_2$
  - $F_3$
  - $F_4$
  - $G_1$
  - $G_2$
  - $G_3$
  - $G_4$

- **Socio-economic viability**
- **Non-sales Production**

- **Project feasibility**
- **Geological knowledge**

Legend:
- Commercial projects
- Potentially commercial projects
- Non-commercial projects
- Exploration projects
- Additional quantities in place
- Other combinations
- Extracted quantities
- Codification ($E_1;F_2;G_3$)
Mapping of UNFC-2009 upon the DONG Classification System

DONG Energy class: 6+
UNFC F-axis: 4
G-axis: 4

Possible further definition of G-axis would benefit Exploration (low, high cases not easily mapped clearly)
Examples of Final Calculations

EUR = RF * HIIP
HIIP = Volume * Porosity * Sh * FVF

Based on Production data
Supported by other tools!

Capital Value Process (CVP)

EUR = Estimated Ultimate Recovery
HIIP = Hydrocarbon Initially In Place
RF = Recovery Factor
Sh = Hydrocarbon saturation
FVF = Formation Volume Factor

DCA

Static & Dynamic Modelling
(large models)

Small models
- Introduction – DONG Energy
- Classification Systems/Procedures
- Example
- Close out
Many WOS discoveries/prospects are deeper than 300 m
DONG E&P acreage in the UK and Faroese shelf (WoS)
West of Shetlands (WOS)

- Key Characteristics
- Hostile environment
  - Deep water, wind, waves, current, cold water temperatures
- Distant from gas market
  - High development cost
- No direct gas pipeline access to NTS
- Diverse partnerships
- 2 Tcf discovered gas
- Up to 2 Tcf upside on discovered resources
- Up to 4 Tcf of undiscovered potential
West of Shetlands (WOS)

- Key Characteristics
- Hostile environment
  - Deep water, wind, waves, current, cold water temperatures
- Distant from gas market
  - High development cost
- No direct gas pipeline access to NTS
- Diverse partnerships
- 2 Tcf discovered gas
- Up to 2 Tcf upside on discovered resources
- Up to 4 Tcf of undiscovered potential
## Example – Field

<table>
<thead>
<tr>
<th>Dong Energy</th>
<th>UNFC-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 5 low</td>
<td>221</td>
</tr>
<tr>
<td>Class 5 mid</td>
<td>+122 (&amp; 222)</td>
</tr>
<tr>
<td>Class 5 high</td>
<td>+123 (&amp; 223,233)</td>
</tr>
</tbody>
</table>

Classification depending on commercial status

Low case define classification status in DONG System for mid/high cases ('112' not possible without '111')
Example – Field – Exploration

<table>
<thead>
<tr>
<th>Dong Energy</th>
<th>UNFC-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 6 low</td>
<td>334</td>
</tr>
<tr>
<td>Class 6 mid</td>
<td>334</td>
</tr>
<tr>
<td>Class 6 high</td>
<td>334 (or 234)</td>
</tr>
</tbody>
</table>

Classification very similar for DONG Exploration projects

Geological definition less well defined, making ranges (high & low) difficult to show clearly
This is currently being looked at via the UNFC Task Force specification work
## Example – Field – Discovery

<table>
<thead>
<tr>
<th>Dong Energy</th>
<th>UNFC-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 5 low</td>
<td>331</td>
</tr>
<tr>
<td>Class 5 mid</td>
<td>+332</td>
</tr>
<tr>
<td>Class 5 high</td>
<td>+333 (or +233)</td>
</tr>
</tbody>
</table>

Classification options suit well for DONG development projects.
Close out

- DONG Energy Volume booking process is closely linked the Company Project Model
- The company system can be mapped onto the UNFC 2009 system with no major modifications
- No major differences in booking numbers within major categories between the system for the examples used
- Some differences between the DONG System and UNFC-2009 with respect to Exploration
  - The 3 dimensional (UNFC) system is generally considered more difficult within the company.
  - UNFC 2009 is well suited for better comparing volumes between different systems (companies or national) - although not shown in this presentation
Thank you for your attention