

## DEP SPECIFICATION

# METOCEAN DATA ACQUISITION – REAL TIME SYSTEMS

DEP 37.00.10.12-Gen.

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## DESIGN AND ENGINEERING PRACTICE

### DEM1



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## 1. INTRODUCTION

### 1.1 SCOPE

This DEP specifies requirements and gives recommendations for facility / installation based real-time metocean systems aimed at the support of onshore and offshore operations including:

- a) logistics (aviation and marine);
- b) construction;
- c) installation;
- d) towing;
- e) float-over;
- f) seismic;
- g) drilling;
- h) production;
- i) general platform operations; and,
- j) onshore base or plant operations.

The main purpose of real-time metocean systems is to provide the data that ensure the safe, cost effective operation of facilities.

The purpose of this DEP is to provide specifications for those aspects of real-time metocean systems and associated data acquisition that is mandated by the company. In addition, national legislation may also determine local requirements for metocean measurements; specific recommendations on these are not provided here. Where safety is particularly important to some aspect of real-time metocean data, safety considerations are elaborated.

This DEP specifically addresses the requirements for the DCAF deliverable; Metocean and Ice Real-time Monitoring Plan & Equipment Specification, DCAF ID 328 (refer to DCAF).

This DEP contains mandatory requirements to mitigate process safety risks in accordance with Design Engineering Manual DEM 1 – Application of Technical Standards.

This is a revision of the DEP of the same number dated February 2011; see (1.5) regarding the changes.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

## 1.3 DEFINITIONS

## 1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The capitalised term **SHALL [PS]** indicates a process safety requirement.

The word **should** indicates a recommendation.

## 1.3.2 Specific definitions

Detailed parameter definition for all metocean parameters are provided as part of the Metocean Data Load Specification in report SR.11.14063. However, where technical terms are used in the document text these are included here:

| Term                            | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cloud Cover</b>              | Cloud cover refers to the fraction of the sky obscured by clouds when observed from a particular location and is usually measured in Oktas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Cloud Height</b>             | The cloud height is the distance between the Mean Sea Level and the cloud base and is used to represent the elevation of the cloud. Several cloud heights can be measured for one condition.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Conductivity</b>             | The electrical conductivity of seawater and used in conjunction with seawater temperature and density to determine the seawater salinity.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Dew Point</b>                | The dew point is the temperature to which a given parcel of humid air must be cooled, at constant barometric pressure, for water vapour to condense into water.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Dry Bulb Air Temperature</b> | The dry bulb air temperature, commonly referred to as air temperature, is basically the ambient air temperature indicated by a thermometer not affected by the moisture of the air.                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Gust</b>                     | A sudden, brief increase in the wind speed over a specified duration of time, e.g. 3-second gust which is the wind speed averaged over a 3-s duration. Different sensor types may record different gust speed values depending upon the individual sensor response characteristics.                                                                                                                                                                                                                                                                                                                                 |
| <b>Infragravity Waves</b>       | Infragravity waves are low frequency waves (nominally 0.003 to 0.05 Hz), generated through: <ol style="list-style-type: none"> <li>1. nonlinear wave-wave interactions within incident sea waves and swell waves;</li> <li>2. wave refraction and breaking on a sloping beach, as well as wave reflection at the shoreline; and,</li> <li>3. oscillations in the longshore current.</li> </ol> Infragravity waves are important to harbour oscillations, sediment transport, and other nearshore hydrodynamic processes and therefore have a high impact on the response of moored large vessels in coastal waters. |
| <b>Metocean</b>                 | Abbreviation of the words meteorological and oceanographic.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

| Term                                   | Definition                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Nonlinear Wave-Wave Interaction</b> | Nonlinear wave-wave interactions often occur when waves are steep enough so that wave components (e.g. with different wave frequencies) affect each other. This process can result in both low and high frequency waves beyond the incident wave frequency range.                                                                                                                                      |
| <b>Relative Humidity</b>               | Humidity is the quantity of water vapour present in air. Relative humidity can be expressed as the ratio of the vapour partial pressure of the air to the saturation vapour partial pressure of the air at the actual dry bulb temperature. Relative humidity can also be expressed as the ratio of the vapour density of the air to the saturation vapour density at the actual dry bulb temperature. |
| <b>Sea State</b>                       | A description of the properties of sea surface waves at a given time and place. In engineering applications, this is usually expressed in terms of the significant wave height and wave period and defined over a time period usually 3 hours.                                                                                                                                                         |
| <b>Sea Waves (or Wind Sea)</b>         | Sea waves (or wind sea) are waves that are generated locally by wind and are correlated to local wind conditions in terms of wave direction and wave height.                                                                                                                                                                                                                                           |
| <b>Significant Wave Height</b>         | This is 4 times the standard deviation of the sea surface height and is approximately equal to the average of the 1/3 highest waves.                                                                                                                                                                                                                                                                   |
| <b>Swell Waves</b>                     | Swell waves are waves produced by distant storms and progress to the considered location. Swell waves typically have longer periods than sea waves and are not correlated to local wind conditions in terms of wave direction and wave height.                                                                                                                                                         |
| <b>Visibility</b>                      | The horizontal distance at which the light intensity from a standard source drops to 5 %. This is calculated by measuring the amount of infra-red scatter in a small volume of air at the sensor location and assuming this sample has similar properties to the surrounding air mass. Contaminants in the air will lower the inferred visibility.                                                     |
| <b>Water Level</b>                     | The actual water level relative to an agreed datum (Usually a chart datum or mean sea level for real time systems).                                                                                                                                                                                                                                                                                    |

### 1.3.3 Abbreviations

| Term        | Definition                                  |
|-------------|---------------------------------------------|
| <b>ADCP</b> | Acoustic Doppler Current Profilers          |
| <b>AWWP</b> | Adverse Weather Working Policy              |
| <b>CCAU</b> | Central Control and Archiving Unit          |
| <b>DAU</b>  | Data Acquisition Unit                       |
| <b>DCAF</b> | Discipline Controls and Assurance Framework |
| <b>DGPS</b> | Differential Global Positioning System      |
| <b>DEP</b>  | Design and Engineering Practice             |
| <b>DLP</b>  | Data Load Plus                              |
| <b>EPBM</b> | Exploration and Production Business Model   |
| <b>FAT</b>  | Factory Acceptance Test                     |
| <b>FSR</b>  | Facilities Status Reporting                 |

| <b>Term</b> | <b>Definition</b>                     |
|-------------|---------------------------------------|
| <b>GID</b>  | General Infrastructure Desktop        |
| <b>HLO</b>  | Helicopter Landing Officer            |
| <b>HMS</b>  | Helideck Monitoring System            |
| <b>HPR</b>  | Heave, Pitch and Roll                 |
| <b>MIE</b>  | Maintenance and Integrity Execution   |
| <b>MSC</b>  | Metoccean System Custodian            |
| <b>OIM</b>  | Offshore Installation Manager         |
| <b>OU</b>   | Operating Unit                        |
| <b>PCD</b>  | Process Control Domain                |
| <b>PS</b>   | Protection Systems                    |
| <b>PTW</b>  | Permit To Work                        |
| <b>RO</b>   | Offshore Radio Operator               |
| <b>RMMS</b> | Real-Time Metoccean Monitoring System |
| <b>SCE</b>  | Safety Critical Element               |
| <b>TA</b>   | Technical Authority                   |
| <b>UPS</b>  | Uninterruptable Power Supply          |
| <b>WMO</b>  | World Meteorological Organisation     |

#### 1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets ( ). Other documents referenced by this DEP are listed in (7).

#### 1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated February 2011. The following are the main, non-editorial changes:

- References to the relevant DCAF deliverable; Metoccean and Ice Real-time Monitoring Plan & Equipment Specification, DCAF ID 328
- Requirement for the Technical Authority (TA) approval and peer review
- Updated Metoccean Data Load Specifications for the Metoccean Toolbox which includes additional parameters and requirements for wave spectra; see report SR.11.14063
- Updated specifications for quality control checks and error flagging (Appendix 2)

#### 1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at [standards@shell.com](mailto:standards@shell.com), using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://sww.shell.com/standards> and on the main page of the DEPs DVD-ROM.

#### 1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

## 2. SCOPE

### 2.1 OBJECTIVES

The overall objectives of this DEP are to:

- Guide metocean engineers, project engineers, operational personnel and drilling personnel in determining the need for real-time metocean information systems to support operations on new and existing facilities.
- Guide metocean engineers, project engineers, operational personnel and drilling personnel in specific system and sensor requirements depending on the logistics model (aviation, marine or land), the operational model (survey, construction, drilling or production, tanker loading/offloading), the remoteness of the location and type of environment (tropical, temperate or Arctic).
- Provide specifications for the requirements of real-time metocean systems in term of: equipment, systems, IT compatibility, installation, inspection, maintenance, data processing, data display and data formats.

### 2.2 INTRODUCTION

Metocean data are collected, processed and displayed in real time to assist with safety and efficiency of both onshore and offshore operations. Specifically the system SHALL [PS] be designed to:

- a) Alert personnel to adverse weather when conducting weather sensitive activities and help prevent weather related incidents (e.g. a boat transfer activity is stopped when the measured wave height exceeds the limits set by the company in their Adverse Weather Working Policy).
- b) Advise personnel of actual conditions so that weather sensitive activities can be adapted to improve safety (e.g. the approach direction of a helicopter is changed dependent on the wind direction to follow the safest approach route).
- c) Reduce exposure of personnel to hazardous conditions (e.g. a daily crew vessel cancels a trip and does not leave port when the weather at site is too rough to carry out the planned operation, such as a boat transfer).
- d) Optimise efficiency of operations and take advantage of weather windows (e.g. site specific measurements present an accurate assessment of the local conditions compared to a weather forecast or visual observations and can be used to determine when conditions drop below the calculated upper limit for a heavy lift and allow an operation to start).
- e) Assist with operational planning and minimise delays by enabling the adaption of operations to rising or falling conditions (e.g. prioritisation of activities with different weather related limits on a rising sea state).
- f) Provide input for modelling oil spill and man overboard events to help with fast response.
- g) Provide input to commercial and national forecast agencies as validation for nowcast and forecast products for the benefit of the installation personnel.
- h) Store both raw and processed data so that it can be subsequently used for post-incident investigations and as input to long term metocean data bases that can be used for future projects in the area.
- i) To provide data over the life of the installation to assist with structural integrity assessment for re-certification of the facility including fatigue and extreme events.
- j) To satisfy national and legal requirements for real-time measurements and their distribution.

## 2.3 SYSTEM REQUIREMENTS

To achieve these objectives and ensure the data collected can be used for metocean design requirements, data provided by the Real-Time Metocean Monitoring System (RMMS) SHALL [PS] be:

- a) accurate, see (4);
- b) reliable, see (5);
- c) relevant to the operation;
- d) representative of the environment being measured;
- e) continuous;
- f) in real-time;
- g) available to all personnel requiring this data (i.e. both offshore at the operational site and onshore by the coordination team);
- h) linked to the Adverse Weather Working Policy (AWWP), which specifies limits related to metocean parameters when operations need to be restricted or stopped; and,
- i) available for data archiving and other uses such as in incident investigation.

## 2.4 MAINTENANCE AND INTEGRITY EXECUTION

The Maintenance and Integrity Execution (MIE) Programme has identified all the Safety Critical Elements (SCE) which constitute a hardware barrier to prevent or limit the consequences of major accident hazards.

The Real-time Metocean Monitoring Systems (RMMS) have been identified as a SCE under this program. As an SCE, the RMMS are now a mandatory requirement for specific operations, as defined in (3), and their requirements and performance requirements are mandated in this document and are separate from DEP 37.00.10.11-Gen.

The MIE process requires that for any SCE there is:

- a) Defined performance criteria.
- b) Defined verification tasks (integrity assurance tasks) to check whether SCEs are meeting their performance criteria.
- c) Clear roles and accountabilities in the day to day management and execution of the maintenance tasks.
- d) A strong competency in setting maintenance priorities, effective preparation and scheduling of work.
- e) Effective preparation of the maintenance work to increase productivity, safety and quality of the work performed.
- f) A reduction in the level of reactive work management and change to proactive maintenance, ensuring all preventative maintenance is performed on time and that exposure from breakdown failures is effectively minimised.
- g) A demonstration of the results of the integrity assurance tasks.
- h) An effective management of change concerning the integrity of assurance tasks.
- i) Common adopted standards of measuring Maintenance and Integrity performance.

## 2.5 DEP OVERVIEW

This DEP document provides the following minimum requirements and specification information to fulfil the safety critical requirements and the MIE program. It provides the required information to the metocean engineers, project engineers, operational personnel and drilling personnel on the following aspects that SHALL [PS] be adopted:

- a) The minimum RMMS requirements that shall be implemented for different types of operation, which include requirements for: different logistics models, operational modes, the remoteness of the location and type of installation. (Additional RMMS requirements associated with operations within ice environments are still be developed.)
- b) The minimum specifications that shall be implemented for the sensor equipment, interfaces/auxiliary equipment, IT equipment and other IT compatibility requirements.
- c) The minimum specifications that shall be implemented for the installation, inspection and maintenance of the equipment including spares and calibration requirements.
- d) The minimum specification that shall be implemented for the data processing, data display, data availability, data storage and data formats.
- e) The MIE performance standard (PS016) and associated verification tasks that shall be complied which is included in (Appendix 1).

This DEP Specification shall be included as part of the contract documentation for any RMMS.

## 2.6 SAFETY CRITICALITY

This system is designated a safety critical system and hence the following rules SHALL [PS] apply:

- All personnel working (either directly or remotely) on this category of equipment shall be aware of the safety critical nature of the data displayed by these systems. Work shall not be undertaken that might result in additional or unscheduled downtime or system malfunction without a full risk assessment and approval of the Metocean System Custodian (MSC) and the Installation focal point; usually the Radio Operator (RO), Offshore Installation Manager (OIM), Helicopter Landing Officer (HLO) or their functional equivalents.
- Prior to the start of any work the MSC, the RO and any other parties using the metocean data displayed by this system shall be informed that there will be an interruption to / display of invalid data values during the maintenance process. Before work is started critical personnel, e.g. RO, OIM, HLO or their functional equivalents, shall be informed of the work and instructed to disregard data during this period.
- Work that will interrupt or invalidate the system display shall not be undertaken directly prior to or during helicopter operations. Low or medium priority work shall not be undertaken during severe weather but should be rescheduled to a calm (safe) weather period. Work should always be undertaken in a way to minimise data loss by minimising system down time where possible.

**It is emphasised that this document shall be interpreted in the context of a functioning PTW (Permit to Work) system. All Shell operations are covered by PTW procedures. All operatives (both Company and Contractor) shall be fully aware of the nature and requirements of the PTW systems that they will be working with and that they play an active role in the safety culture both of their Company and the installations they visit.**

Though metocean (and ice) data collection systems and methods have common features, (instrumentation, data processing, etc.) a data collection plan shall be put together in a bespoke manner in order to meet the regional climate and specific project needs.

## 2.7 RESPONSIBILITY FOR THIS DEP

It is the responsibility of the appropriate Civil, Structural and Offshore TA1 (which may be metocean TA1 but could also be outside the metocean discipline) to assign a competent metocean TA2 to the project to implement the DCAF deliverable; Metocean and Ice Real-time Monitoring Plan & Equipment Specification, DCAF ID 328. This person should be appointed as metocean (and ice) TA2 for the project, and meet the minimum competence associated with the Metocean Opps Support Job Group 4 (JG4) Competence profile, and be approved as covering metocean on the DCAF Discipline Authority Manual.

## 2.8 TECHNICAL AUTHORITY REVIEW

While the different activities associated with the Metocean and Ice Real-time Monitoring System may be carried out by either the Principal's staff or Contractors, the same specifications and requirements apply in all cases. When using Contractors for any of these activities, this DEP shall be provided as part of the contract documentation and attention drawn to the sections relevant to the type of service contracted. The Metocean Technical Authority (TA2 or above) designated for the project shall authorise Metocean and Ice Real-time Monitoring Plan & Equipment Specification, and establish that the functional performance specifications will meet specific project needs and is appropriate for the local metocean (and ice) conditions.

### 3. REQUIREMENT AND SPECIFICATION INFORMATION

#### 3.1 RMMS REQUIREMENTS FOR DIFFERENT OPERATIONS

The minimum functionality requirements for the RMMS SHALL [PS] be dictated by **both the logistics model used to support the facility and the operational mode of the facility**. The following five categories for operational functionality have been defined which have requirements for the RMMS. These are:

1. **Aviation** based logistics for manning and/or supplies.
2. **Marine** based logistics for manning and/or supplies including tanker loading / unloading.
3. **Drilling** operations.
4. **Construction** operations including heavy lifts and float-over installation for facilities installation.
5. **Production / LNG Plant** operations including operations such as LNG processing, refining, loading and offloading and oil terminal operations.

NOTES: 1. There are no specific RMMS requirements for a land transport based logistics model.  
2. The requirements of these operations are additive, if all operations are undertaken then all requirements for each operations shall be included.

The minimum functionality requirements for the RMMS SHALL [PS] also be dictated by both the **location's remoteness and facility type**: The following five categories of location have been defined which have requirements for the RMMS. These are:

1. **Known – onshore/coastal** (a location with comprehensive infrastructure, for example a commercial airport or commercial harbour)
2. **Remote - onshore** (e.g. an onshore location with limited infrastructure, for example desert or Arctic location or a remote airbase)
3. **Remote - offshore fixed** (e.g. fixed shallow water platform or coastal jetty for example associated with remote LNG terminal)
4. **Remote - offshore floating shallow** (e.g. floating platform)
5. **Remote - offshore floating deepwater** (e.g. floating platform or floating LNG in water >250 m [>820 ft])

NOTE: At present, there are no offshore locations defined as 'Known', but see (3.3) for exemptions for satellite locations)

The minimum functionality requirements for the RMMS shall also be dictated by the **type of environment**. The following three categories have been defined:

1. **Tropical**
2. **Temperate**
3. **Arctic**

NOTE: Full RMMS requirements associated with operations within Arctic environments are still to be developed.

The minimum requirements for the type of system required for all environment types can be determined from the five by five matrix shown in Table 3.1. In all cases requirements are additive.

Additional requirements for tropical, temperate and Arctic environments are included in Table 3.2.

**Table 3.1 - Matrix showing RMMS requirements for different operational modes and facility types**

|                              |                                                          | Logistics Support and Operational Modes                                                                                                                                                                                |                                                                                                                                                                   |                                                                                                                          |                                                                                                                                               |                                                                                                                                                                                            |
|------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              |                                                          | Aviation Operations <sup>(11)</sup> (14)                                                                                                                                                                               | Marine Operations                                                                                                                                                 | Drilling                                                                                                                 | Production /LNG Plant                                                                                                                         | Construction (Float over/ heavy lift)                                                                                                                                                      |
| Remoteness and facility type | Known (13)<br>Onshore/ harbour                           | <ul style="list-style-type: none"> <li>None required (10)</li> </ul>                                                                                                                                                   | <ul style="list-style-type: none"> <li>None required</li> </ul>                                                                                                   | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> </ul>                             | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> <li>Air temp/ humidity</li> </ul>                      | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> </ul>                                                                                                       |
|                              | Remote<br>Onshore (9)                                    | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> <li>Air temp/ humidity</li> <li>Barometric pressure</li> <li>Visibility (1)</li> <li>Cloud base/cover (2)</li> </ul>                    | <ul style="list-style-type: none"> <li>N/A</li> </ul>                                                                                                             | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> <li>Air temp/ humidity</li> </ul> | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> <li>Air temp/ humidity</li> </ul>                      | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> </ul>                                                                                                       |
|                              | Remote<br>Shallow-water Fixed<br>Shallow-water Jetty (9) | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> <li>Air temp/ humidity</li> <li>Barometric pressure</li> <li>Visibility (1)</li> <li>Cloud base/cover (2)</li> <li>Sea state</li> </ul> | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> <li>Sea state</li> <li>Current speed (3)</li> <li>Current direction (3)</li> </ul> | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> </ul>                             | <ul style="list-style-type: none"> <li>Wind speed (8)</li> <li>Wind direction (8)</li> <li>Air temp/ humidity</li> <li>Water level</li> </ul> | <ul style="list-style-type: none"> <li>Wind speed</li> <li>Wind direction</li> <li>Sea state</li> <li>Water level (7)</li> <li>Current speed (4)</li> <li>Current direction (4)</li> </ul> |

|  |                                     |                                                                                                                                                                                                                                                                                        |                                                                                                                                                                             |                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                             |
|--|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Remote<br>Shallow-water<br>Floating | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Air temp/ humidity</li> <li>• Barometric pressure</li> <li>• Visibility (1)</li> <li>• Cloud base/cover (2)</li> <li>• Sea state</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Sea state</li> <li>• Current speed (3)</li> <li>• Current direction (3)</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed (8)</li> <li>• Wind direction (8)</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> <li>• Offset</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>• Wind speed (8)</li> <li>• Wind direction (8)</li> <li>• Air temp/ humidity</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> <li>• Offset</li> <li>• Water level / airgap (12)</li> </ul>                                                                       | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Sea state</li> <li>• Current speed (5)</li> <li>• Current direction (5)</li> </ul>                 |
|  | Remote<br>Deepwater Floating        | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Air temp/ humidity</li> <li>• Barometric pressure</li> <li>• Visibility (1)</li> <li>• Cloud base/cover (2)</li> <li>• Sea state</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Sea state</li> <li>• Current speed (3)</li> <li>• Current direction (3)</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed (8)</li> <li>• Wind direction (8)</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> <li>• Offset</li> <li>• Current speed profile</li> <li>• Current direction profile</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed (8)</li> <li>• Wind direction (8)</li> <li>• Air temp/ humidity</li> <li>• Motion sensor (HPR)</li> <li>• Heading</li> <li>• Offset</li> <li>• Current speed profile</li> <li>• Current direction profile</li> <li>• Water level / airgap (12)</li> </ul> | <ul style="list-style-type: none"> <li>• Wind speed</li> <li>• Wind direction</li> <li>• Sea state</li> <li>• Current speed profile (6)</li> <li>• Current direction profile (6)</li> </ul> |

## NOTES for Table 3.1:

1. Visibility - locations with visibility problems >5% of the time shall have a visibility sensor.
2. Cloud base / cover - locations with cloud base and or visibility problems >5% of the time shall have a cloud height sensor.
3. Current speed and direction - locations which have experienced current related problems at any time with vessels alongside platforms shall have current measurements.
4. Current speed and direction - for installation of infrastructure where current could influence success for example installing skirt piles or launch jackets current sensors shall be deployed. For installation of lift jackets, full leg piling and lifting of deck modules this may not be required.
5. Current speed and direction - for the installation of infrastructure, mooring and risers of shallow water floating structures.