Design of Arctic Mobile Offshore Drilling Unit

Alexei Bereznitski
Huisman Equipment B.V.

KIVI NIRIA

170 34e lustrum 170 jaar TU Delft

Arctic Battle

Symposium - 8 March 2012

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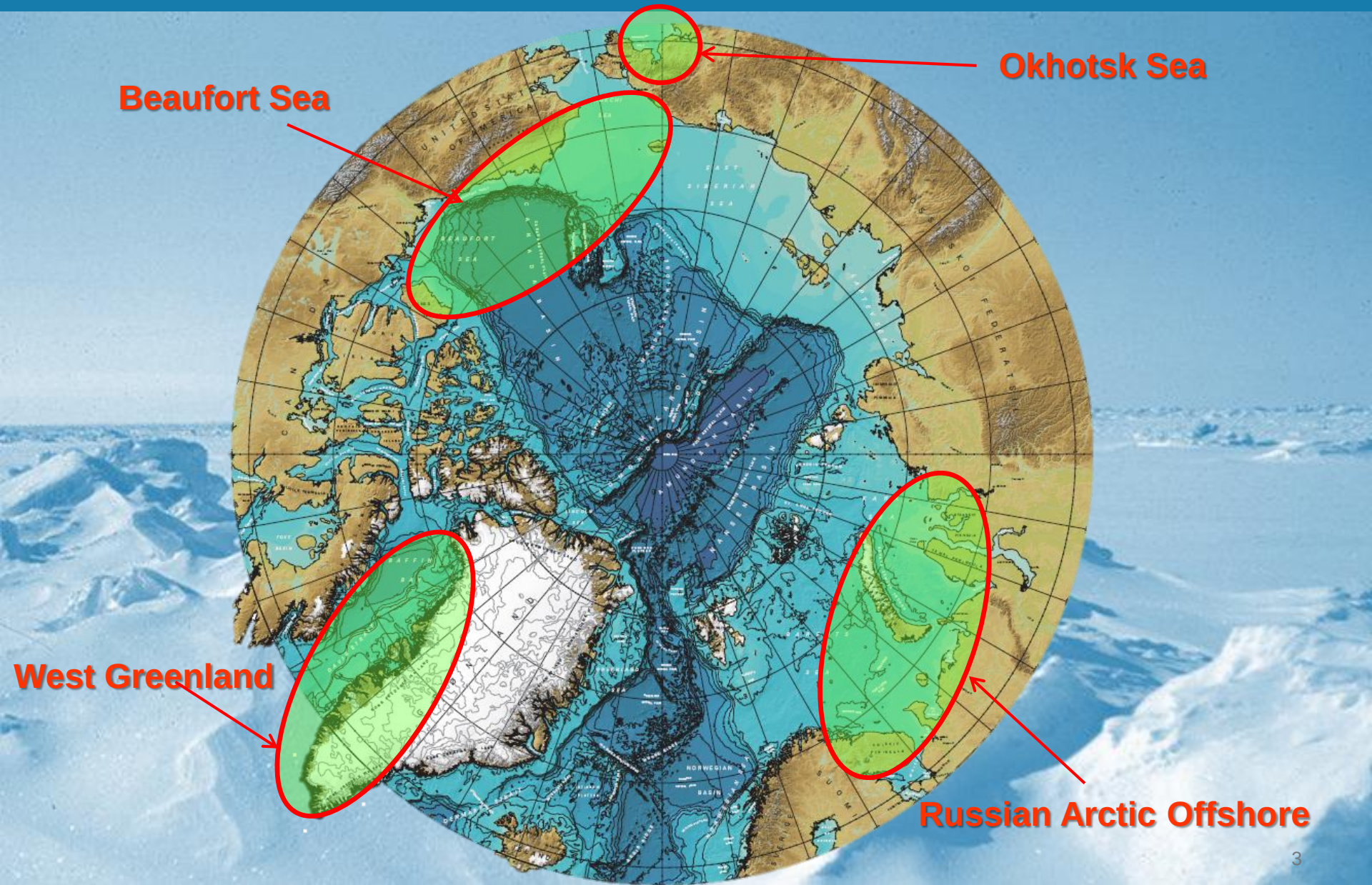
- Introduction
- Existing design solutions
- Concept of JBF Arctic
- Seakeeping
- Performance in ice
- Mooring
- Drilling

Arctic


Okhotsk Sea
Beaufort Sea
West Greenland
Russian Arctic Offshore

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)

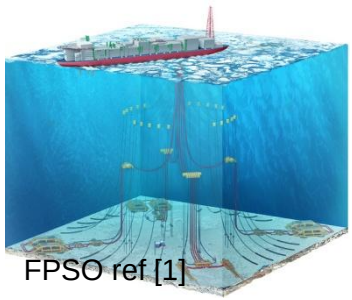
Drill ships (monohulls)

Existing units

Drilling semi-submersibles

Arctic circular drilling platform

Production units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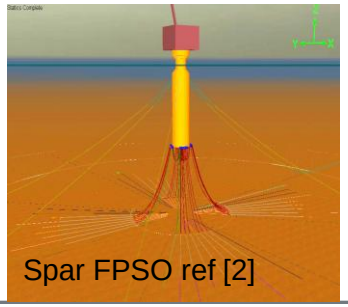
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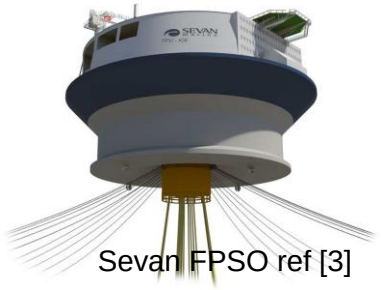

Sevan FPSO ref [3]

Existing design solutions (floating structures)

Drill ships (monohulls)

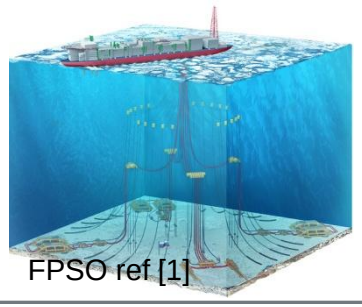
Drilling semi-submersibles

Summer season

Arctic circular drilling platform

Extended season

Production units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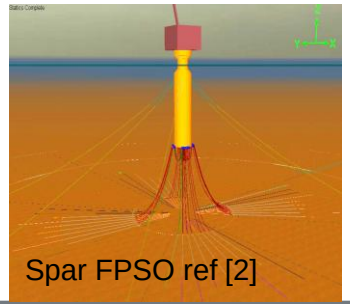
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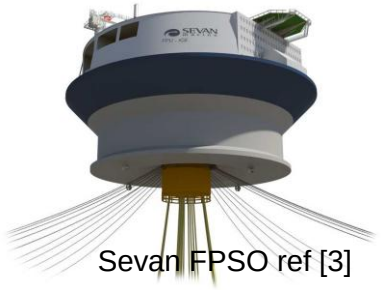
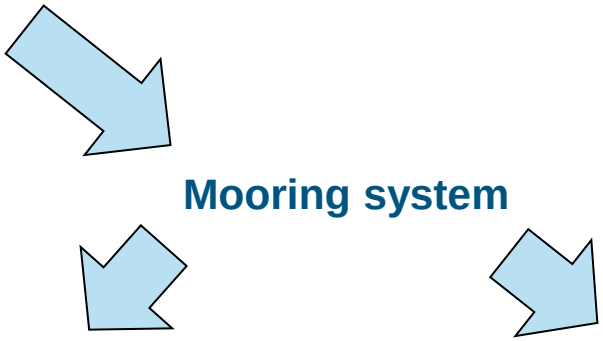

Sevan FPSO ref [3]

Year round

Existing design solutions (floating structures)

Why round shape for drilling unit?

Global ice forces are very high



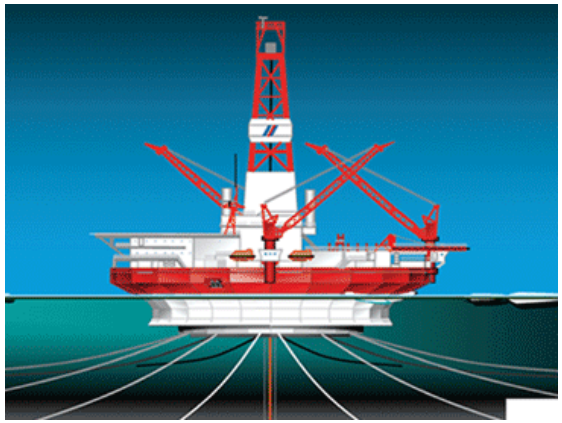
Mooring system

Monohull with a turret

Round shape unit

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

JBF Arctic: Idea of the concept



Kulluk

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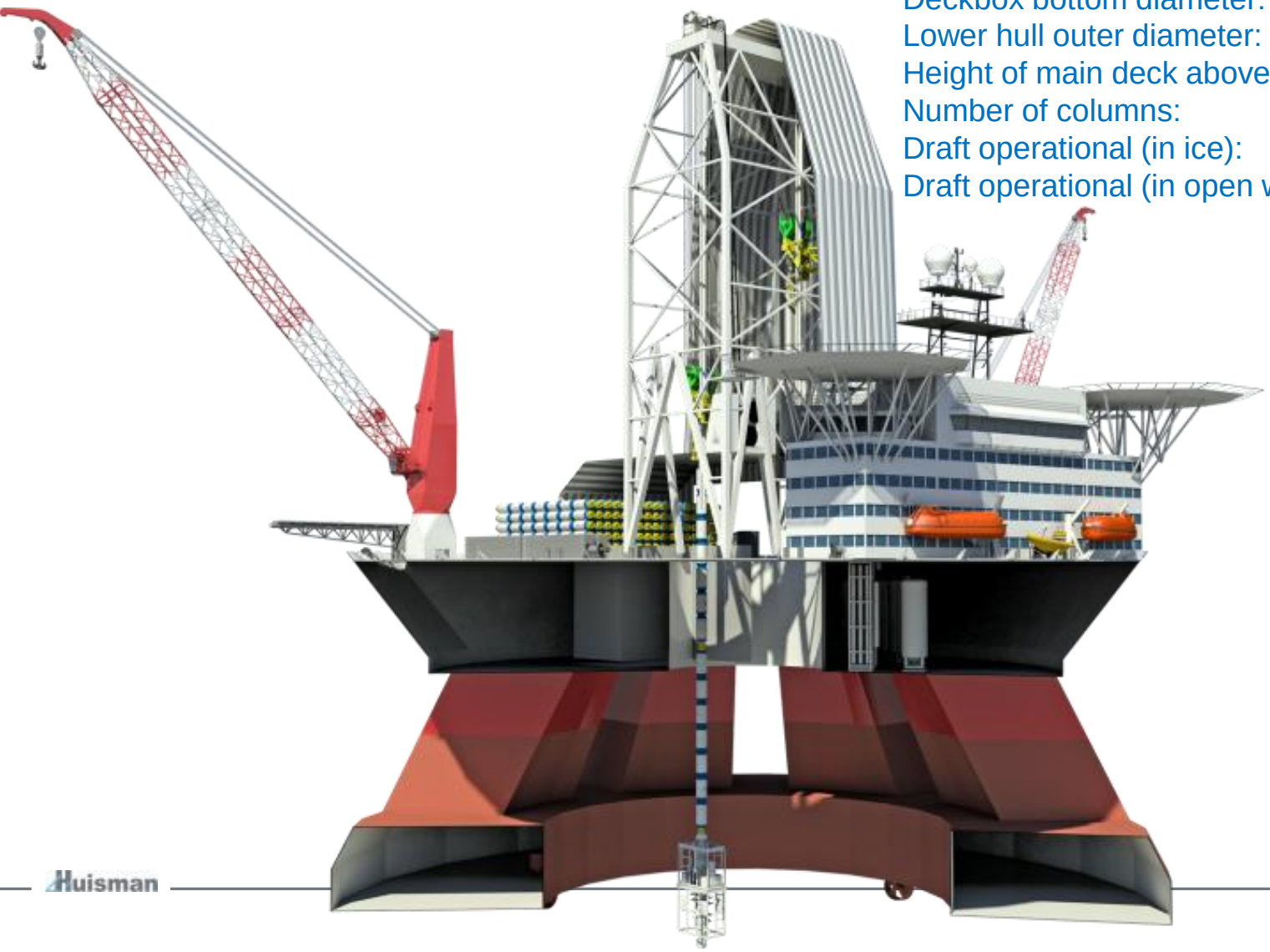
JBF 10000 W

JBF Arctic: Main Particulars



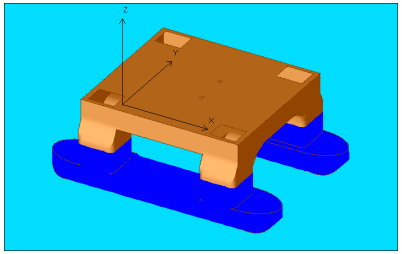
Deckbox top diameter:	106.0 [m]
Deckbox bottom diameter:	90.0 [m]
Lower hull outer diameter:	116.0 [m]
Height of main deck above base:	49.0 [m]
Number of columns:	8 [-]
Draft operational (in ice):	39.0 [m]
Draft operational (in open water):	18.0-22.0 [m]

JBF Arctic

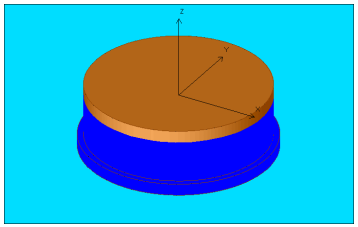
Ice draft (excellent ice resistance)

Operating in waves draft (excellent seakeeping performance)

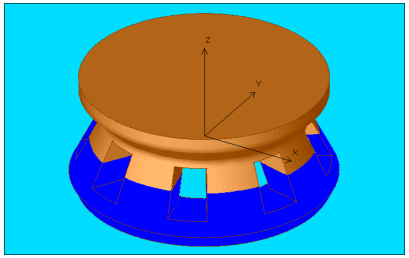
Motions



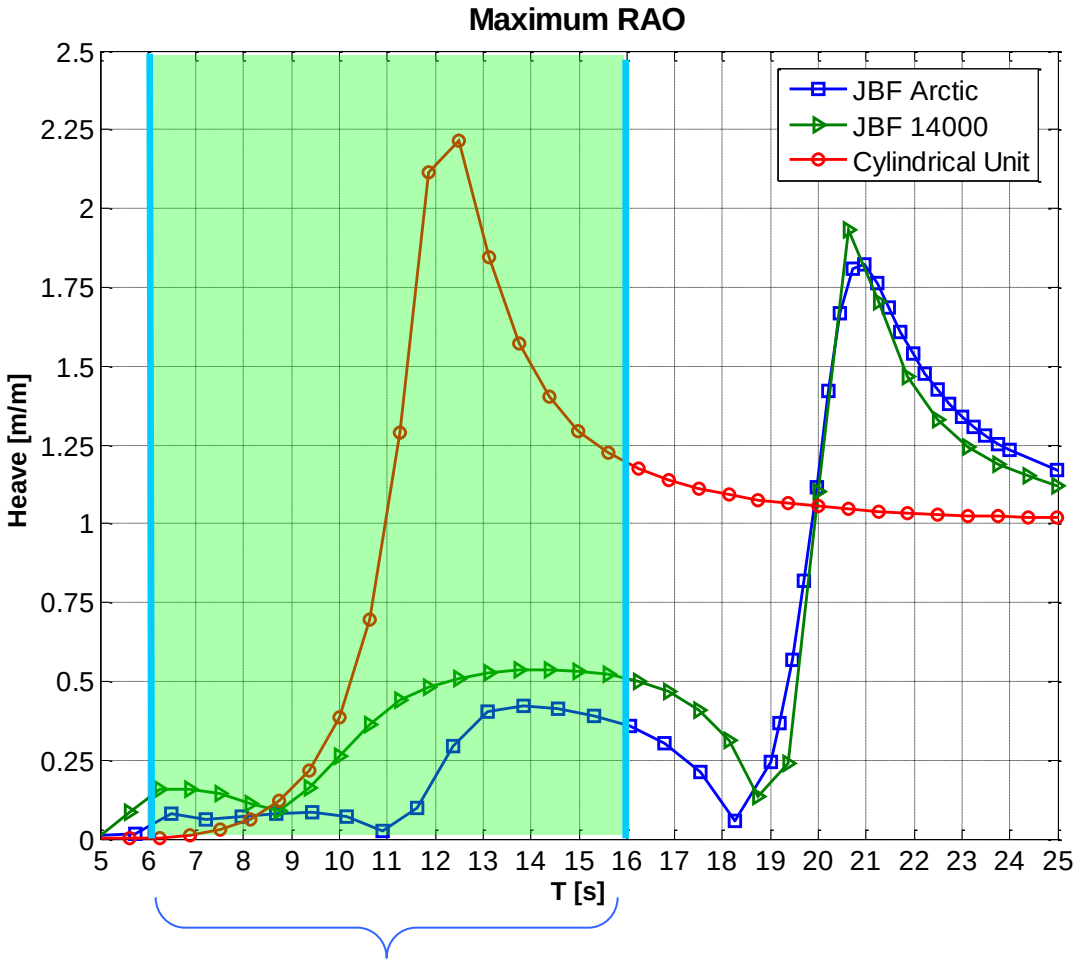
JBF 14000
(typical semi)



Cylindrical
Type Unit



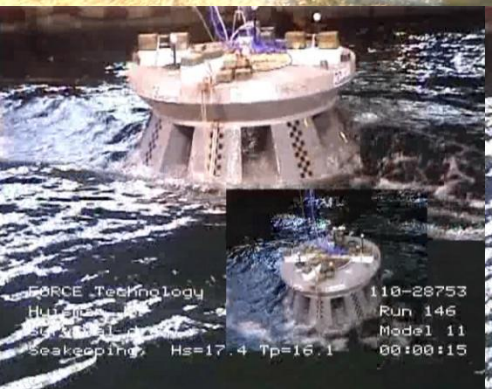
JBF Arctic

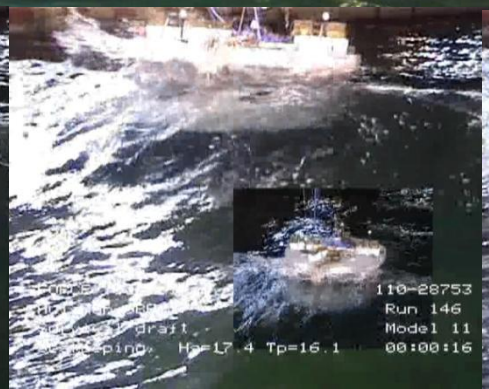


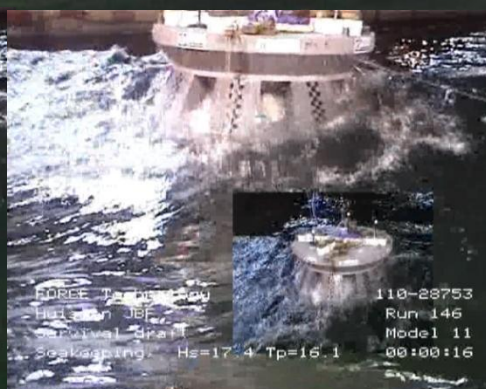
range of typical wave periods

Seakeeping Model Tests

Successful model testing in FORCE Technology, Denmark, September 2010







Seakeeping Model Tests

Model tests showed:

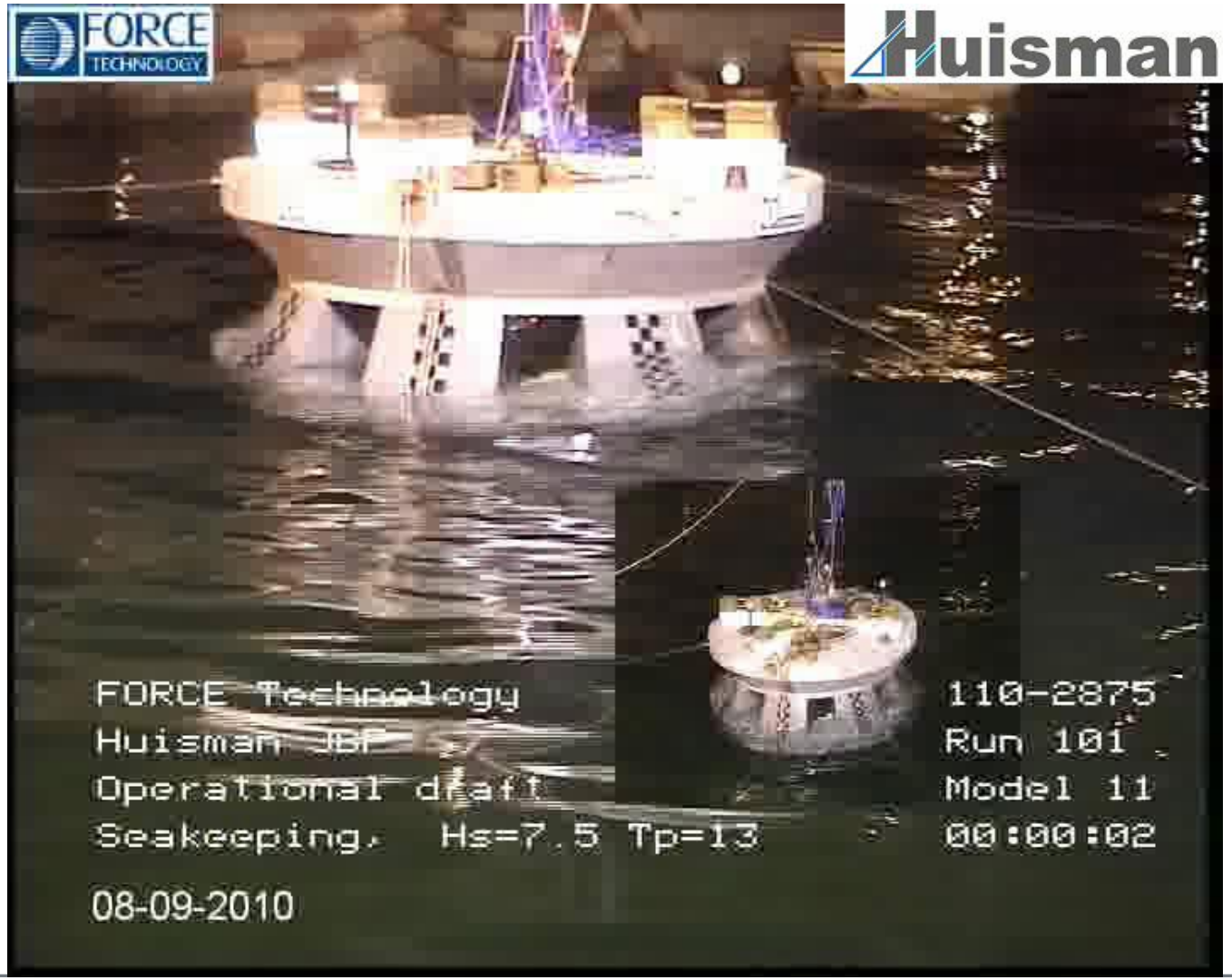
- No significant non-linear effects were observed
- Air gap was found to be sufficient
- As expected the model tests confirmed good seakeeping performance of the unit as predicted earlier by numerical analysis

Seakeeping Model Tests

Transit draft (Hs=5m)

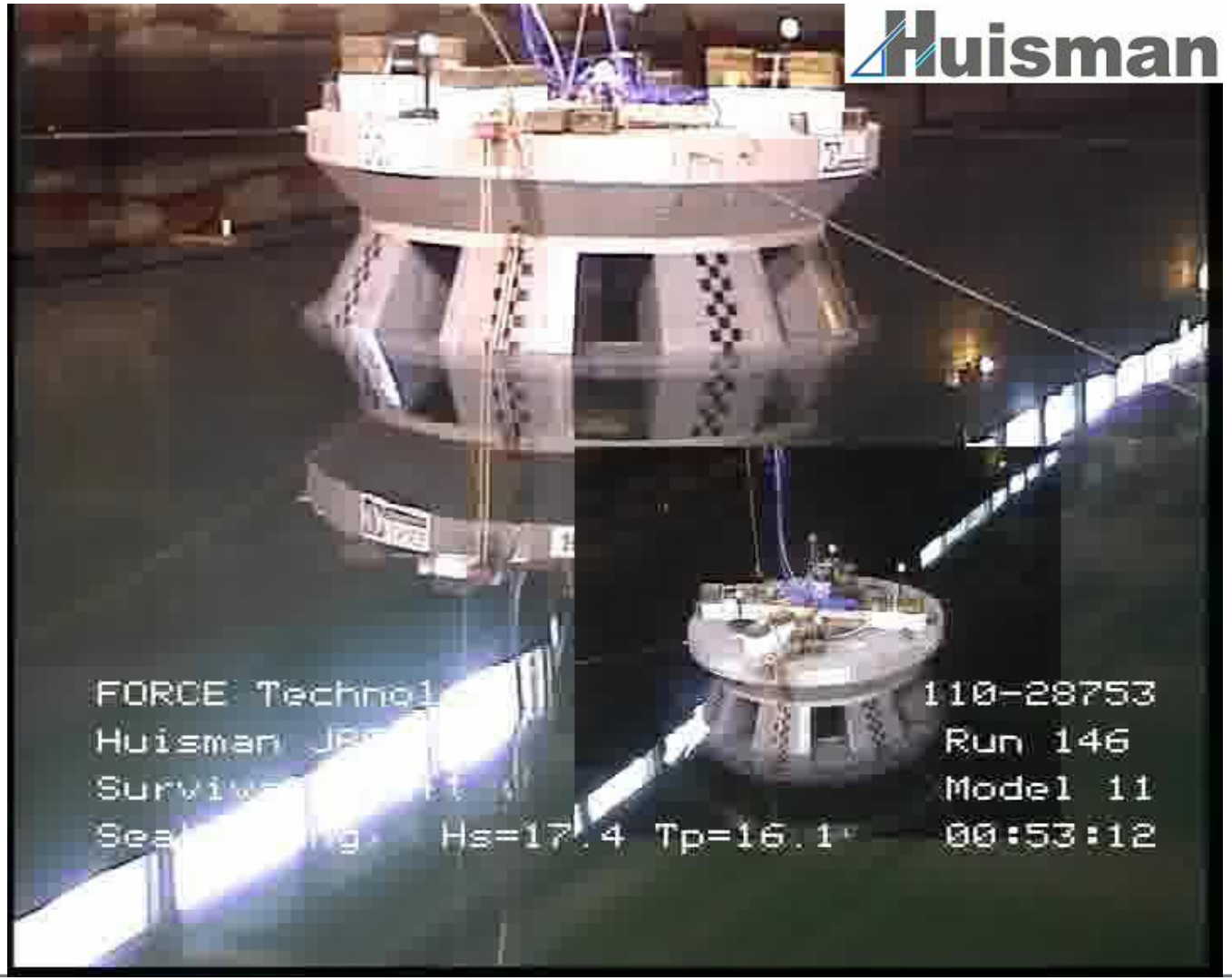
Seakeeping Model Tests

Operating draft (Hs=7.5m)



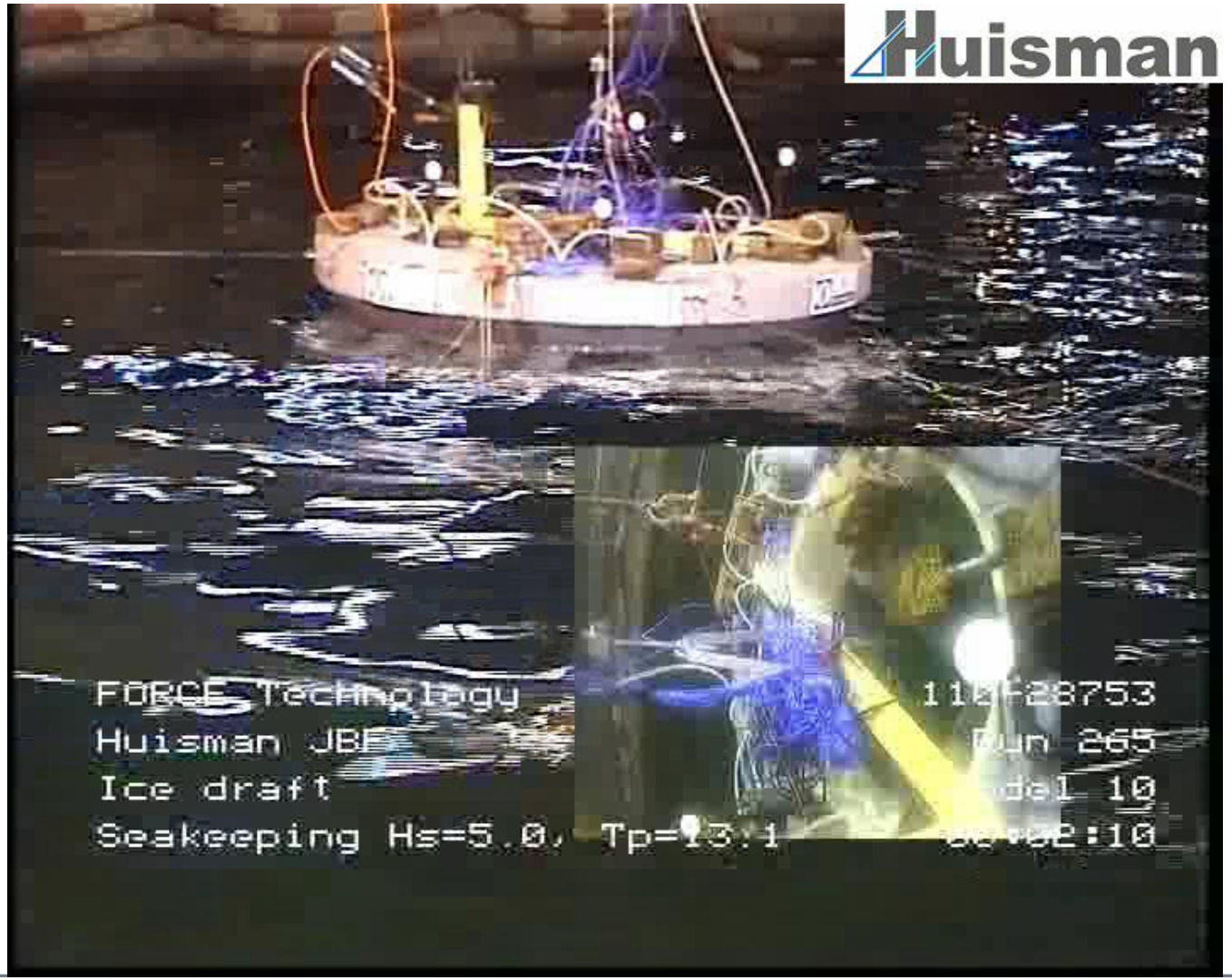
Seakeeping Model Tests

Survival draft (Hs=17.4m)

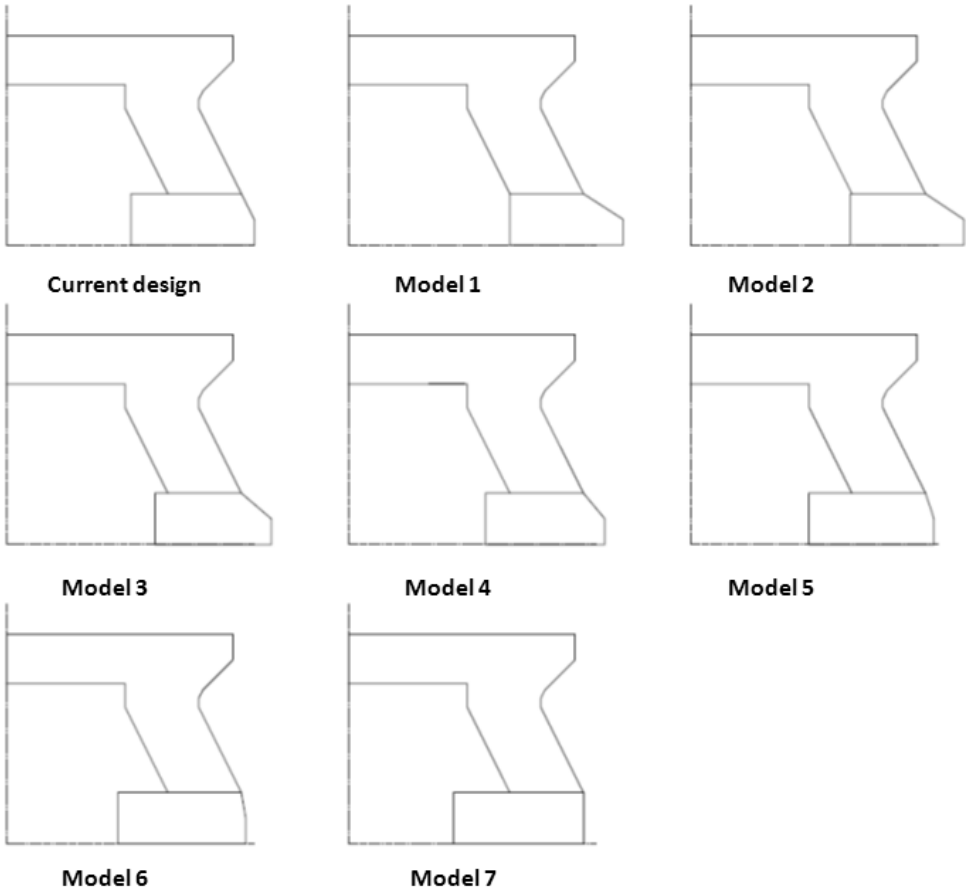


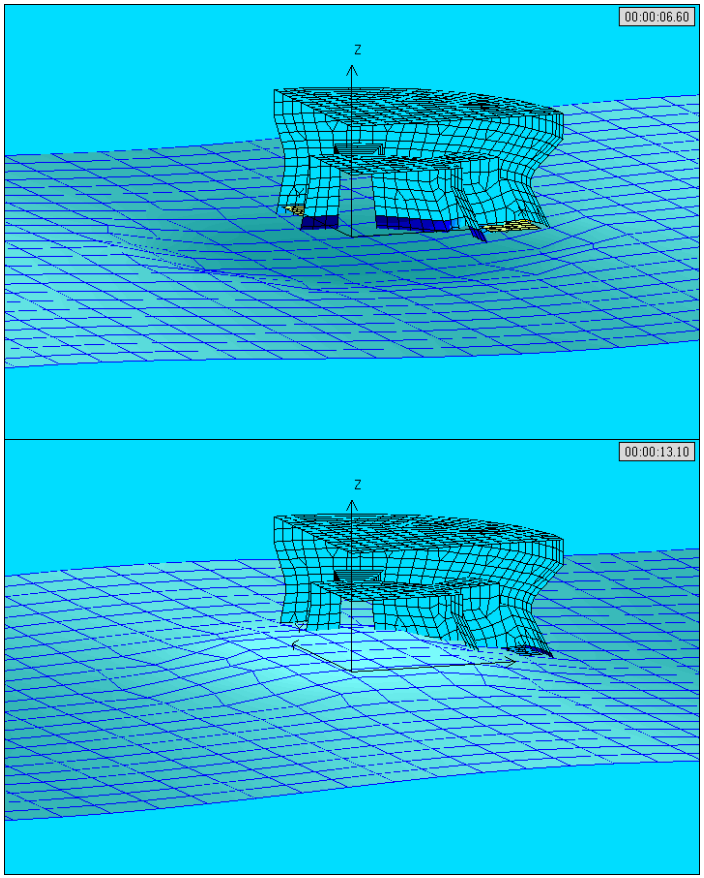
Seakeeping Model Tests

Ice draft (Hs=5m)

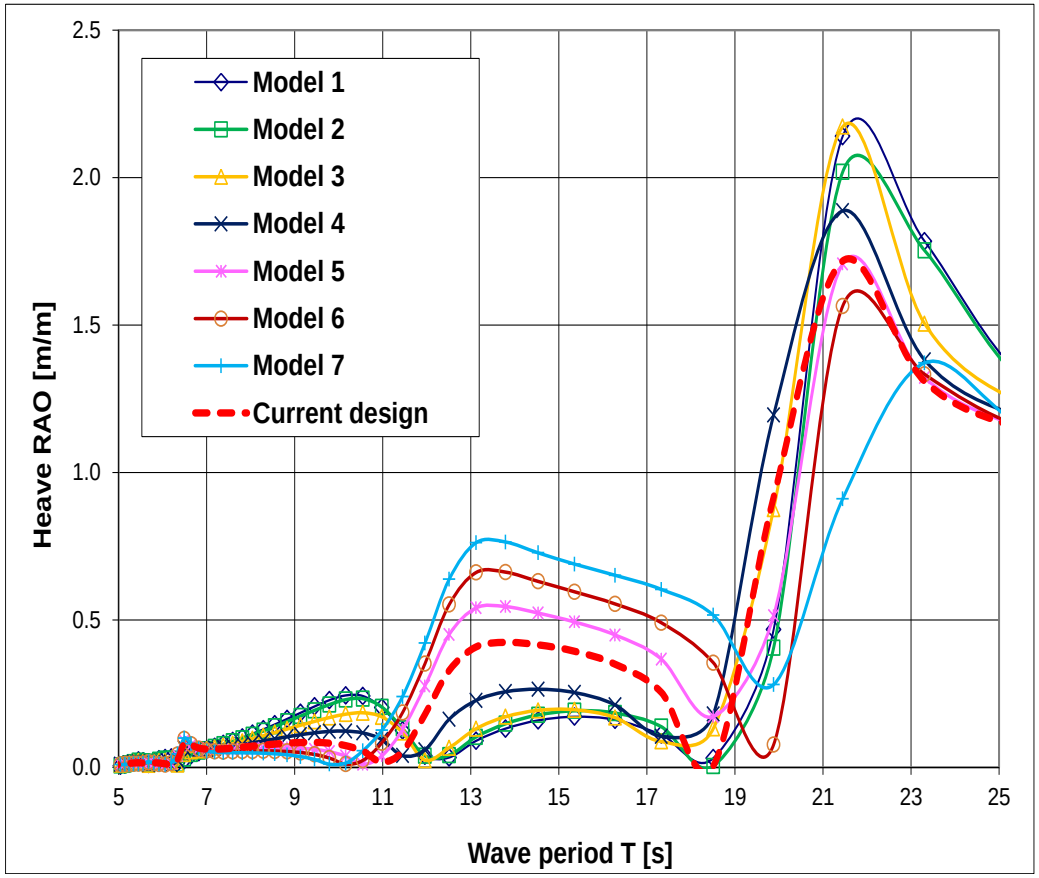


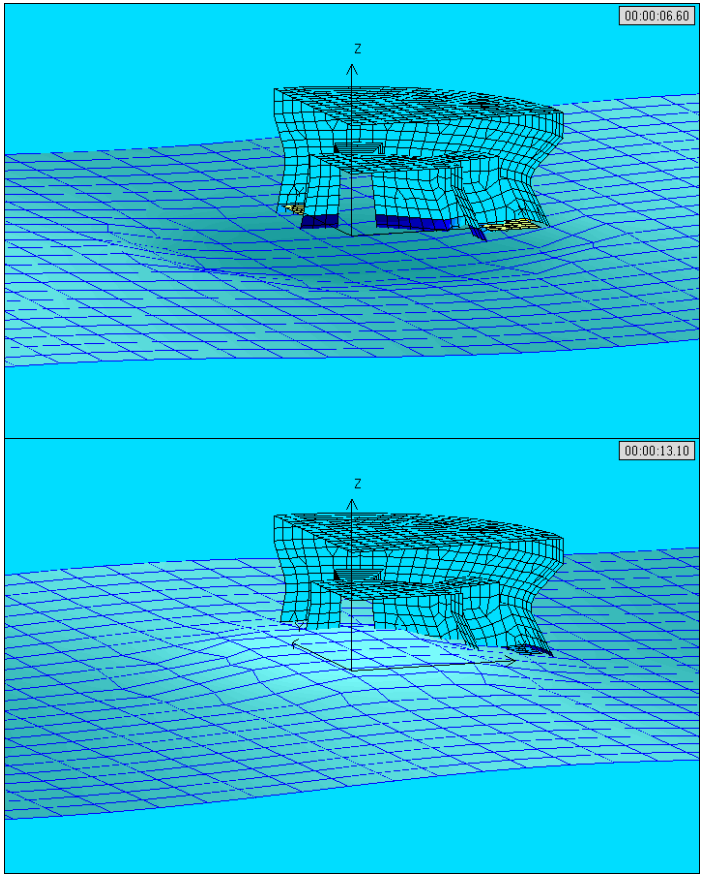
Optimization of hull shape



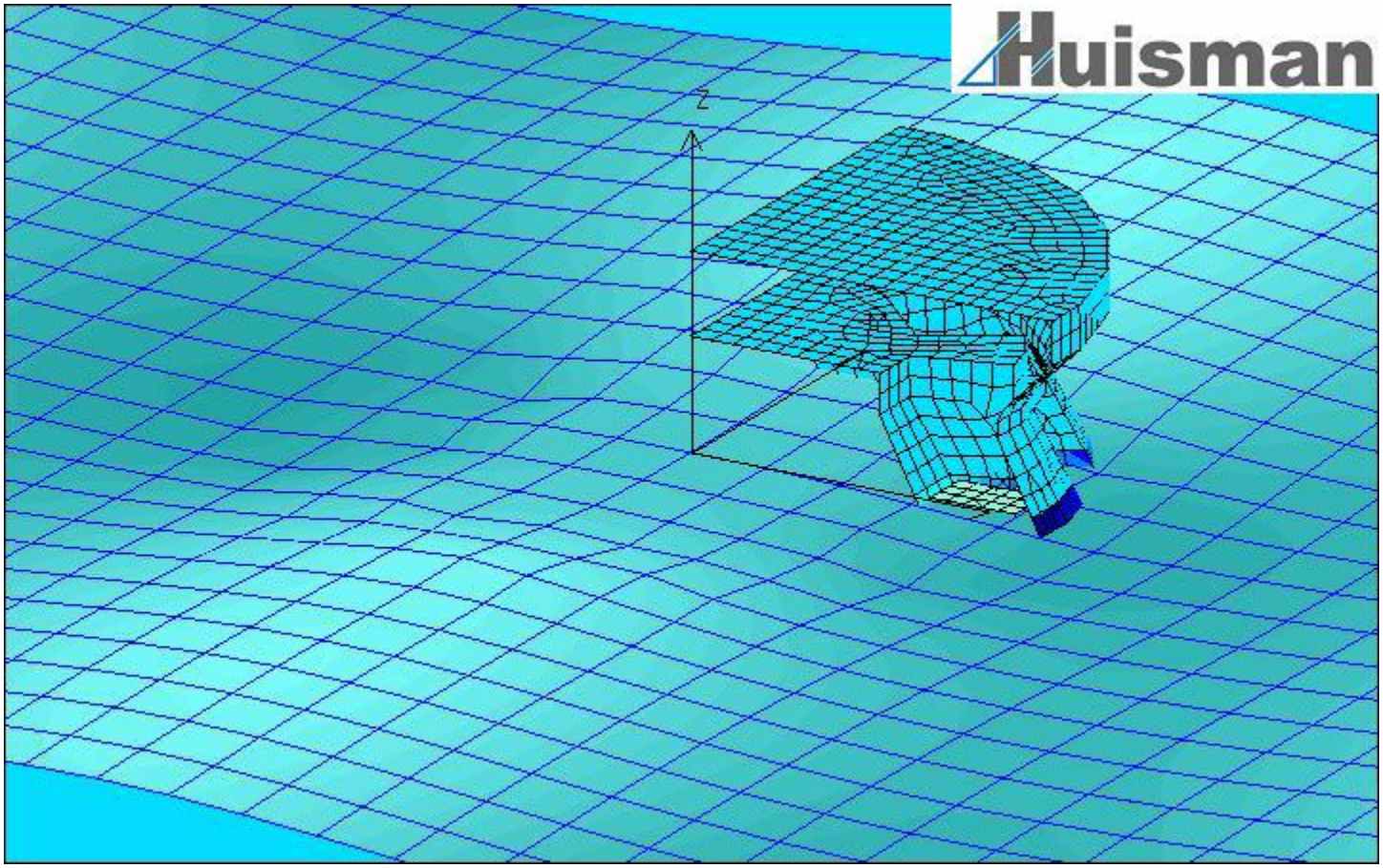


Optimization of hull shape





Optimization of hull shape



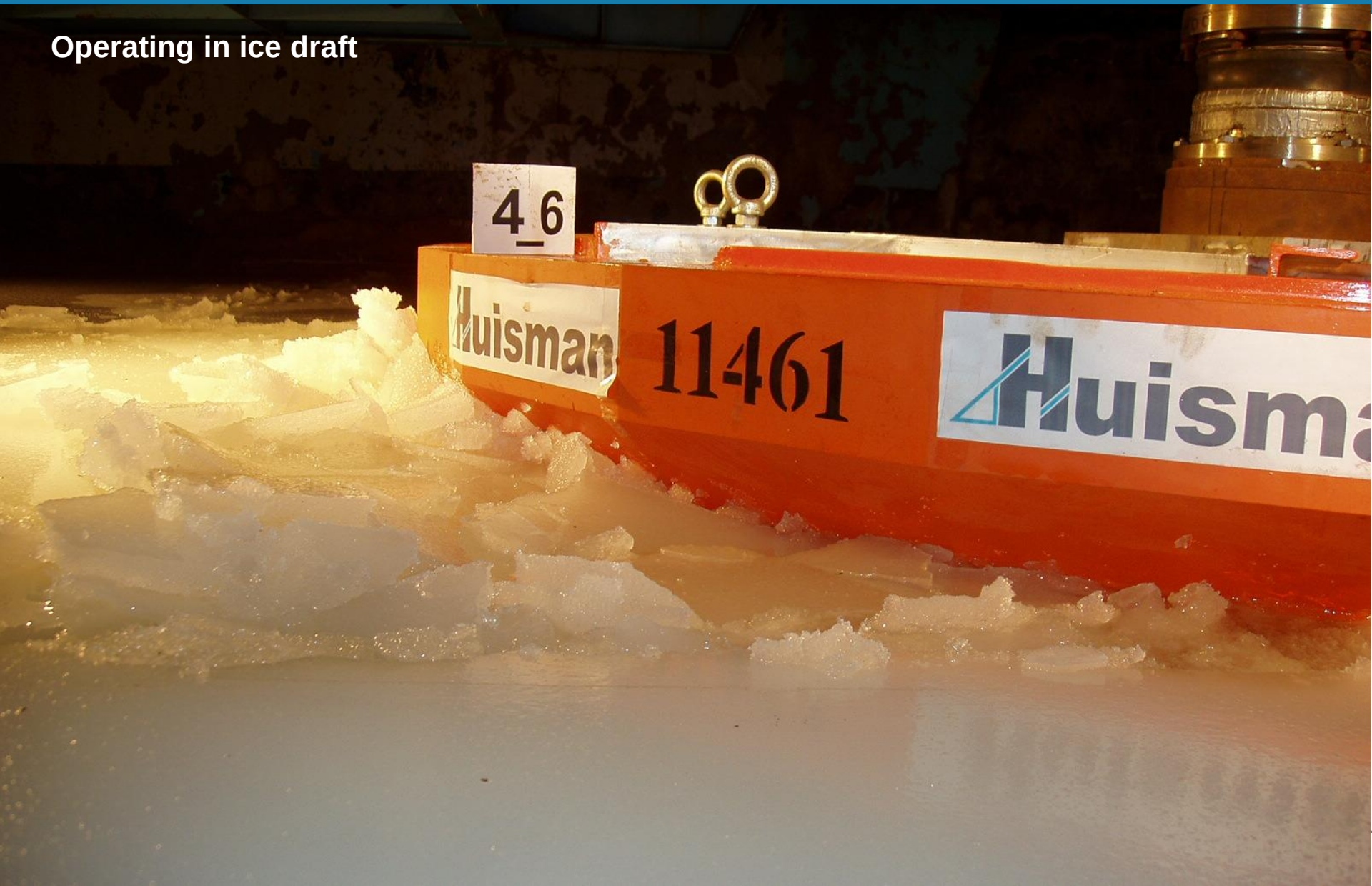
Model tests in ice tank

Model tests in ice December 2010 in Krylov Shipbuilding Research Institute in Saint-Petersburg

Date	Field No.	Draft	Ice thickness, m	Ice conditions
08.12.2010	1	Transit draft	1.0	Level ice
				Channel (40m) behind ice-breaker in level ice
				Broken ice (100 m)
				Broken ice (30 m)
10.12.2010	2	Transit draft	2.0	2 channels behind ice-breakers in level ice
				Broken ice (100 m)
				Broken ice (30 m)
15.12.2010	3	Operational ice draft	1.5	Level ice
				Level ice
				Broken ice (100 m)
17.12.2010	4	Operational ice draft	2.0	Level ice
				Level ice
				Broken ice (100 m)
22.12.2010	5	Operational ice draft	3.0 (consolidated layer)	Broken hummock, keel depth 18 m
				Broken hummock, keel depth 10 m

Additional test in March 2011, level ice 3.0m thick

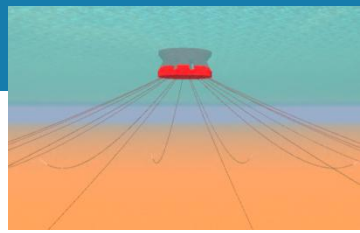
Model tests in ice tank



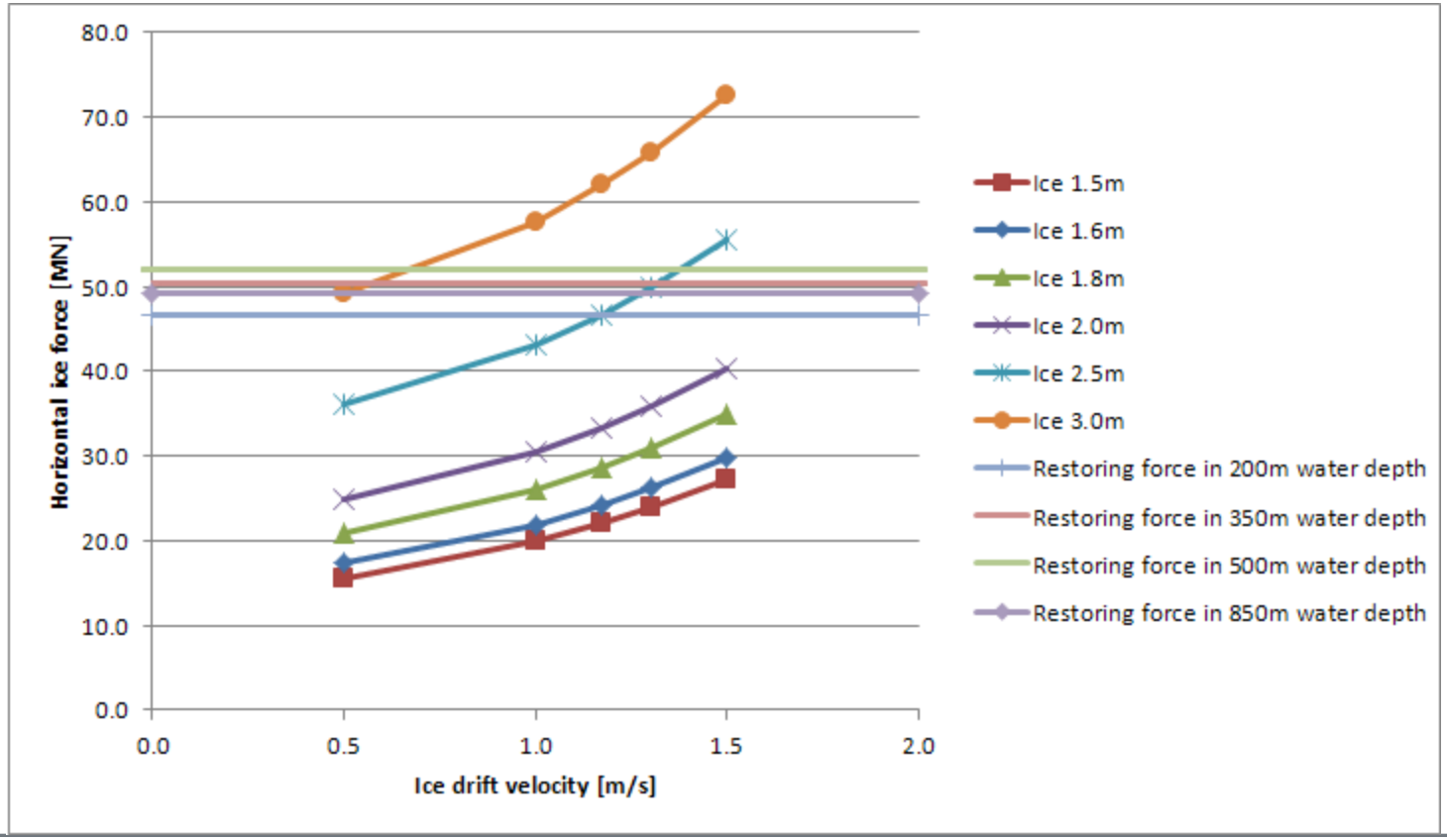
Model tests in ice tank

Model tests in ice tank

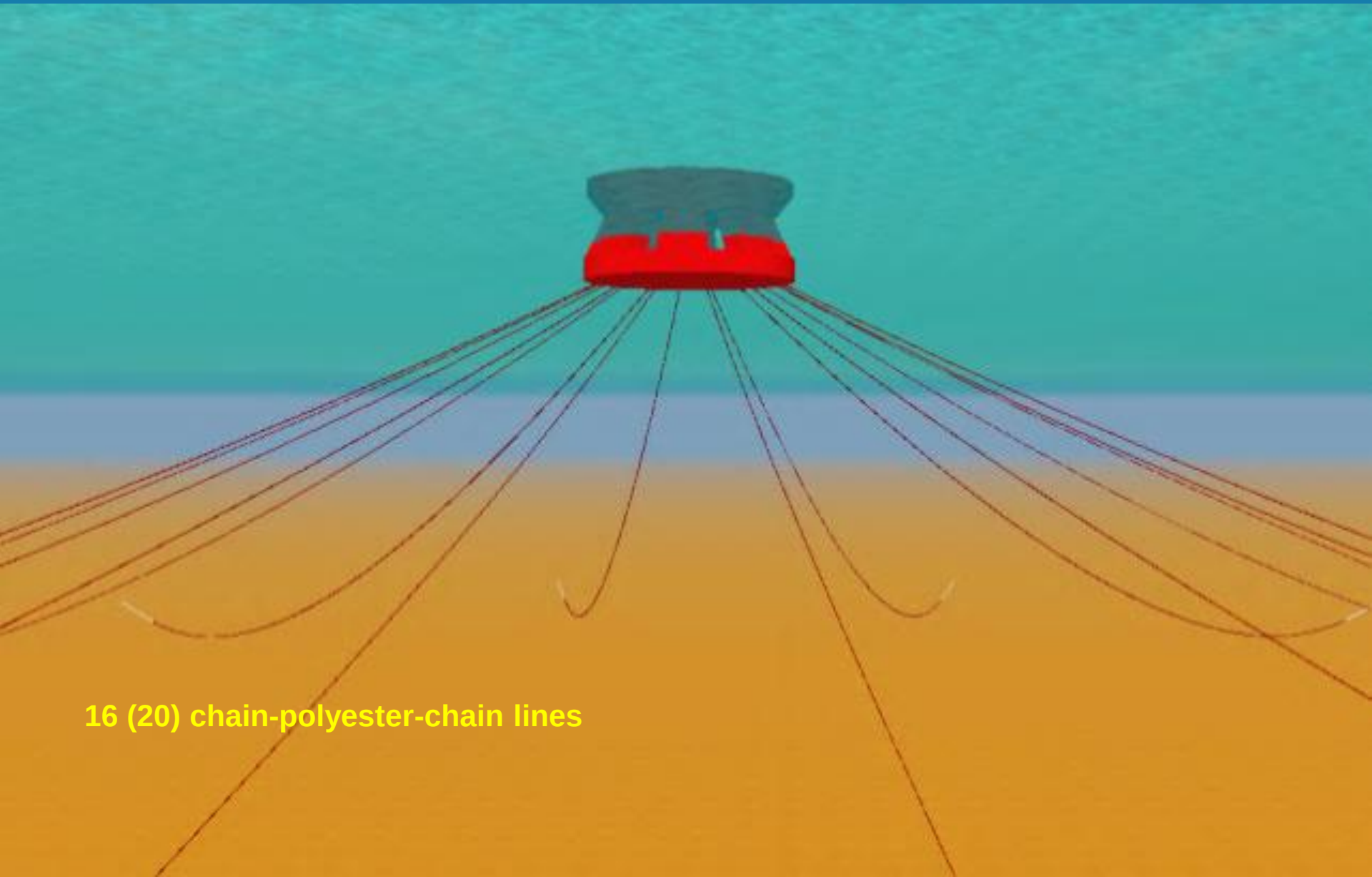
Mooring



- 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:



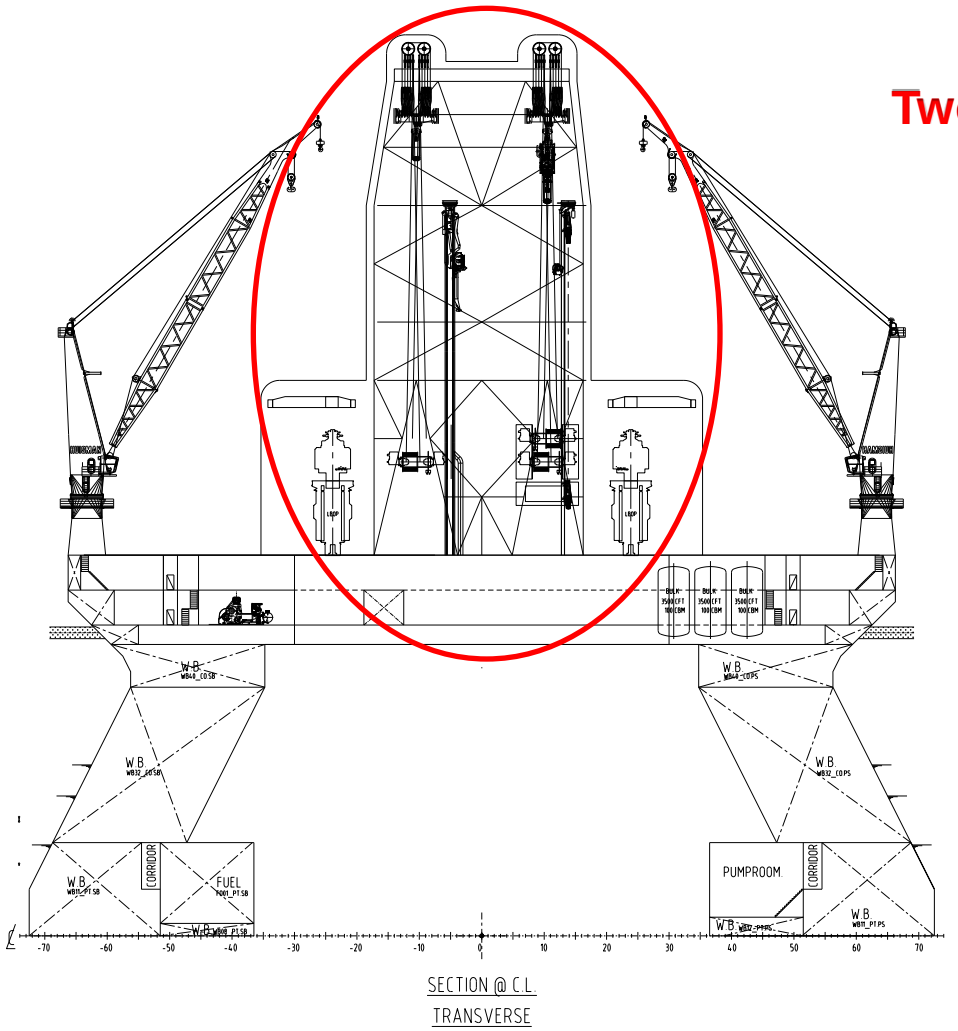
Mooring



16 (20) chain-polyester-chain lines

JBF Arctic

JBF Arctic – Dual Drilling Activity

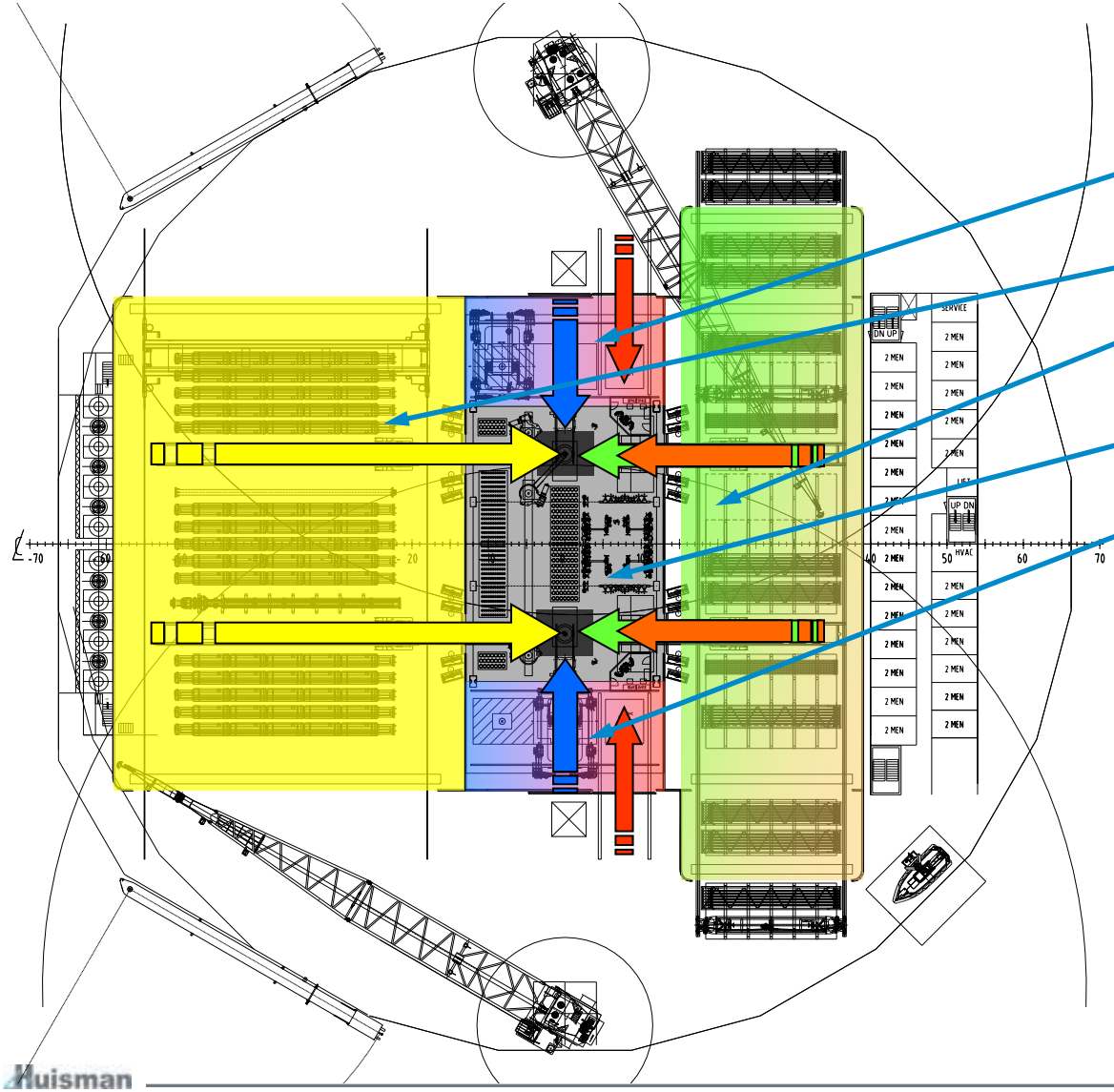


SECTION @ C.L.
TRANSVERSE

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

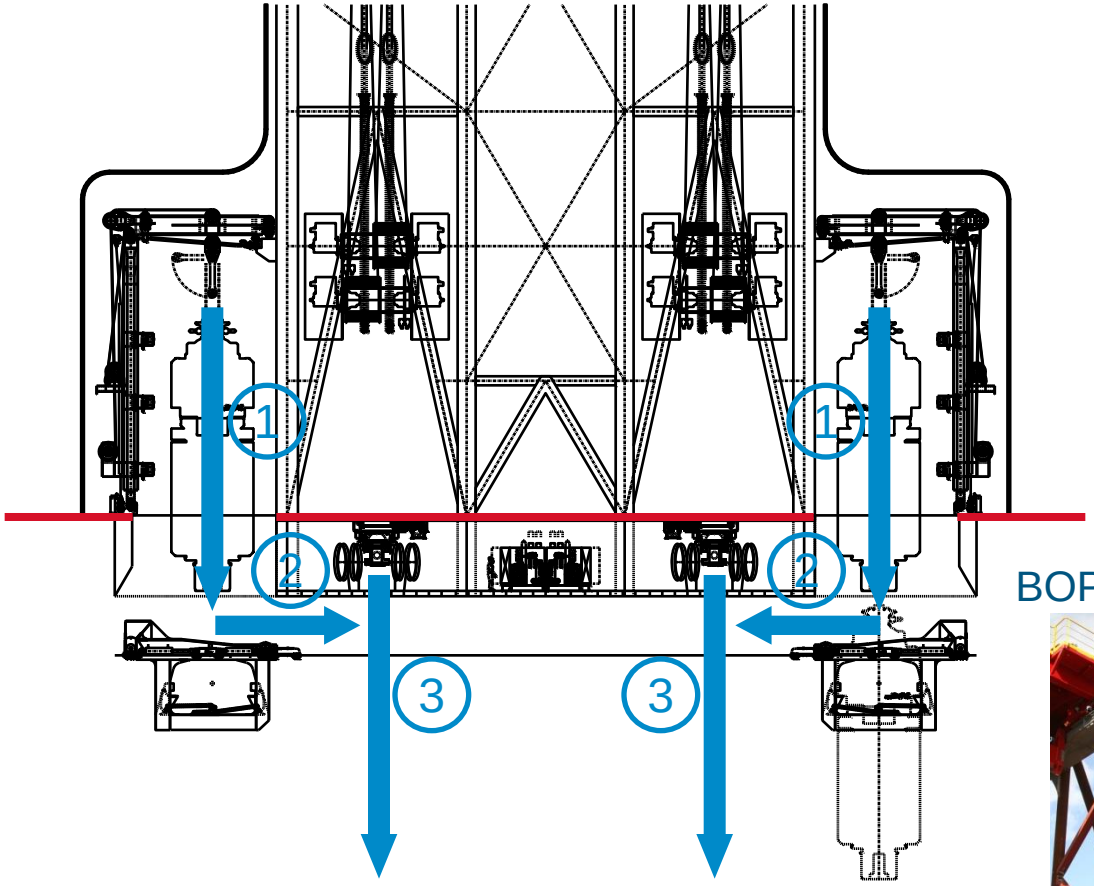
STAND BUILDING

BOP HANDLING

RISER HANDLING

X-MAS TREE HANDLING

JBF Arctic – BOP Handling



Drill floor 100% flush with main deck

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

BOP handling crane

Moonpool skid cart

JBF Arctic – Dual Drilling Activity

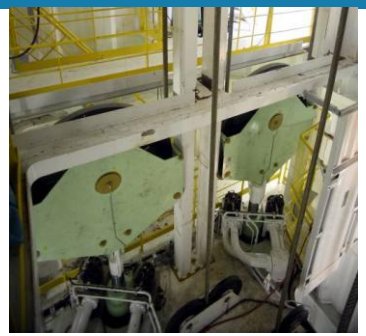
Dual drilling tower containing:

- 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

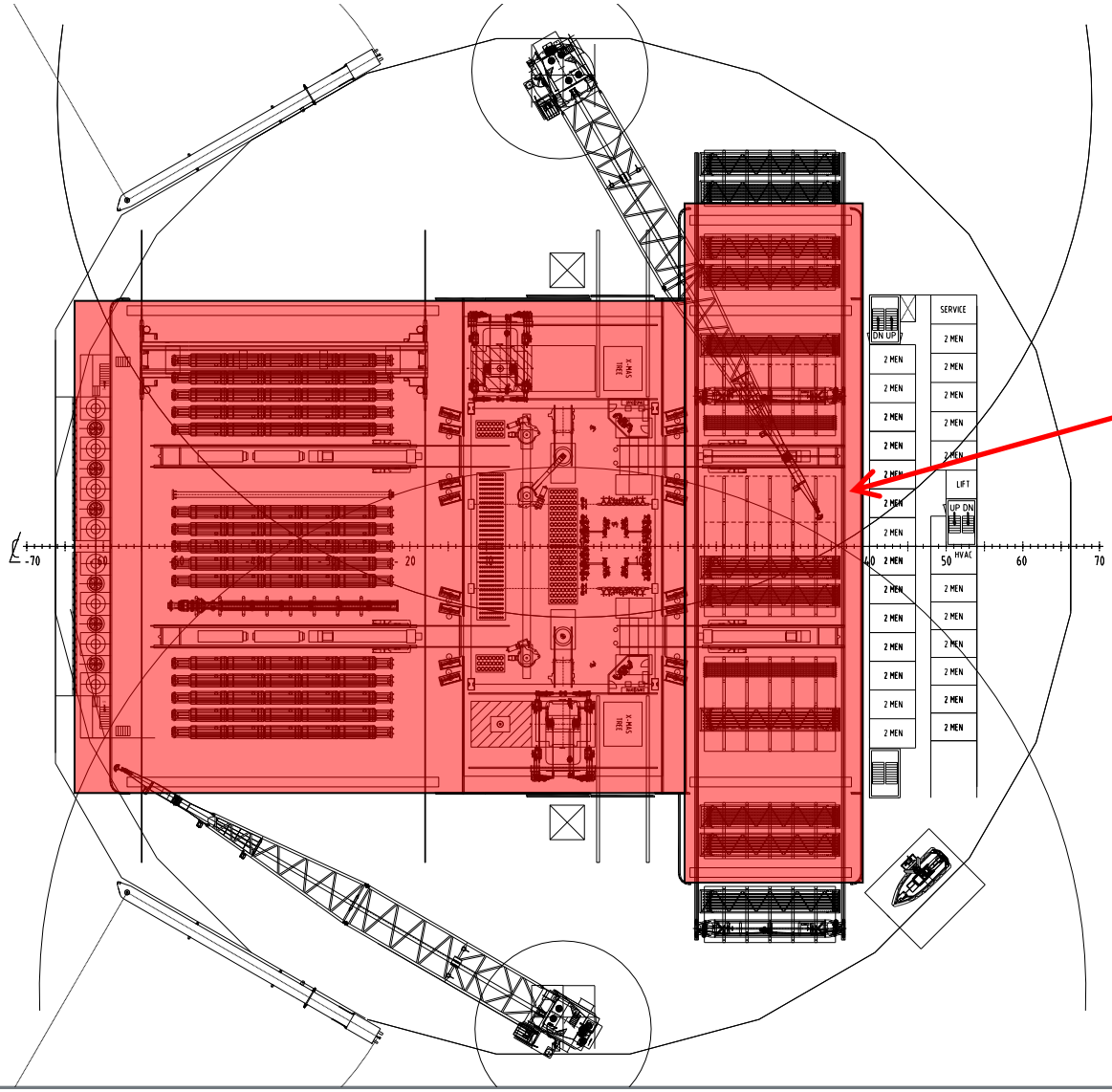
The large drill floor shares:

- 3 x pipe rackers
- Large drill pipe setback area
- Large casing setback area

All equipment inside protected environment



JBF Arctic – Closed Working Areas



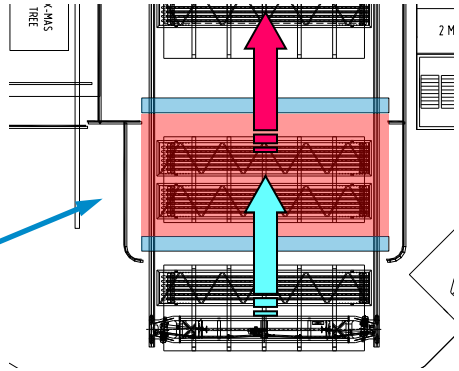
Closed working areas of 4400 m^2

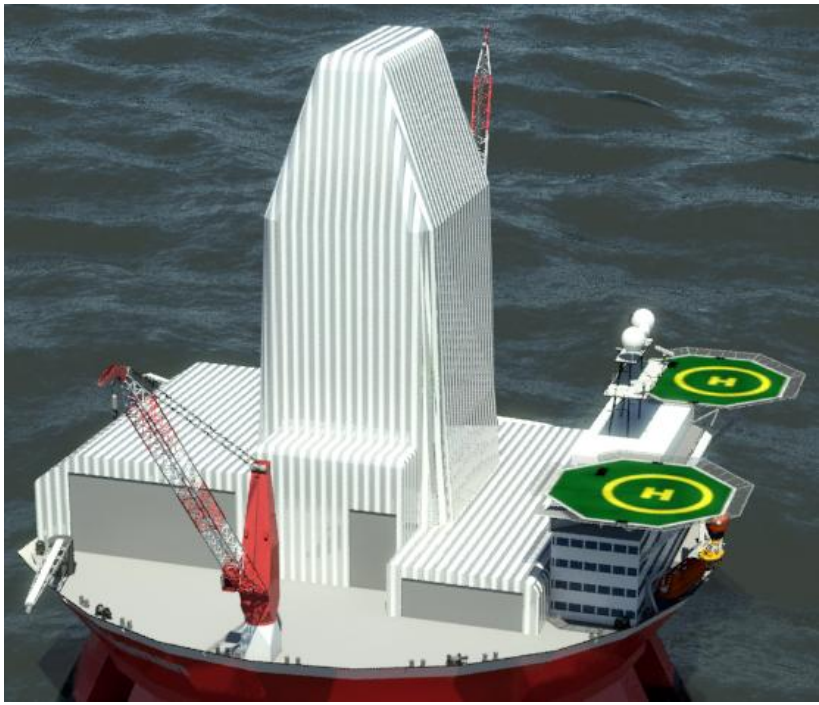
JBF Arctic – Isolated Enclosure

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*

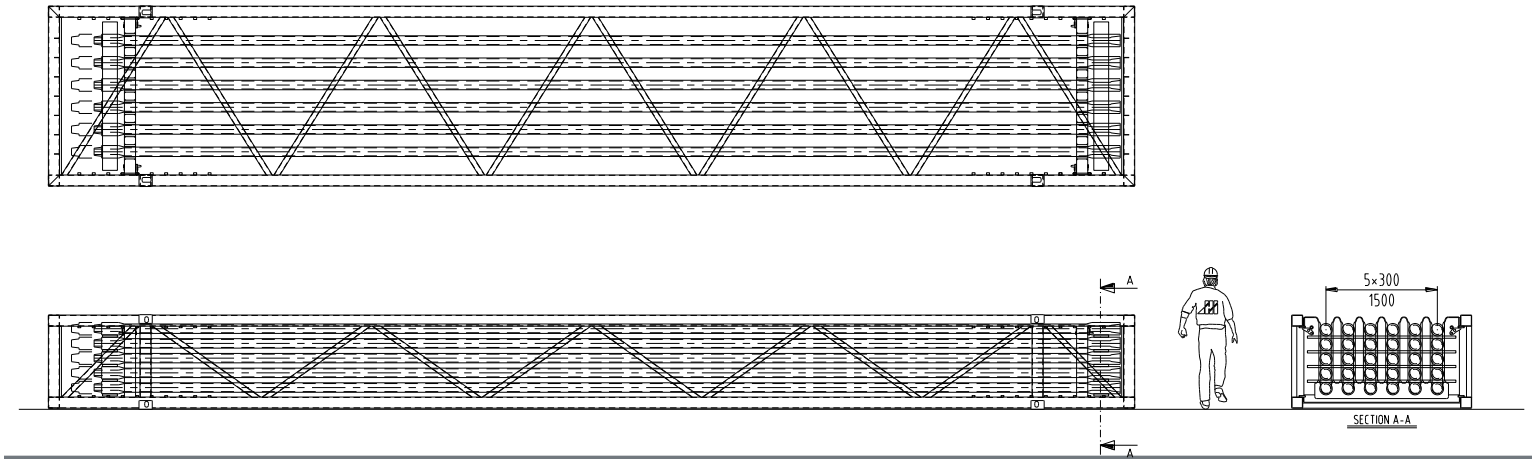




JBF Arctic – Containerized tubular handling

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?

http://arcticdove.com

JBF Arctic

Drilling in ice and in open waters

Huisman

Worldwide Lifting, Drilling and Subsea Solutions

Thank you for your attention

References

1. Marechal, G.Le, Anslot, P., Mravak, Z., Liferov, P. and Guennec, S. Le (2011). Design of a floating platform hull for arctic conditions in the Barents Sea, Arctic Technology Conference, Houston, TX, February 2011.
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