Design of Arctic Mobile Offshore Drilling Unit

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Contents

• Introduction
• Existing design solutions
• Concept of JBF Arctic
• Seakeeping
• Performance in ice
• Mooring
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Drilling in Arctic

- Low temperatures
- High winds
- Snow
- Remote areas / lack of infrastructure
- Ice covered waters in winter season
- Extreme waves in open water season

Are there technical solutions for all the year round operations?
### Existing design solutions (floating structures)

#### Drill ships (monohulls)
- [www.dsme.co.kr](http://www.dsme.co.kr)

#### Drilling semi-submersibles
- [www.mossww.com](http://www.mossww.com)

#### Arctic circular drilling platform
- Kulluk (www.ogj.com)

#### Production units
- FPSO ref [1]
- Spar FPSO ref [2]
- Sevan FPSO ref [3]
Existing design solutions (floating structures)

Drill ships (monohulls)
- www.dsme.co.kr

Drilling semi-submersibles
- www.gvac.se
- www.mossww.com

Arctic circular drilling platform
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Production units
- FPSO ref [1]
- Spar FPSO ref [2]
- Sevan FPSO ref [3]

- Summer season
- Extended season
- Year round
Existing design solutions (floating structures)

Why round shape for drilling unit?

- Global ice forces are very high

Mooring system

Monohull with a turret

- Bow (stern) towards drifting ice
- Maneuvering to change heading can cause large offset unacceptable for riser

Round shape unit
JBF Arctic: Idea of the concept

Kulluk + JBF 10000 W
JBF Arctic: Main Particulars

- Deckbox top diameter: 106.0 [m]
- Deckbox bottom diameter: 90.0 [m]
- Lower hull outer diameter: 116.0 [m]
- Height of main deck above base: 49.0 [m]
- Number of columns: 8 [-]
- Draft operational (in ice): 39.0 [m]
- Draft operational (in open water): 18.0-22.0 [m]
JBF Arctic

Ice draft (excellent ice resistance)

Operating in waves draft (excellent seakeeping performance)
Motions

JBF 14000 (typical semi)

Cylindrical Type Unit

JBF Arctic

Maximum RAO

Heave [m/m]

range of typical wave periods
Seakeeping Model Tests

Successful model testing in FORCE Technology, Denmark, September 2010
Seakeeping Model Tests

Model tests showed:

- No significant non-linear effects were observed
- Air gap was found to be sufficient
- As expected the model tests confirmed good seakeeping performance of the unit as predicted earlier by numerical analysis
Seakeeping Model Tests

Transit draft (Hs=5m)
Seakeeping Model Tests

Operating draft (Hs=7.5m)
Seakeeping Model Tests

Survival draft (Hs=17.4m)
Seakeeping Model Tests

Ice draft (Hs=5m)
Optimization of hull shape

Current design

Model 1

Model 2

Model 3

Model 4

Model 5

Model 6

Model 7
Optimization of hull shape
Optimization of hull shape
Model tests in ice December 2010 in Krylov Shipbuilding Research Institute in Saint-Petersburg

<table>
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<th>Date</th>
<th>Field No.</th>
<th>Draft</th>
<th>Ice thickness, m</th>
<th>Ice conditions</th>
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<td>Level ice</td>
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<td>Channel (40m) behind ice-breaker in level ice</td>
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<td>(consolidated layer)</td>
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<td>Broken hummock, keel depth 10 m</td>
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</table>

Additional test in March 2011, level ice 3.0m thick
Model tests in ice tank

Operating in ice draft
Model tests in ice tank

Transit draft
Model tests in ice tank
Mooring

- Mooring system provides restoring of 47MN to 52MN depending on the water depth in the range from 200m to 850m (ABS static safety factor 2.0).
- This allows to withstand ice of 2.5m (up to 3.0m) at low drift speeds:
Mooring

16 (20) chain-polyester-chain lines
JBF Arctic
JBF Arctic – Dual Drilling Activity

Two wells can be drilled simultaneously

- Increase of efficiency
- Minimize the time required for drilling
JBF Arctic – Handling Principle

- BOP 1 & SST (covered)
- Riser storage (covered)
- Tubular storage (covered)
- Drill floor (covered)
- BOP 2 & SST (covered)

WELL CENTRES
- DRILLING
- STAND BUILDING
- BOP HANDLING
- RISER HANDLING
- X-MAS TREE HANDLING
SSBOP (& SST) handling:

1. Lower SSBOP with BOP handling crane (BOP is guided) and land on moonpool skid cart
2. Skid moonpool skid cart with BOP under well centre
3. Lower riser joint through rotary table connect to SSBOP and lower SSBOP to seabed

Drill floor 100% flush with main deck
JBF Arctic – Dual Drilling Activity

Dual drilling tower containing:
- 2 x Dual drum drawworks with AHC
- 2 x Dual passive compensators
- 2 x Splittable blocks system
- 2 x Riser tensioning system
- 2 x Drillers cabin
- 2 x BOP garage

The large drill floor shares:
- 3 x pipe rackers
- Large drill pipe setback area
- Large casing setback area

All equipment inside protected environment
Closed working areas of 4400 m²
JBF Arctic – Isolated Enclosure

Full enclosure with isolation
- Around drilling tower and riser tensioners
- Over riser hold with large doors for loading risers
- Over pipe hold with double doors and airlock for loading tubulars
- Personnel friendly working environment
- No dropped ice on working floors
  - Safety, efficiency, working environment
JBF Arctic – Containerized tubular handling

Containerized tubular handling

- Reduced number of crane movements
- Less damage
- Increased weather window
- Improved logistics
- Remote controlled pickup, 100% hands off
- No personnel in pipe hold
- Safer handling on supply boats
- Safety, efficiency
Independent operation: fuel supply?
JBF Arctic

Drilling in ice and in open waters
Thank you for your attention