Arctic Marine Operations Challenges & Recommendations
Volume 2  Gap Analysis Study Matrix

Final report of the Arctic Operations Handbook Joint Industry Project
Version 15-12-2013
EXECUTIVE SUMMARY

The Arctic Operations Handbook Joint Industry Project (JIP) was launched in February of 2012 supported by a number of companies and knowledge institutes. The JIP was initiated by a number of Dutch companies in the framework of the Maritime Innovation Program (MIP) and was awarded a subsidy from the Dutch Ministry of EL&I (Economic affairs, Agriculture & Innovation). With it the JIP participants committed to issue an open source document to ensure that the work from the JIP is offered to the international arctic offshore community and the general public for further use.

The participating companies have the ambition to execute projects in arctic areas, such as installation and operations of oil and gas production facilities. The term arctic as used here refers to areas where ice, permafrost and low temperatures may influence offshore operations, field development and decommissioning.

Currently, there is no specific standard for companies operating in arctic offshore areas. To support this industry and to ensure services can be provided in a safe manner with minimum environmental impact, it was proposed to prepare guidance/standards for such operations. This project has taken an important step in gathering existing rules & regulations, identifying the areas which require additional guidance, and has taken some steps in defining guidance. The focus is on the operational activities for installation of fixed, floating and subsea units, dredging, trenching, pipe laying and floating oil/gas production. Detailed design of facilities & equipment was not covered in this JIP as it is already supported through ISO 19906 for Arctic Offshore Structures.

The development of guidelines and regulations in modern industry are expected to be functional, goal based, as much as possible relying on procedures and technology already in general use and, in this case, focused on arctic operations.

As part of the work scope the JIP has taken the initiative to liaise with Class Societies, Arctic Governmental Authorities and international standards organizations such as ISO. A diversified group of Dutch operators and knowledge centers have assessed deficiencies in existing standards and it is therefore considered useful and beneficial for the ISO TC67 SC 8 and SC 7 to use this report when preparing their new ISO norms.

This Arctic Marine Operations Challenges & Recommendations Report presents existing rules & regulations, identifies the areas which require additional guidance, and in those cases where possible defines recommendations for arctic operations. The index used in this report is based on ISO 19901-6; Petroleum and natural gas industries — Specific requirements for offshore structures — Part 6: Marine operations. The index has been adjusted and complemented with aspects specific for arctic operations.
The following key observations/guidance have been gathered within the scope of this Joint Industry Project:

- It was noted from the gap analysis that there was limited (ISO) guidance for pipe lay, trenching and dredging operations, let alone for the arctic areas. It was therefore chosen to provide a number of best practices for these operations, considering the arctic environment. The efforts concentrated on the aspects that would be new in the arctic when comparing with open water operations in non-arctic areas.
- Site specific operations should be considered when planning and carrying out operations.
- Considerable effort was performed to align the knowledge on weather conditions and in particular on the requirements for monitoring and forecasting as well as the requirements for decision based tools.
- For the transportation & logistic aspects input relied heavily on the existing guidance for arctic shipping which is further developed and was evaluated and transferred to recommendations for the specific services of this guide.
- This report provides guidance as required specifically for contractors expecting to work in arctic areas on the aspects of health, safety, training and also stakeholder mapping.
- A framework is provided to perform environmental impact assessments both in early as well as detailed stages of design in order to ensure that impacts can be managed and mitigated.
- Specific attention was given to the evaluation of the loads on and the operation of disconnectable floating production units.

The other volumes of this report contain results of the gap analysis performed in the project as well as relevant results of the pilot projects of the Arctic Operations Handbook (AOH) JIP:

- The IceStream – Pilot project, described in volume 3, has shown that the egg code (which is a method to describe characteristics of ice fields), when used as a basis to establish a visualization of the ice field, can serve as input to numerical models with which ice loads can be predicted on floating structures. More field data is required to support development of new analytical models.
- The Environmental Impact – Pilot project, described in volume 4, has developed an enhanced approach (interaction of linked sensitivities) for understanding the environmental impact of operations in an early project stage in a semi-quantitative manner. Application of such an approach is recommended to assess, evaluate and reduce the environmental impact of operations in arctic areas.
- A state of the art review for marine icing on vessels has been performed and has been documented in volume 5, Marine icing on arctic offshore operations – Pilot project. It highlights that although there are many approaches, there is no common approach and no industry standard for marine icing calculations. It strongly recommends more field observations and improved prediction models to determine sea spray formation and icing accretion.
Key recommendations from the Arctic Operations Handbook JIP are:

- Prepare more detailed operational standards including waiting on weather and ice, uptime and risk and hazard management.
- Develop equipment standards especially for the niche operations in this report.
- Prepare ice management guidelines, in concert where possible with the ISO TC67 SC 8 Work group 4, ice management.
- Guidance text for marine operations in arctic conditions has been prepared in this report. It is recommended that this can be incorporation into ISO 19901-6, or other ISO documentation.
- Implementation of an operational ice level into the ISO documentation for defining the ice action at which the (vessel) position may no longer be retained, due to structural or station keeping capability.

List of participants

The following companies have participated in the Arctic Operations Handbook JIP:

Allseas Engineering B.V.
American Bureau of Shipping
Bluewater Energy Services B.V.
Canatec Associates International Ltd.
Delft University of Technology
Deltarcs
GustoMSC B.V.
Heerema Marine Contractors B.V. [Project Coordinator]
Huisman Equipment B.V.
Imares, Institute within Stichting Dienst Landbouwkundig Onderzoek
IntecSea The Netherlands
MARIN
IHC Merwede
Royal Boskalis Westminster N.V.
Shell Global Solutions International B.V.
TNO
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1.0 ARCTIC GAP ANALYSIS VOLUME 2A

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1.2 Chapter 6 Organization, documentation and planning
1.3 Chapter 8 Weight control
1.4 Chapter 9 Stability
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1.9 Chapter 14 Construction and outfitting afloat
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1.19 Chapter 27 Dredging
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SECTION 2

WG2 GAP VOLUME 2B
2.0 WG2 GAP VOLUME 2B

2.1 Staff selection and training
2.2 Safety Management
2.3 Emergency Response
2.4 Escape, Evacuation and Rescue
2.5 Waste Management
2.6 3D Metocean & Environment
7.2 Weather-restricted/weather-unrestricted operations

Defines operations, design impact and weather margins

6.3 Arctic Factory Acceptance Testing

19906

Ice conditions

0

1 week to 1 month 10 year environmental condition (seasonal)

High

Fewer than 3 days Based on specific weather window

1

and

5

7.4 Oceanography

19906

Medium

It

1

7.5 Weather windows

19906-4

Low

1

Operational duration

Add a Section specifically pertaining to the needs to measure and forecast winds, temp and current for people, workability and safety as well as station keeping and the not only for ice management

High

consistent needed; check sea states for ice conditions

7.7 Monitoring & forecasting

Table B.1 — General guidance for ice conditions

Check for operation, sea ice impact on operations and monitoring requirements

7.3 Metocean conditions (to include Meteorology & Oceanography)

19906-4

High

Medium

WG3; WG5 for the Arctic

WG3;

WG5

WG3 Design

WG3 Design

WG3 Design

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7.7.1 Weather monitoring

**Wave and swell conditions**
- Wave and swell conditions shall be considered in the planning and engineering of marine operations. For the description of the wave parameters, reference is made to ISO 19901-1.
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**Current conditions**
- Current conditions shall be considered in the planning and engineering of marine operations. For the description of the current parameters, reference is made to ISO 19901-1.

**Ice management plan**
- An ice management plan shall be prepared, describing the actions it is necessary to take in response to such ice conditions. This plan shall specify when it is necessary to suspend operations and the method or order of suspension. This plan shall also make provision for unprepared or unusually severe ice conditions.

**Contingency plans**
- Contingency plans should address ice conditions that exceed forecasts and operational limits. Operations under limited visibility should be given due consideration. Capabilities to detect icebergs and sea ice by survey vessels and advance scouting in case of reduced visibility should be provided where appropriate.

**Contingency equipment**
- Contingency equipment should be compatible with that of the ice patrol or reconnaissance aircraft. Due account should be taken of replacement supplies for all types of essential equipment.

**On-site monitoring**
- Wave and swell conditions, current magnitude and direction, wind magnitude and direction, air temperature and visibility, and sea conditions shall be checked.

**Design**
- Wave condition's statistical extremes for the area and season concerned. Not relevant for AOH, except for the weather conditions in relation to the operational environment for the area and season concerned. Design issue; delete.

**Further study work**
- All relevant parameters should be reviewed and enhanced.

**Check parameters individually and in combinations**
- Check parameters individually and in combinations.

**Other factors and combinations of factors that can be critical**
- Other factors and combinations of factors that can be critical and shall be considered include:
  - Current, wind, wave and ice conditions.
  - Water temperature, including tidal water surge.
  - Standing requirement for WP2
  - See Row 258
  - See Row 258
  - See Row 258
  - See Row 258
  - See Row 258

**Index item**
- A list is the main support for the Section BMO monitoring. Not to be enhanced.

**Reference**
- This plan shall specify when it is necessary to suspend operations and the method or order of suspension. Such criteria shall include, but not be limited to:

**Priority**
- Priority: High

**Assessment**
- Further study work: JIP; assessment.
For the design metocean parameters, the directionality of waves, wind and current shall be considered.
For weather-unrestricted operations, the operational metocean criteria are the same as the design criteria, although lower values can be set for practical reasons.
For weather-restricted operations, the operational metocean criteria are that set of values for the metocean parameters (wind, wave, current, water level, visibility, water density, water salinity, water temperature, marine growth and so on), for which design calculations are carried out, and which the structure and/or operations are checked.

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For weather-restricted operations, the operational metocean criteria are that set of values for the metocean parameters (wind, wave, current, water level, visibility, water density, water salinity, water temperature, marine growth and so on), which are not exceeded at the start of the operation and which are forecast not to be exceeded for the duration of the operation, allowing for contingencies.

Design items, not for WG2 and not for ADQ1

Statistics shall be compiled in a form useful for probabilistic analysis. Data can be obtained from direct observations at a location, interpretation of satellite imagery, historical information at the geographic region of the installation, and interpretation of historical information from a nearby site or on a similar geographical region.

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Meteorological information should be obtained from official weather bureaus, and supplemented by local observations.

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Environmental Impact Assessment EIA

- float-out; needed?

Navigator qualifications

7.7.3 IT Information and communication technology

- the wind speed should indicate 1 min and 1 h means and also indicate wind gusts;
- The wind speed should indicate 1 min and 1 h means and also indicate wind gusts;
- The wind speed should indicate 1 min and 1 h means and also indicate wind gusts;

- Forecasting

S 3.5

2

7.7.2 Forecasting

For complex and/or long-weather-restricted operations, forecaster(s) with local experience shall preferably be present on-site to check the local situation and provide regular weather briefing based on forecasts from two independent sources. This applies to major marine operations such as these examples:

- add ice requirements and local and global monitoring needs; add ice forecasts; use ISO test since it is applicable
- add ice requirements and local and global monitoring needs; add ice forecasts; use ISO test since it is applicable
- add ice requirements and local and global monitoring needs; add ice forecasts; use ISO test since it is applicable
- add ice requirements and local and global monitoring needs; add ice forecasts; use ISO test since it is applicable

- Consequence of the forecasts

S 7.7.2

- Good section; add
- Good section; add
- Good section; add
- Good section; add

- residents; assistance to WG4
- residents; assistance to WG4
- residents; assistance to WG4
- residents; assistance to WG4

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<th>Recommendations for new or additional guidance</th>
<th>Priority: High</th>
<th>Medium</th>
<th>Low</th>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>7.1.3 Information and communication tech</td>
<td>Database of institutional contacts</td>
<td><strong>B</strong> is an important requirement for future operations monitoring. All offshore operations must be monitored such that all have access to key information and the most reliable access and use; exchange of data is key to safe operation; certain data must be exchanged either by being exchanged. Systems should be in place to monitor data received, allow system to be stored safely filed, allow all data to be exchanged effectively and can be sent around; data formats to be checked and standardized.</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>7.8 Earthquake</td>
<td>Possible effects of earthquakes (not tsunamogenic effects as tsunami) on structures during marine operations, if applicable, should be taken into account.</td>
<td><strong>A</strong> that a piece of guidance text will be drafted, or <strong>B</strong> that further study/work/assessment should be performed, or <strong>C</strong> that no further action is required.</td>
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<tr>
<td>8</td>
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<td>9</td>
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<td>For further work needed specifically on hazardous ice conditions, icebergs and other</td>
<td></td>
<td>Medium</td>
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</table>

### Notes

- **A** - Adoption: more work related to the effects of noise and disturbances on wildlife in Arctic conditions;
- **B** - Adoption: more work needed on the effects of noise and disturbances on wildlife in Arctic conditions;
- **C** - Adoption: this is not part of monitoring, or more related to EIS in WG4.
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<tr>
<th>Section</th>
<th>Title</th>
<th>Comments</th>
<th>Recommendations for new or additional guidance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.10</td>
<td>Environment &amp; ecosystem monitoring</td>
<td>Weather windows should be developed based on thresholds of the key sensitive parameters of the operation, the number of data sources and the quality of the available data.</td>
<td>a) That a piece of guidance text will be drafted, or b) That further study work / assessment should be performed, or c) That no further action is required.</td>
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<tr>
<td>7.11</td>
<td>Seabed stations</td>
<td>The station network for field-specific monitoring should be finalised once the installation(s) and local and global environmental conditions are determined. New industrial activities and results from monitoring may also call for the establishment of new stations.</td>
<td>a) That additional work may be required to comply with local and global environmental conditions.</td>
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<tr>
<td>7.12</td>
<td>Surveys</td>
<td></td>
<td>a) That a piece of guidance text will be drafted, or b) That further study work / assessment should be performed, or c) That no further action is required.</td>
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### Table 1: Recommendations for new or additional guidance

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<th>Particular</th>
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<td>Ice impact</td>
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<td>Check with ice group.</td>
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<tr>
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<td>Check the relation between the number of stations and the area of operations / severity of conditions.</td>
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### Table 2: Survey areas

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<td>Local and global</td>
<td>Seismic surveys and inspections of existing equipment in areas with sea ice.</td>
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<tr>
<td>North Sea</td>
<td>Seismic surveys and inspections of existing equipment in areas with sea ice.</td>
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### Table 3: Monitoring of environmental conditions

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</tr>
</tbody>
</table>
In an Arctic environment (depending on severity class) review need to perform interim inclining test

- Review by appropriate parties

- Add winterisation considerations

- Identify manual override options applicable for arctic climate

- Ability to access / control / work at ballasting control areas and winch control areas

- Ability to access / control / work at ballasting control areas and winch control areas

- Add winterisation considerations

- Ability to access / control / work at ballasting control areas and winch control areas

- Ability to access / control / work at ballasting control areas and winch control areas
The table below provides a structured view of the document content:

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
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<th>Comments</th>
<th>Recommendations for New or Additional Guidance</th>
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<tbody>
<tr>
<td>16.3</td>
<td>Fluke Anchor Installation</td>
<td>ISO 19906-8:1998</td>
<td>Low</td>
<td>Indicate guidance for additional considerations in the event of cold temperature operations.</td>
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<tr>
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<td>Low</td>
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<td>Lifting operations</td>
<td>ISO 19911-4:2000</td>
<td>Low</td>
<td>Indicate guidance for additional considerations in the event of cold temperature operations.</td>
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<td>Crew Change</td>
<td>BS 6349-5:1991, API Recommended</td>
<td>Low</td>
<td>Indicate guidance for additional considerations in the event of cold temperature operations.</td>
</tr>
</tbody>
</table>

### Additional Guidance

- **Ice Management**
  - Code implies that ice management and ice forecasting system should be in place including prediction of big and pole ice. If ice is unexpected, consider additional planning and training.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
  - Includes recommendations for new or additional guidance.

- **Transport Logistics**
  - Code implies that transport logistics should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More guidance is required on selection of transport vessels and systems for cold temperature operations.
  - Includes recommendations for new or additional guidance.

- **Structural Decommissioning**
  - Code implies that structural decommissioning should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
  - Includes recommendations for new or additional guidance.

### Further Study Work

- **Fluke Anchor Installation**
  - Code implies that fluke anchor installation should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
  - Includes recommendations for new or additional guidance.

- **Plate Anchor Installation**
  - Code implies that plate anchor installation should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
  - Includes recommendations for new or additional guidance.

- **Lifting Operations**
  - Code implies that lifting operations should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
  - Includes recommendations for new or additional guidance.

- **Transport Logistics**
  - Code implies that transport logistics should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
  - More quantitative guidance is required in the estimation of ice regime including IDT for specific dredging activities.
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- **Structural Decommissioning**
  - Code implies that structural decommissioning should be considered for temporary moored vessels to ensure safe and efficient operations during cold temperature operations.
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- a) That a piece of guidance text will be drafted, or
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<td>Welding (root, filler, gap) multiple stations</td>
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<td>Move vessel (or its sections) over multi joint length, pay-off</td>
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<td>Several solutions exist: suction pile, anchor, deadman anchor, driven pile, existing structure (jacket, template)</td>
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<td>Pipe Lay Activities (J,S,R lay)</td>
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<td></td>
<td>Offshore standard DNV-OS-F101</td>
<td>Sec. 4 - B100</td>
<td>Effects from the following phenomena are the minimum to be considered when establishing functional loads: changed axial friction due to freezing</td>
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<td></td>
<td>Offshore standard DNV-OS-F101</td>
<td>Sec. 4 - C400</td>
<td>In areas where ice may develop or drift, the possibility of ice loads on the pipeline system shall be considered. Guidance note: ice loads may be due to ice frost on the pipeline system itself, or partly due to freezing, or combination of these.</td>
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</tbody>
</table>
Sec. 4 - C 402 The possibility of ice scouring and impacts from drifting ice shall be considered for shore approaches and areas where ice may interfere with the vessel and the submarine pipeline system. Ice increased hydrodynamic loading due to presence of ice shall be considered. Ice in case of ice frozen to parts of the submarine pipeline system or vessels, (e.g. due to sea spray) the following forces shall be considered: weight of the ice, impact forces due to flow of the ice, forces due to expansion of the ice and increased wind, waves and current forces due to increased exposed area. Ice forces from floating ice shall be calculated according to recognized theory. Due attention shall be paid to the mechanical properties of the ice, contact area, shape of structure, direction of ice movements, etc. The oscillating nature of the ice forces (build-up of lateral force and fracture of moving ice) shall be accounted. Where forces due to aerial ice motion will govern structural dimensions, model testing of the ice may be required.

Sec. 4 - C 406 Combinations of characteristic environmental loads in terms of return period. 100-year for both permanent and temporary conditions.

Sec. 8 - F400 Icing shall be considered for the loading capacity of temporary linepipe storage and transportation.

ISO 19906:2010 A) Welding consumables shall be selected with due consideration given to minimizing preferential corrosion of welded connections. B) Materials and welding procedures adapted to the actual temperatures during welding and during the design service life on site shall be used.

ISO 19906:2010 A) Deploy equipment for metrology (measurement of flange orientations and relative positions) B) Lifting operations shall be performed with due consideration given to minimizing preferential corrosion of welded connections. C) All materials and welding procedures are adapted to the actual temperatures during welding and during the design service life on site.

ISO 19901-6:2009 17 Offshore installation operations

ISO 19901-6:2009 17 Offshore installation operations

ISO 19901-6:2009 17 Offshore installation operations

ISO 19901-6:2009 17 Offshore installation operations
29.3 Offloading (tanker)

The following gaps are identified in the existing guidelines with respect to Arctic offloading operations:

- Ice load prediction on shuttle tankers in free sailing condition as well as when moored to the floating production vessel, including effects of passive aids or active ice management (see other WP)
- Maneuverability of shuttle tankers in (broken) ice, especially when approaching the insured production vessel.
- Ice load prediction on combined storage and shuttle tanker and the effects of passive aids or active ice management (see other WP)
- Guidelines on offloading philosophy and downtime assessment of tandem offloading in (broken) ice
- Remote sensing techniques and risk assessments based on historic data base and operational database (not base before other than SAG and a few recent offloading towers), i.e. ice drift forecasting, identification of hazardous ice, etc.
- Check for above additions
- Visibility, ice, ballast water, deck water, snow cover, safe access on deck to all equipment, EER, access to and from

Recommendations for new or additional guidance:
- a) That a piece of guidance text will be drafted, or
- b) That further study / work / assessment should be performed, or
- c) That no further action is required.

Priority: High

29.5 Disconnection Facility

In Section 2.6.2 is explained that no general rules, regulations, guidelines or standards are available that describe the specific operation of disconnection of a floating production platform. Neither ISO 19906, nor ISO 19901 cover this quite special, field dependent procedure. Obviously, Arctic conditions will affect the operation of disconnection, as explained in Section 2.2.3. The following documents provide information with respect to the general guidelines for Arctic (disconnection) operations:

- ISO 19906
- Barents 2020, phase 4
- Arctic FPSO – Technical Feasibilities and Challenges, OMAE2012-83028, Guang Li, SBM Atlantia, Houston, TX, USA

The above guidelines are not developed for disconnection operations. As guidelines for disconnect operations in non-Arctic climates are developed on a project-by-project basis, it is recommended to develop the guidelines or procedures for this operation in arctic conditions also on a project-by-project basis.

Priority: Low

29.7 Stationkeeping

Guidelines are needed to cover the operational aspects mentioned in section 2.3.3., and which are specific for operation in Arctic conditions. The following topics can be mentioned as potential gaps:

- Mooring integrity monitoring and assessment
- Ice load forecasting to support strategies for shut-down/disconnection
- Requirements on ice management systems
- Ice drift and risk analysis
- Safety/reliability/redundancy requirements to systems needed in a potential disconnection scenario.
- Training and testing requirements

Recommendations for new or additional guidance:
- a) That a piece of guidance text will be drafted, or
- b) That further study / work / assessment should be performed, or
- c) That no further action is required.

Priority: High

29.8 Re-connection Facility

The above guidelines are not developed for reconnection operations. As guidelines for reconnect operations in non-Arctic climates are developed on a project-by-project basis, it is recommended to develop the guidelines or procedures for this operation in arctic conditions also on a project-by-project basis.

Priority: Low

Annex A (informative) Additional information and guidance
A.1 General
A.2 Guidance for 6.6.2: Required or recommended documentation
A.3 Guidance for 11.46: Loadout manual
A.4 Guidance for 13.8: Transport manual
A.5 Guidance for 17.2: Operation manual
A.6 Guidance for 18.4: Bumper and guide boats
Annex B (informative) Regional information
B.1 Introduction
B.2 Canada
Bibliography
SECTION 2

WG2 GAP VOLUME 2B
2.0  WG2 GAP VOLUME 2B

2.1  Staff selection and training
2.2  Safety Management
2.3  Emergency Response
2.4  Escape, Evacuation and Rescue
2.5  Waste Management
2.6  3D Metocean & Environment
### Staff selection and training

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<th>Sea ice and icebergs</th>
<th>Seabed</th>
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<td>Water depth</td>
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<td>Broken ice conditions (coverage)</td>
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<td>Ice condition (drifting)</td>
<td>Ice surface features</td>
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<td>Other classes as function of season</td>
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<tr>
<td>Permafrost</td>
<td>Seabed scouring effect</td>
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<tr>
<td>Boulders</td>
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</tbody>
</table>

#### MEDICAL SUPPORT

- General
- Medics on board: Training
- First aid
- Psychological support
- Experience

#### SELECTION AND TRAINING

- General
- Gender
- Ethnicity
- Age
- Familiarization
- Training session
- Drills
- Documentation

#### FACILITIES

- General
- Nutrition
- Alcohol consumption
- PPE
- Other
- Clothing
- Accommodation
- Other

#### STAFF AND CREW

- General
- Personnel on board
- Personnel on bridge
- EER & ER team\Firefighting team (other matrises)

= Major challenge
### Safety Management

#### CONDITIONS

<table>
<thead>
<tr>
<th>Environment</th>
<th>Meteorology</th>
<th>Oceanography</th>
<th>Sea ice and icebergs</th>
<th>Seabed</th>
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</table>

- **Weather Conditions**
  - Solar radiation
  - Cloudiness
  - Temperature
  - Humidity
  - Wind speed
  - Wind chill
- **Oceanographic Conditions**
  - Tides
  - Currents
  - Oceanography
  - Sea ice and icebergs
- **Seabed Conditions**
  - Seabed characteristics
  - Bathymetry

#### OPERATIONS

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<th>Fire fighting preparation</th>
<th>Fire fighting</th>
<th>Fire detection/Alarm</th>
<th>Fire control</th>
<th>Hospital and medical care</th>
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<td>Fire fighting equipment</td>
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<td>Access &amp; use PPE</td>
<td>Number of medics</td>
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<td>Training</td>
<td>Fire fighting procedures</td>
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<td>Hospital</td>
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#### Specific Guidelines

- **ISO 13702 1999**
- **ISO 19906**
- **Barents 2020**

- **G 2.1.1**
  - General, i.e. consider anti-freeze agents
- **G 2.1.2**
  - Not Arctic specific
- **G 2.1.4 a**
  - Barents 2020 4.2.1
  - Risk Identification for the Barents Sea
- **G 2.1.4 b**
  - Practise: sufficient salt, sand, gas detectors which are exposed to atmospheric icing or heavy fog.
- **G 2.1.4 c**
  - Practise: provide sufficient PPE to allow change of wet clothing

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*Legend:*
- **= Major challenge**
- **= Minor challenge**

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15, B14

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5, 7, 8

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13.8.1.2

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14, B12

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13.8.1.2

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13.8.2

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4.2.1

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15, B14

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## Vol 2B Sec. 2.3  Emergency Response

### OPERATIONS

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<td>Ice type</td>
<td>Ice condition (drifting)</td>
<td>Ice surface features</td>
<td>Other classes as function of season</td>
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<td>Sea ice and icebergs</td>
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<td>Tidal currents</td>
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<td>Temperature seawater</td>
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<td>Recovery, fire fighting, towing,</td>
<td>Maintenance, inspection &amp; repair</td>
<td>Unit-based ER equipment</td>
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<td>Emergency repairs</td>
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<td>Helicopter operations</td>
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<td>Conditions</td>
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### CONDITIONS

- **Environment:**
  - Eco system sensitivity
  - Environmental vulnerability
  - Socio-economic aspects
  - Remoteness
  - Darkness
  - Daylight hours
- **Meteorology:**
  - Temperature
  - Wind speed
  - Wind chill
  - Precipitation
  - Sea surface long
  - Visibility
- **Oceanography:**
  - Polar ice
  - Ice type
  - Ice condition (drifting)
  - Ice surface features
- **Sea ice and icebergs:**
  - Sea ice (thickness)
  - Broken ice conditions (coverage)
- **Seabed:**
  - Sea depth
  - Seawater
  - Temperature seawater

### Major Challenge

- MOB & helicopter ditch/crash
- Recovery, fire fighting, towing,
- Maintenance, inspection & repair
- Unit-based ER equipment
- Emergency repairs
- Including rigging, scaffolding, welding,
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<td>Transfer to beyond hazard zone</td>
<td>Take-off</td>
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<td>Indirect and Semi-Dry [B]</td>
<td>Vessel (ERV) [C]</td>
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<td>Dry transfer from the facility to the vessel</td>
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<td>Oceanography</td>
<td>Marine &amp; Amphibious Craft (Active)</td>
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<td>Launch</td>
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<td>Touch-down/ Impact</td>
<td>Transfer to beyond hazard zone</td>
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<td>Rafts (passive)</td>
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<td>Individual</td>
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<tr>
<td>Transfer to beyond hazard zone</td>
<td>Touch-down/ Impact</td>
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<td>Transvessel transfer</td>
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= Major challenge
### Conditions:

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<td>Socio-economic aspects</td>
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<td>Wind chill</td>
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#### Operations

**6. Waste Management**

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</tr>
</thead>
<tbody>
<tr>
<td>Oily water</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Metals</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Incineration residues</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Organic waste</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Paints and solvents</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Paper, card and wood</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
<tr>
<td>Plastic</td>
<td>Tracking</td>
<td>Handling</td>
<td>Storage</td>
<td>Disposal</td>
</tr>
</tbody>
</table>

#### Definitions:

- **Tracking:** When is waste produced, how much is produced, waste contents, where is it stored
- **Handling:** Lifting materials, pumping, man handling, processing (shredding, burning, filtering)
- **Storage:** Storage condition (on deck, in containers, at a certain temperature, in open waste skip), storage duration, stored amount
- **Disposal:** Over board, ship to shore, incinerate, recycle

#### Sources:

1. **IMO MARPOL** Annex 1, 10, 2
2. **IMO MARPOL** Annex 1, 10, 3
3. **ARCTIC COUNCIL ARCTIC OFFSHORE OIL AND GAS GUIDELINES** Chap. 6,2
4. **IMO MARPOL** Annex 1, 10, 3

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G1; Annex 1, 12