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**Olje og Gass Project:  
«HMS utfordringer i Nordområdene»  
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**«Design of MODUs for harsh environment operation»**

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# Moss Maritime Profile

## Core Business

- Licensing of Concepts
- Business Development
- Project Management
- Engineering Assistance



## Level of Expertise:

- Natural Gas
- Exploration and Production from Platforms
- Offshore Service Vessels
- Special Projects

## Disciplines:

- Process engineering
- Marine machinery, piping & EIT
- Naval architecture
- Structural engineering
- Project Development
- HSE



# Moss Maritime - a Leader in Maritime Technology





# Moss Semi-Submersible Drilling Platforms

✓ 22 platforms of Moss design are built





# Moss Semi-Submersible Drilling Platforms

## ✓ 5 more are contracted/under construction

- 3 new contracts 2012– 3 units ( 2 at HHI, 1 Jurong)
- 2 new contracts 2013- (2 units + options) (1 at HHI, 1+ at SHI)





# Anchor Handling Tug Supply

## Moss Maritime:

An experienced Offshore Support Vessel Designer

more than 30 years  
experience in  
designing support vessels  
for the offshore industry  
Including AHTS, Diving  
Support and Ice  
Breaker  
vessels

Moss 424



Moss 828 MISV



Moss 606



Moss 808-Ice





# Winterization of MODUs

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## Purpose

- Ensure that MODUs can operate safely and efficiently in cold climate

## Objectives

- Provide protection from freezing
- Provide protection from build-up of snow / ice
- Protection from wind chill



# Winterization Measures Categories

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- **Material selection**
- **Anti-icing / anti-freezing measures**
  - Enclosure
  - Heat-tracing / insulation
  - Anti-freeze fluid
  - Proper fluids & lubrication oils
  - Continuous flow piping
  - (Vibration and pneumatic panels)
- **De-icing measures**
  - Steam / hot water
  - Manual removal with shovel, etc.
- **Wind chill shielding**
  - Wind walls / enclosure
- **Heating of local (working) areas (hot air blowers)**



# Winterization Philosophy

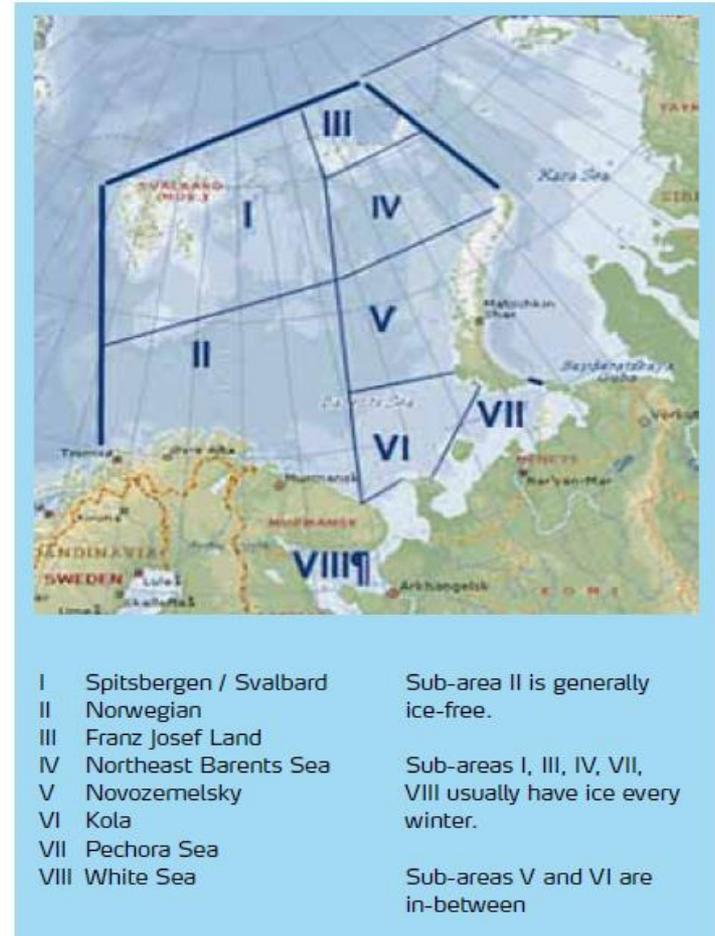
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- **Philosophy to be established by rig owner**
- **Should define / clarify**
  - Operation areas
  - Operation period of the year
  - Design air temperature for structure, equipment and systems (Based on LMDAT and extreme low air temperature)
  - Minimum water temperature (0 to -2 degrees)
  - Operation in open waters or ice-infested waters
- **Decides degree of need for winterization measures**
  - Barents Sea is not necessarily «arctic», ref. «Barents Sea 2020 – Phase III» report (p.61)



# Barents Sea - Regional breakdown

In the Barents Sea, environmental conditions vary substantially from north to south and east to west. In the judgment of the Work Group, the regional breakdown for the Barents Sea found in Annex B.16 of the draft ISO 19906 standard does not adequately differentiate the conditions, particularly from north to south. To better harmonize cold risk assessment and management for work operations in the Barents Sea, the Work Group therefore recommends using the climate zones defined by the Arctic and Antarctic Research Institute of St. Petersburg and used in the Barents 2020 Environmental Baseline report. <sup>1</sup>





# Design Temperatures

	Requirement
<b><u>Structural steel</u></b>	
Above transit waterline	LMDAT
Below transit water line	Lowest Sea Water Temp
Internal heated areas	> 0°C
<b><u>Marine equipment</u></b>	
Machinery components	LMDAT
Internal heated areas	> 0°C
Operating limit	LMDAT
<b><u>Drilling equipment</u></b>	
Equipment	LMDAT
Operation limit	LMDAT
<b><u>Safety Critical Equipment</u></b>	
Structure	LMDAT
Equipment	Lowest value on the annual mean daily <u>lowest</u> temp. or Lowest ever recorded
Operation limit	

# Recommended MODU Winterization Measures (1/3)

- **Weather shielding / enclosure**
  - Life boat- and muster stations
  - BOP-and X-mas tree handling areas
  - Drill floor including derrick (fully or partly cladded)
  - Anchor winches
  - Hose loading stations
  - Potential additional areas resulting from wind chill study





# Recommended MODU Winterization Measures (2/3)

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- **Anti-icing measures**
  - Primary escape / evacuation routes
  - Helicopter deck
  - Air vents in exposed areas
  - Drain systems in outdoor areas
  - Pipe lines in outdoor and unheated indoor areas (e.g fire line)
  - Water tanks in exposed areas (e.g ballast tanks in columns)
  - Navigation equipment



## **Recommended MODU Winterization Measures provided operation in ice-infested waters (3/3)**

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- 1. Hull strengthening (Ice class)**
- 2. Provision of riser protection structure**
- 3. Provision of anchor chain protection structure**
- 4. Fully enclosed derrick & working areas ?**



# Special area of concern: Effects of Weather Shielding / Enclosure

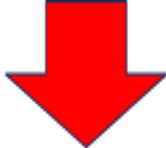
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## Positive

- Improved working environment

## Negative

- Reduced ventilation
- Increased confinement



- Increased explosion pressure in case of explosion
- Increased heat radiation in case of fire



# Special area of concern: Effects of Enclosure / Weather Shielding

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## Potential remedies

- Design with weather panels / explosion panels
- Rig design that reduces the need for manual operations in exposed areas during cold periods

***« The preferred solution is to rely on natural ventilation for weather protected hazardous areas »***

(Open platform design typically gives 100-200 Air Changes per Hour in hazardous areas 50 per cent of the time)



# General areas of concern («R&D issues») (1/2)

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- **Degree of enclosure of derrick and working areas (pipe deck, riser deck, etc.)**
  - Working environment
  - Safety (explosion risk)
  - Ventilation (natural/mechanical)
- **Design winterization air temperature for various operation areas in Barenst Sea**
- **Evacuation and rescue**
  - Long distances to support base and other facilities – Need for helicopter platform?
  - Traditional EER methods may not be appropriate for parts of the year (i.e. during operation in ice-infested waters)



# General areas of concern (R&D issues)

## (2/2)

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- **Communication / navigation at high latitudes**
  - Magnetic conditions
  - Lack of satellite coverage
- **Energy optimization**
- **Working environment**
  - Temperature / **Wind chill** / Darkness
  - Today's industrial standard (NORSOK S-002) probably drives the design to be more enclosed design than necessary which result in
    - increased confinement (= increased risk of explosion)
    - reduced line of sight

# Outdoor operations - NORSOK S-002 too conservative?

NORSOK S-002 (Sec. 5.8):

Wind chill index:  $WCI = 1.16 \times (10.45 + 10 \times U^{0.5} - U) \times (33 - T)$

		Temp	10°C	7,5°C	5°C	0°C	-2,5°C	-5°C	-7,5°C	-10°C	-12,5°C	-15°C	-17,5°C	-20°C
Wind (m/s)	Wind (km/h)	Wind (knot)												
0.0	0.0	0.0	279	309	339	400	430	461	491	521	552	582	612	642
5.0	18.0	9.7	742	823	903	1065	1145	1226	1307	1387	1468	1548	1629	1710
7.5	27.0	14.6	809	897	985	1161	1249	1337	1425	1513	1601	1689	1777	1865
10.0	36.0	19.4	856	949	1042	1228	1321	1414	1507	1600	1693	1786	1879	1972
12.5	45.0	24.3	889	985	1082	1275	1372	1468	1565	1661	1758	1854	1951	2048
15.0	54.0	29.2	912	1011	1110	1308	1408	1507	1606	1705	1804	1903	2002	2101
17.5	63.0	34.0	928	1029	1130	1331	1432	1533	1634	1735	1836	1937	2038	2138
20.0	72.0	38.9	938	1040	1142	1346	1448	1550	1652	1754	1856	1958	2060	2162
22.5	81.0	43.7	944	1047	1149	1355	1457	1560	1662	1765	1868	1970	2073	2175
25.0	90.0	48.6	946	1049	1151	1357	1460	1563	1665	1768	1871	1974	2077	2179
27.5	99.0	53.5	944	1047	1149	1355	1457	1560	1663	1765	1868	1971	2073	2176
30.0	108.0	58.3	940	1042	1144	1348	1450	1553	1655	1757	1859	1961	2063	2165

# Outdoor operations - NORSOK S-002 too conservative?

ISO 15743:2008 “Ergonomics of the thermal environment Cold workplaces, Risk assessment and management” provided a less conservative approach compared to NORSOK S-002

$$t_{wc} = 13.12 + 0.6215 \times t_{air} - 11.37 \times v_{10}^{0.16} + 0.3965 \times t_{air} \times v_{10}^{0.16}$$

↓

Wind (km/h) \ T <sub>air</sub> (°C)		T <sub>air</sub> (°C)											
		5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
Light air	5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
	10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
Gentle breeze	15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
	20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
Moderate breeze	25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
	30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
Fresh breeze	35	0	-7	-14	-20	-27	-33	-40	-47	-54	-60	-66	-73
	40	-1	-7	-14	-21	-27	-34	-41	-48	-55	-61	-68	-74
Strong breeze	45	-1	-8	-15	-21	-28	-35	-42	-48	-56	-62	-69	-75
	50	-1	-8	-15	-22	-29	-35	-42	-49	-57	-63	-69	-76
High wind	55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
	60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
Fresh gale	65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
	70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
Strong gale	75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
	80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

## Explanation of colours

Classification of risk	t <sub>wc</sub> (°C)	Effect
1	-10 to -24	Uncomfortable cold
2	-25 to -34	Very cold, risk of frost bits
3	-35 to -59	Biting cold, danger of frost bite of exposed skin after 10 minutes
4	-60 and cooler	Extreme cold, danger of frost bite of exposed skin after 2 minutes





## NORSOK S-002 – too conservative?

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- **Current version of NORSOK S-002 (wrt. to outdoor operations) results in more encloement of working areas than perhaps necessary which have the following negative consequences:**
  - Increased risk of explosion due to confinement
  - Reduced «line of sight» (crane operations)
  - (Weight / costs)
- **NORSOK S-002 stipulates unavailability shall be less than 2 % on a yearly basis – models do not at all have sufficient accuracy to verify such.**
- **«Barents 2020» states that NORSOK S-002 is too conservative wrt. to outdoor operations but the requirement is still in force and thus a challenge until next revision**



**Takk for oppmerksomheten!**

