

GENERAL SPECIFICATION

SURVEYS

GS EP GEO 505

Monitoring of Metocean Conditions for Offshore Units

05	10/2012	Minor corrections on time sampling intervals in sections 8.3.2 and 9.3.2. Reference to GS EP EXP 131.
04	01/2012	Update - Integration of requirements from STR/LSO/PLR/HSE - Draft 4
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1. Scope

This General Specification is applicable to monitoring of metocean, motion and positioning parameters for offshore units. The specification is common to fixed platforms and floating units, differences between the requirements for each type of structure being highlighted when necessary.

This specification covers the design, supply, calibration, test, installation, commissioning, operation and maintenance of the whole system, including instruments, data processing equipment, operator interface, and interfaces with other systems.

Despite the fact that this document was originally developed for offshore unit, it provides useful guideline for onshore meteorological system and for marine terminal applications.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
Bristow Group, Bond and CHC, Rev. 8c Sept 2010	Standard Measuring Equipment for Helideck Monitoring System (HMS) and Weather Data
CAP 437	Offshore Helicopter Landing Areas - Guidance on Standards
ISO 19901-1, 2005	Petroleum and natural gas industries - Specific requirements for offshore structures - Part 1: Metocean design and operating conditions
NORSOK Standard N-002, Edition 2, October 2010	Collection of metocean data
WMO no. 8 - 2008	Guide to meteorological instruments and methods of observation
WMO no. 49 - Vol. 1 - 1988	General meteorological standards and recommended practice
WMO no. 306 - Vol. I-1 - Part A	Manual on Codes International Codes

Note: The compliance with the [CAP 437](#) standards will ensure the compliance with ICAO Annex 14 regulations.

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Reference	Title
GS EP EXP 131	Design and installation of Process Data Server
GS EP EXP 201	Operations preparation during project - Maintainability & Inspectability criteria
GS EP EXP 203	Maintenance and inspection documentation preparation during project phase
GS EP EXP 205	Requirements to MIE Team for Spare parts
GS EP EXP 207	Installation description structure
GS EP EXP 311	Plant integrity. Minimum inspection requirements
GS EP GEO 504	Comprehensive evaluation of metocean conditions
GS EP INS 101	Instrumentation engineering, supply and construction general requirements
GS EP LSO 110	Environmental effects considerations for helidecks
GS EP LSO 115	Helideck specifications
GS EP POS 001	Offshore surface positioning works
GS EP POS 004	The use of Differential Global Navigation Satellite System

3. Definitions, Abbreviations

3.1 Definitions

For this specification:

Offshore Unit means either fixed platforms or floating units.

Floating Unit is defined as any floating platform used for production (for instance FPSO, FSO, FPU, TLP, and Semi-submersible) or any floating platform installed at the same location for an extended period, i.e. greater than one year. Smaller floating facilities used in association with Floating Units are excluded from this definition (e.g. offloading buoy associated with FPU).

QNH is a Q code used by pilots, air traffic control (ATC) and low frequency weather beacons to refer to the current mean air pressure over a given region at sea level (if there is no sea, this is a virtual value by adjusting the value at the ground for its elevation), the "regional pressure setting". This value is used by pilots to calibrate the altimeter on board the aircraft, to ensure that the pilot is accurately aware of his actual flying height. The QNH allows a pilot to know his altitude with respect to mean sea level.

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QFE is a Q code used by pilots and air traffic control to refer to the current air pressure which will calibrate the pilot's altimeter to give actual height above the ground at a particular airfield. This setting is used during take-off and landing and when flying in the circuit. A mnemonic for the code is "Q Field Elevation".

Hs The significant wave height is the average wave height (trough to crest) of the one-third largest waves. For monitoring system, Hs is computed as

$$H_s = 4\sqrt{m_0}$$

With m_n the n th order moment of the wave spectrum

Hmax The maximum wave height maximum crest to trough from wave time series

Tmean The mean wave period: $T_{mean} = \frac{m_0}{m_1}$

Tpeak The peak wave period: $T_{peak} = \frac{m_{-2} \cdot m_1}{m_0^2}$

Extract from [WMO no. 8](#):

- **Accuracy of measurement:** The closeness of the agreement between the result of a measurement and a true value of the measure.
- **Resolution:** A quantitative expression of the ability of an indicative device to distinguish meaningfully between closely adjacent values of the quantity indicated.

3.2 Abbreviations

ACK/NAK	Acknowledged/Not Acknowledged.
ASCII	American Standard Code for Information Interchange.
ASL	At Sea Level.
BOEMRE	Bureau of Ocean Energy Management Regulation and Enforcement
DCS	Distributed Control Systems.
FAT	Factory Acceptance Test.
FTP	File Transfer Protocol.
GNSS	Global Navigation Satellite System.
GTS	Global Telecommunication System.
HSE	Health safety environment.
I3MS	Integrated Monitoring of Metocean and Motion parameters System
ICSS	Integrated Control and Safety System.
IFAT	Integrated Factory Acceptance Test
INS	Inertial Navigation System.
IT	Information Technology
LSO	Logistic Support Operation.

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Metocean	Meteorological and Oceanographic.
MRU	Motion Reference Unit.
PI	Plant Information
SAR	Search and Rescue.
SAT	Site Acceptance Test.
UTC	Coordinated Universal Time.
UHF	Ultra High Frequency.
MOR	Meteorological Optical Range.
RVR	Runway Visual Range.
WIFI	Wireless Fidelity.
WMO	World Meteorological Office.
XML	Extensible Markup Language.

4. Functional requirements

4.1 General description

The I3MS is an integrated suite of equipment comprising:

- An array of sensors for meteorological and oceanographic parameters six degrees of freedom motions and positioning
- A main processing unit
- One or more visual display units
- A data storage and recording facility
- A link to other system(s) of the offshore unit.

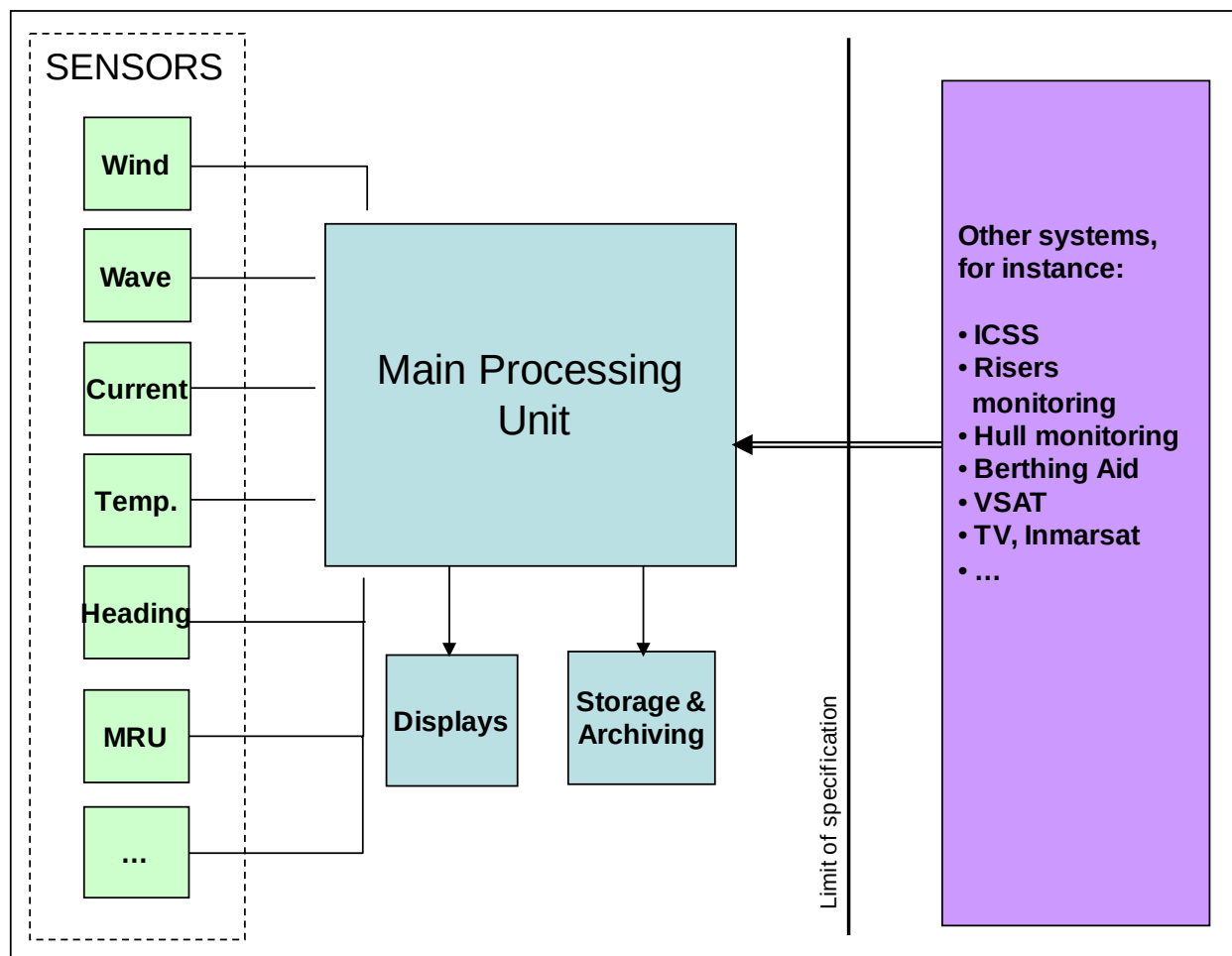


Figure 1 - Block Diagram of I3MS

The integrated monitoring system is a common monitoring system combining requirements of different users. The principle is to combine similar requests from different users in a single system to avoid multiplication of monitoring systems. Only requirement common to different users are integrated in the I3MS system. User's specific requirements are excluded from this specification. User's specific requirements, typically, concern monitoring of mooring loads, hull stress, riser monitoring...

User requirements covered in this specification are those associated to:

- Helicopter operation
- Marine operation
- Telecoms operations : TV, VSAT, Inmarsat
- Metocean, motion and position monitoring necessary for structural analysis
- Metocean, motion and position monitoring necessary for pipeline and riser analysis
- Metocean motion and position monitoring necessary for HSE.

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Definition of user's requirements to be implemented in I3MS is specified in an associated particular technical specification.

For each user's requirements, the definition of monitoring systems to be installed is defined in sections from 4.2 to 4.8. These sections are to be used independently from one to another.

In each section describing user's requirements, the following information is provided: reference to technical specification of associated sensors and to associated displays. The list of parameters to be monitored is defined by adding the compulsory data measurements selected by each specific user's requirement.

If specific parameter is requested by different user's requirement then:

- Only one single sensor of the kind is requested to perform the acquisition, unless otherwise mentioned
- Recording and processing of the data will then be performed with the most severe constraint
- Data display will be performed following each department recommendations.

Offshore units that are equipped with a I3MS shall operate the I3MS continuously at all times. For floating structures, the I3MS should operate prior to yard sail away for on-board equipment and prior to mooring hook-up for current and wave monitoring equipment.

All system identified by user's requirements shall be compliant with [WMO no. 8](#) and [NORSOK Standard N-002](#).

4.2 Helicopter operation

If a helideck is installed on the offshore units, the I3MS shall be compliant with [GS EP LSO 110](#), [GS EP LSO 115](#) and [CAP 437](#).

Offshore units hosting a helideck shall operate the I3MS continuously at all times in order to acquire the following compulsory data intended to provide an aid to aerial operations.

- Barometric pressure as QNH and QFE (see section 6.3)
- Air temperature (see section 6.4)
- Humidity (see section 6.4)
- Dew-point temperature (see section 6.4)
- Wind speed and direction in free air (see section 6.5)
- Visibility (see section 6.6)
- Present weather - rainfall (see sections 6.6 & 6.8)
- Cloud base and cover (see section 6.7).

If the offshore unit is floating, the following parameters shall be added:

- Wave parameters (see sections 6.9 and 6.10)
- Motion Recording Unit (offshore unit, pitch, roll, heave) (see section 6.2)

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- Gyrocompass, offshore unit heading (see section 6.2)
- Floating unit position (GNSS) relevant (see section 6.2).

Display for helicopter operations in section 9.3.2 and shall be compatible with [Bristow Group, Bond and CHC](#).

4.3 Marine Operation

Offshore units with requirements for marine operations shall operate the I3MS continuously at all times in order to acquire the following compulsory data intended to provide an aid to offloading and other marine operations.

- Wind speed and direction in free air (see section 6.5)
- Wave parameters (see sections 6.9 and 6.10)
- Current from surface to 30 m depth (see section 6.11).

Associated displays are described in section 9.3.3.

4.4 Telecoms Operation

Offshore units with requirements for telecom operations shall operate the I3MS continuously at all times in order to acquire the following compulsory data for operating stabilized antennas for entertainment, VSAT, Inmarsat, etc.

- GNSS (Offshore Unit position) (see section 6.2)
- Gyrocompass (Offshore unit heading) (see section 6.2).

4.5 Structural monitoring

Offshore units on which structural monitoring is considered shall operate the I3MS continuously at all times in order to acquire the following compulsory data:

- Wind speed and direction in free air (see section 6.5)
- Wave parameters (see sections 6.9 and 6.10) including 2D spectral data
- Current from surface to 30 m depth (see section 6.11).

If the offshore unit is floating, the following parameters shall be added:

- GNSS (Offshore Unit position) (see section 6.2)
- Motion Recording Unit (offshore unit, pitch, roll, sway, surge, heave, yaw) (see section 6.2)
- Gyrocompass (Offshore unit heading) (see section 6.2).

For fixed platforms, water level and airgap (see section 6.10) shall be monitored.

Display for structural monitoring is described in section 9.3.4.

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4.6 Pipeline and Riser Monitoring

Offshore units on which pipeline and riser monitoring is considered shall operate the I3MS continuously at all times in order to acquire the following compulsory:

- Wave parameters (see sections 6.9 and 6.10)
- Sea Current from surface to seabed (see section 6.10).

Monitoring shall be compliant with requirement set up in **GS EP EXP 311** on dynamic riser systems.

If the offshore unit is floating, the following parameters shall be added:

- GNSS (Offshore Unit excursion) (see section 6.2)
- Motion Recording Unit (offshore unit, pitch, roll, yaw, sway, surge, heave) (see section 6.2)
- Gyrocompass (Offshore unit heading) (see section 6.2).

Display of metocean and positioning data for pipeline and riser monitoring is described in section 9.3.5.

4.7 HSE - Monitoring

Offshore units hosting a HSE monitoring system shall operate the I3MS continuously at all times in order to acquire the following compulsory data:

- Air temperature (see section 6.4)
- Wind speed and direction in free air (see section 6.5)
- Cloud cover (see section 6.7)
- Rainfall (see section 6.8)
- Currents (see section 6.10)
- Water temperature (see section 6.12).

Display of HSE-Monitoring is described in section 9.3.6.

4.8 Additional requirements

Additional requirements that are project specific could be requested. These specific requirements are defined in the particular specification.

Typical specific requirements could be:

- Windchill derived from the wind speed and air temperature data for locations that are subject to low temperature
- Dust and dust storms
- Lightning detector
- Field of surface current
- Sea ice or iceberg detection

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- Individual wave parameters (see section 6.9)
- Water level (see section 6.9)
- Sea temperature at specified depths (see section 6.12)
- Salinity at specified depths (see section 6.12).

I3MS shall further be equipped to receive input from an operator and hence display and record. Typical, visual observation to be considered is:

- Visual observations of sea ice
- Visual observations of icebergs
- Visual observations of structural icing
- Visual observation of relevant weather or marine phenomenon (at the discretion of dedicated operator).

Display of weather and marine observation are described in sections 9.3.7 and 9.3.8.

5. General Conditions

5.1 Units

Units to be used are specified in Appendix 1. If a parameter's unit is not defined in Appendix 1, the appropriate SI unit shall be used for data, both recorded and displayed.

Time references shall be given in UTC. For ease of operation local user interfaces may show local time or UTC provided that the display clearly indicates which is being displayed.

Local coordinate system(s) used shall be fully defined, especially for MRU. Preferred coordinate system is the ship coordinate system. Ship coordinate system is defined as: x axis similar to base line (or keel line) oriented from aft to bow, z axis is vertical pointing up and y axis is defined to generate a positive (or right-hand rule) coordinate system. Reference point of this system is located along the centerline at the aft of the vessel.

If different local coordinate system are used, transformation parameters to and from the ship coordinate system shall be provided.

5.2 Communication

Data from all sensors shall be transmitted to the Main Processing Unit, through suitable communication links:

- Hardwire links for sensors installed on offshore units
- UHF radio links for remote sensors (e.g. wave buoy)
- Submarine acoustic modems.

Attention will be paid to the design of links (cables, junction boxes, etc.) to ensure good communication and no loss of information between sensors and Main Processing Unit.

In case of UHF radio links, frequencies shall be approved by Company.

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For sensors that will not be permanently connected to the main processing unit, action shall be taken to ensure that data are time synchronized with the main processing unit.

Use of NMEA 0183 protocol is preferred for communication between sensors and Main Processing Unit, but others are available as discussed in Appendix 3.

5.3 Real-time information

I3MS shall be able to provide real-time information that could be accessed within internal network or from Internet, either for Company use or for transmission to international observation networks.

Preferred solution for data transfer is based on Company Plant Information system "PI" in agreement with **GS EP EXP 131**. If this solution is not available, data transfer can be done through an FTP server or by email.

If the transfer is done by FTP, I3MS shall be able to automatically upload data to an agreed FTP site. FTP address, login and password shall be easily configurable from the main processing unit. I3MS has to check if the transfer was completed properly.

When done by email, this check is embedded within the email protocol. I3MS shall be configured to also offer this transfer possibility.

If not specified, data format for export shall be in a self describing file in ASCII format. This format shall be documented and submitted for approval.

As a base case, all monitored parameters shall be transferred in real-time except 2D wave spectrum. In case of limited bandwidth, a reduced list of parameters and associated sampling shall be provided for review and approval.

The Plant Information (PI) system is the recommended system to establish a network connection. It is recommended to use MODBUS communication protocol. A MODBUS license should then be used for PI. The main processing unit (see Figure 1) should serve as a MODBUS server and the PI server as a MODBUS client. The PI software layer should also be installed on the main processing unit. Alternatively, OPC (OLE for process control) communication protocol could be used.

Appendix 3 provides more details about data output formats to third parties and communication protocols.

5.4 Transmission to shore

The receiving station should automatically acknowledge receipt of each transmission.

Where acknowledgement of the transmission is not received by the transmitting station, then the transmitted values should be buffered for subsequent transmission at the next opportunity.

The communications system shall have error checking mechanisms in place to verify in a timely manner the reliability and availability of the real-time data transmitted by an appropriate technique. For example, parity checks (Hamming code or similar) for digital systems.

In respect of safety related information, the cabling and the connection systems shall be of a suitable standard, and all other systems shall show due regard for system integrity.

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Where data are transmitted via radio links, frequency protection, data encryption and interference protection techniques shall be addressed as part of the system integrity studies.

5.5 Long-term data quality

The I3MS system shall be designed so that a high level of data quality is ensured. The duration of operation between each maintenance visit (section 10) shall be carefully chosen, with consideration of the sensors wear during lifetime, and that of the acquisition system.

For each measurement system (the sensor and its packaging), the normal lifetime on site shall be determined, as well as the expected sensor drift (section 8.5).

Calibration coefficients (section 7.1) shall be clearly documented and saved in the I3MS acquisition system, as they will be required for validating the archived data.

5.6 Equipment lifetime

The I3MS system shall be designed to operate continuously for a period of no less than 5 years, subject to routine maintenance and repair.

I3MS shall be constructed using parts for which replacements will be available for no less than 5 years from the date of supply. A check shall be done to ensure that no equipment is subject to an end of life notice.

6. Technical Specification of Sensors

6.1 General Requirements

Sensors shall be able to withstand extreme environmental conditions for the particular location in which the unit is destined to operate.

Evidence of design verification shall be made available upon request.

Installation of Meteorological sensors shall comply with [WMO no. 8](#). As a basis, sensors' range, resolution and accuracy shall be defined as in [NORSOK Standard N-002](#), Appendix A or in [WMO no. 8](#). If a helideck is foreseen on the unit, sensor's range, resolution and accuracy shall also be compliant with [GS EP LSO 110](#) and [CAP 437](#) requirements. Appendix 2 of this specification provides illustrative values of typical range, resolution and accuracy for various sensors.

Instrumentation equipment shall fulfill [GS EP INS 101](#).

Locations of sensors shall be chosen with care, taking into account the necessity to:

- Minimize the influence of surrounding structures and equipment on the quality of data
- Ensure that sensors do not interfere with other activities onboard
- Provide safe access to sensors for service and maintenance visits
- Provide suitable cable runs.

Figure 2 provides typical location for the different type of sensors.

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Special consideration for direction:

- The direction (wind, wave, current ...) must be based on a vector average. An arithmetic average of direction data that included values either side of North would be in error (e.g. $(359 + 001)/2 = 180$).
- Oceanographic convention is that winds and waves approach from the given direction, whilst currents flow towards the given direction. This can cause confusion to non-specialist users. The I3MS display must explicitly state whether the specified direction is 'from' or 'towards'.

Considerations with respect to the selection of an appropriate sensor shall include:

- Does it measure over the required range?
- Does it measure to the required level of accuracy?
- Is it sufficiently robust for offshore use?
- What is the recommended service interval? Will it be possible to place service engineers on the platform at sufficiently frequent intervals to maintain the equipment?
- Has the equipment been shown to perform adequately in previous applications?
- Is equipment rated according to hazardous area rating of the considered location on the installation (intrinsically safe rating)?

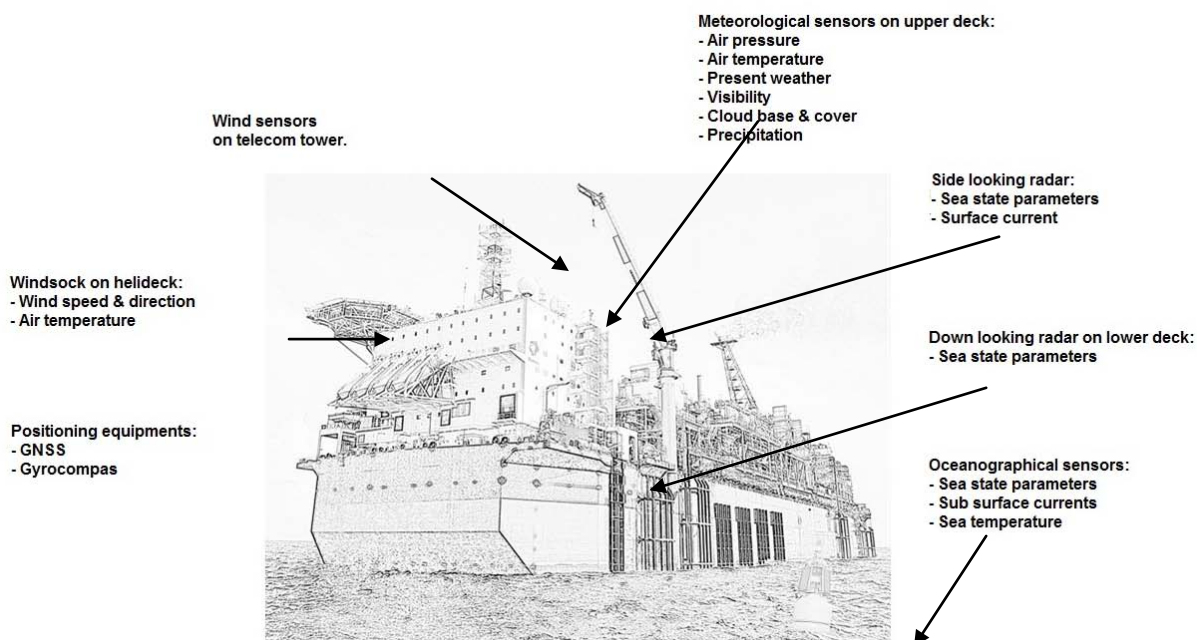


Figure 2 - Sensors typical locations on a floating unit

For an independent system, not connected to a power source (for instance a wave buoy), the system shall be designed to minimize the need for intervention to change battery. This could be obtained by use of solar panel or another independent source of power.

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6.2 Motion and Positioning System

The equipments shall be a combination of GNSS (with differential positioning system), gyrocompass and MRU. Positioning system shall be designed according to [GS EP POS 001](#) and [GS EP POS 004](#).

6.2.1 GNSS

The aim of the positioning (position, attitude and velocity) is to provide the unit with a long term monitoring and to link this information to other information. This accuracy must be set in accordance with the magnitudes and frequencies of the expected movements.

Preferably, the MRU shall be installed on one of the intermediate decks below the living quarters. The DGPS antennae should better be installed with an unobstructed view of the sky. The exact location shall be specified and agreed during project phase.

Position acquisition frequency shall be around 1 Hz and MRU acquisition frequency shall be around 2 Hz.

DGPS and MRU system shall be directly connected for operation of stabilized antennas used for entertainment, VSAT, Inmarsat, etc.

6.2.2 Gyrocompass

The preferred type of gyrocompass is one based on fibre optic rate sensor technology. In addition to be connected to the main processing unit, the gyrocompass shall be directly connected to stabilized antennas.

For direct communication with stabilized antennas, dedicated serial RS232/RS422 port or Ethernet port should be available. Associated output formats are either NMEA or ASCII.

6.2.3 Requested accuracy

The positioning systems shall provide the following items quoted at 95% confidence level:

Data	Accuracy
Position of each reference point (Projection, Geodetic system)	0.5 m
Elevation of each reference point (Chart datum)	0.5 m
Heading, Roll, Pitch (relative motion)	0.1 degree
Heave, surge and sway (relative motion)	5 cm

6.3 Air Pressure

An automated triple-headed sensor is recommended.

A minimum of 2 co-located sensors shall be used with a difference lower than 0.5 hPa (a warning flag will be triggered in the software in case this threshold is exceeded).

The equipment shall be installed so that measurements are free from un-natural or internal influences (air conditioning for instance).

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The sensor sampling rate shall permit output averaging time of 1 minute.

6.4 Air Temperature, Relative Humidity and Dew-Point

The sensors shall be mounted at an appropriate location and in a position where the data will not be degraded by anomalous temperatures and will be protected from the exhaust fumes (of aircraft or turbines for instance).

The sensors shall be exposed in an instrument housing of an approved design which provides protection from atmospheric radiation and water droplets, either as sea spray, precipitation or fog.

The formula for deriving dew point from relative humidity should be clearly stated in technical documentation.

Where platform configuration permits the siting of an additional temperature sensor that will not interfere with helicopter operations, it is desirable that air temperature, in the vicinity of the helideck, is acquired. Typically, the sensor can be mounted on the windsock.

An alert shall be raised if:

- The temperature difference between the two sensors is more than 2 °C
- Helideck temperature fluctuation (based on consecutive 3-second means) has varied by more than 2 °C between successive samples.

The sensor sampling rate shall permit output averaging time of 1 minute.

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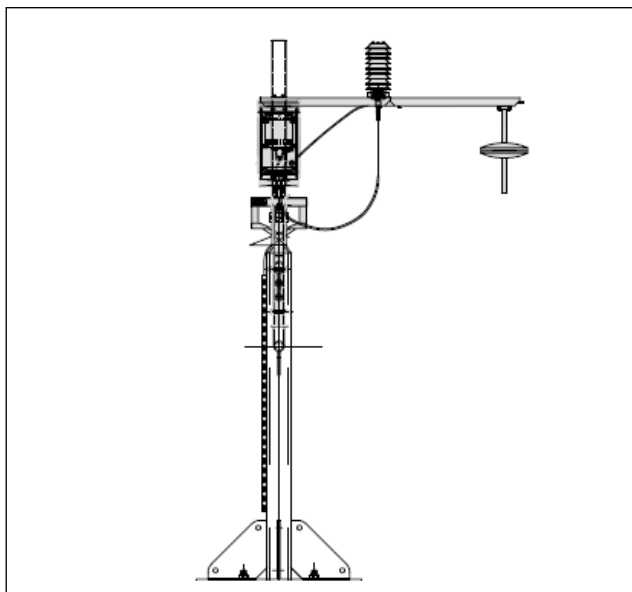


Figure 3 - Typical humidity and temperature positions- sensors at 2 meters height

6.5 Wind Sensor

6.5.1 Sensor Location

The reported wind speeds and directions shall be representative of the free air wind conditions.

- The primary sensor should be located as far as possible from elements of the structure that may significantly influence wind flow.
- As it is difficult to achieve a representative measurement of the free air conditions in all directions with a single sensor, then two or more sensors are required to provide adequate coverage. A logical test shall select the best sensor to be used for data acquisition, typically based on the wind direction against the sensor location.

The chosen site should, if possible, be one that is unlikely to be influenced by hot gas plumes. The positioning issues to take into account are:

- Sheltering from the structures on the installation
- Necessity for cable runs
- Accessibility for service engineers
- HSE issues during servicing - derrick climbing, overside-working, etc.
- Interference and corrosion issues due to hot gas emissions
- Careful documentation of sensor elevation relative to platform bench mark (required to facilitate correction of wind speed to standard height).

The telecom mast should be considered as the default location for a wind sensor. If telecom mast is deemed inadequate, then the top of the crane(s) A-frame(s) combined with a crane rotational direction sensor may be considered.

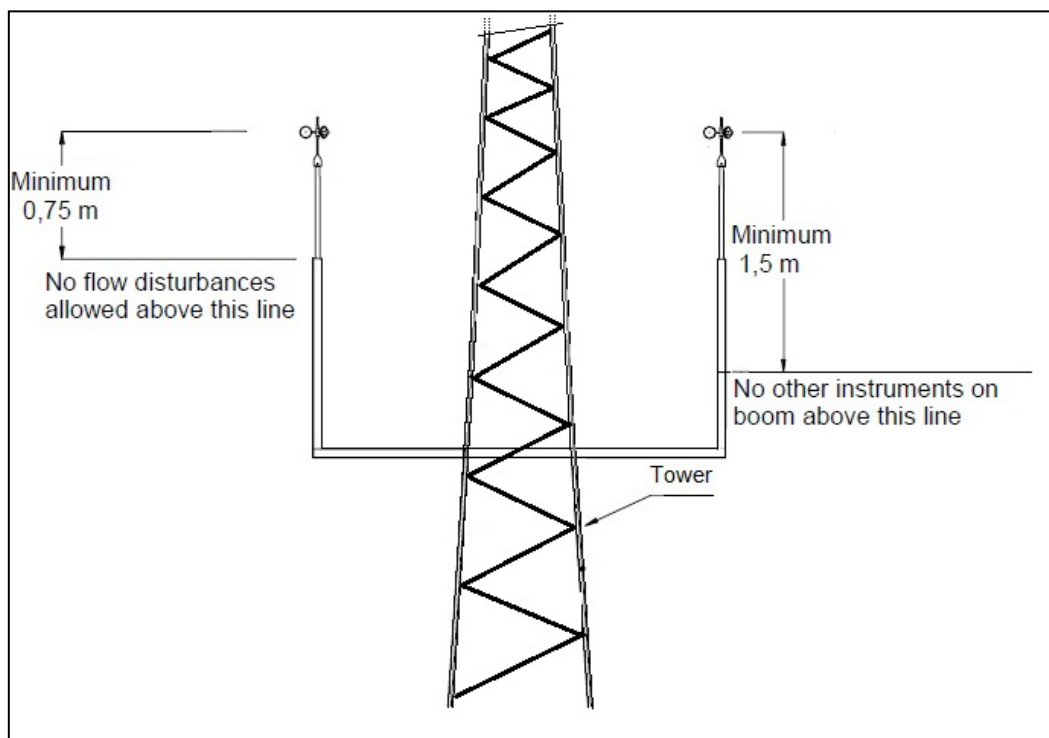


Figure 4 - typical 2 anemometers position

6.5.2 Sensor

The sensor technology shall be of a proven type for this application.

The sensor sampling rate shall permit wind speed and direction average output averaging time of 2 and 10 minutes.

The sensor sampling rate for the 3 s gust shall be established at 4 Hz.

6.5.3 Specific requirement in case of Helideck

An additional sensor in the vicinity of the helideck can give useful information. It may be appropriate to consider the deployment of a helideck wind sensor, particularly if the platform structure is such that turbulence may occur over the helideck.

Where platform configuration permits the sitting of a wind sensor that will not interfere with helicopter operations, it is desirable that both wind speed and wind direction in the vicinity of the helideck are acquired using extra sensors. Typically sensors can be mounted on the windsock.

6.5.4 Windsock for Helideck

A wind direction indicator (windsock) is not strictly part of the I3MS, but is required by law for helicopter operations and will normally be provided by the helideck Contractor. Specifications for the windsock are as follows:

The windsock should be provided and located so as to indicate the (clean) area wind conditions at the location of the offshore unit. It is often inappropriate to locate the windsock as close to the helideck as possible where it may reduce obstacle protected surfaces, create its own dominant

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obstacle or be subjected to the effects of turbulence from structures resulting in a confused wind indication. The windsock should be illuminated for night operations. Specific installations may benefit from a second windsock to indicate a specific difference from the area wind. The equipment performances and position shall be compliant with [CAP 437](#).

6.6 Present weather and Visibility

Present weather includes precipitation, obscurations, well-developed dust/sand whirls, squalls, tornadic activity, sandstorms, and duststorms.

These parameters shall be determined by automated sensing. The sensors shall be compliant with [WMO no. 8](#) recommendations.

These parameters shall be distributed in AUTO METAR form compliantly to [WMO no. 49](#) and [WMO no. 306](#).

The sensor sampling rate shall permit output averaging time of 1 and 10 minutes.

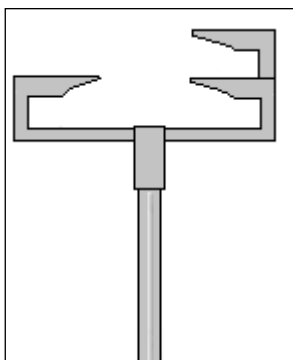


Figure 5 - Typical present weather position, sensor heads at 3 m height

6.7 Cloud base and cloud cover

These parameters shall be determined by automated sensing.

The sensors shall be compliant with [WMO no. 8](#) recommendations.

These parameters shall be distributed in AUTO METAR form compliantly to [WMO no. 49](#) and [WMO no. 306](#).

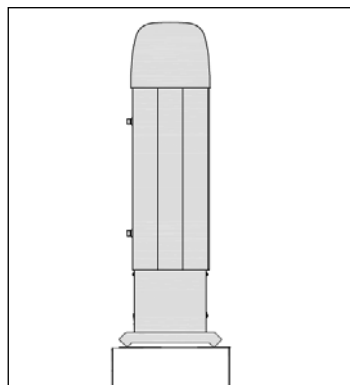
The sensor sampling rate shall permit AUTO METAR messages to use updated information between the reports time interval. The cloud amount and height of base should be referenced above sea level.

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Figure 6 - Typical ceilometer position

6.8 Precipitation

Precipitation is defined as the liquid or solid products of the condensation of water vapour falling from clouds or deposited from air onto the ground. It includes rain, hail, snow, dew, rime, hoar frost and fog precipitation.

Measurement of rate of precipitation of rainfall is frequently made via a tipping-bucket rain gauge.

Tipping bucket size must be selected according to the intensity of the rain expected. In tropical regions or other locations where deluge events might be expected, it may be appropriate to install two rain gauges, one with a bucket size appropriate to 'normal' precipitation and another with a bucket suitable for the recording of deluge events. In cold climate use of a heated system should be considered.

The sensor sampling rate shall permit intensity output averaging time of 1 minute.

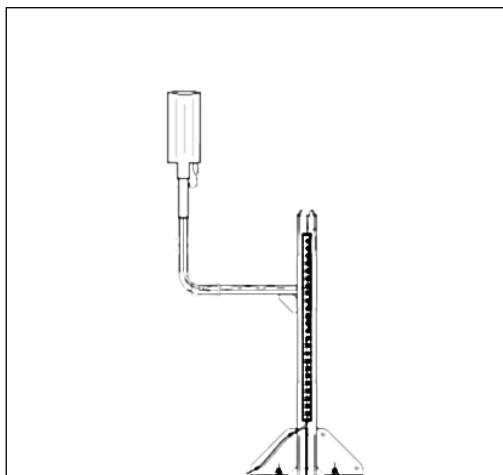


Figure 7 - Typical rainfall position

6.9 Wave

6.9.1 Type of sensors

Different wave sensors technologies may be used, the choice is mainly dependant on the type of information requested and the type of offshore unit considered.

Recommended sea state sensors may be divided into the following categories:

- Wave buoy
- Downward looking (including radar and laser devices)
- Sideways looking radar
- Use of current profiler for wave measurement.

Wave observations are split in two categories:

- Sea-state parameters including
 - Significant wave height
 - Peak wave period
 - Peak wave direction
 - Energy spectrum (wave energy vs. frequency)
 - Directional wave spectrum.
- Individual wave parameters from time series of sea surface elevation.

The Table 1 summarizes the type of wave sensor that shall be used in terms of parameters and types of structure.

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Table 1 - Type of wave sensors

	Sea-state parameters	Individual parameters
Fixed Platforms		
- Low diffraction (Jacket)	Sideways looking radar	Downward looking device
- Important diffraction (GBS)	Sideways looking radar	Wave Buoy
Floating unit		
- Low motions floaters	Sideways looking radar	Wave buoy
- Mild environment		
- Other ...		

6.9.2 Sideways looking wave radar

These sensors are generally composed of radar and a processing unit. The radar may be an X-band radar. Consideration with respect to the selection of sideways wave radar shall include:

- Associated radar should be selected with care to ensure proper observation.
- Radar antenna should be located at a sufficient height.
- Radar antenna should be located such that the minimum free viewing angle is sufficient to ensure good quality acquisition.
- The main direction of the antenna should be pointing towards the dominant wave direction.
- Radar antenna should be selected with sufficient width to obtain required accuracy.
- A 6 months to 12 months calibration with a directional buoy at site location is mandatory
- Attention should be paid to sensor efficiency especially during precipitation.
- Selection of location of radar antennae shall be done to protect personal of potential health impact due to radio-frequencies fields

Note: Sideways looking radar is also effective for upper layer (< 1 m) current acquisition.

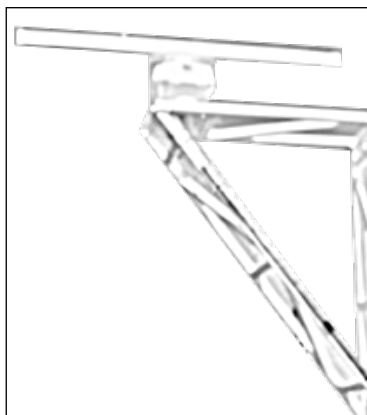


Figure 8 - Typical side way looking radar design

6.9.3 Downward looking wave sensors

Consideration with respect to the selection of a downward looking wave sensor shall include:

- Location of device shall be chosen so that the influence of the platform structure on sea level is minimized. For example an access bridge between two platforms may be a good location.
- The “half angle beam width” value of the sensor shall be clearly specified (typically: 3 to 6 degrees for radar, a fraction of degree for laser).
- The footprint on the sea level shall be clear of fixed obstructions.
- For laser device, the lense shall be regularly cleaned from sea spray, salt crystals and other dirt.

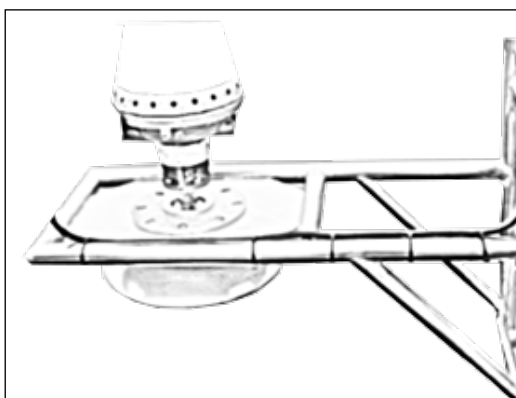


Figure 9 - Typical down looking radar design

6.9.4 Wave buoy

Consideration with respect to the selection of a wave buoy shall include:

- The location of the wave buoy shall be chosen so that waves will not be influenced by offshore structures.

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- If located in deep water and/or harsh environment, special attention shall be paid to the design of the wave buoy mooring.
- The location of the deployed mooring and its watch circle shall be known with an accuracy of 10 meters at 95% probability level.
- The wave buoy should be equipped with radar reflectors and GPS
- The wave buoy monitoring software should provide a warning onboard the offshore unit if the wave buoy gets adrift.
- A method of tracking the position of the buoy should be included in the configuration of the mooring. This method shall be working in case of mooring failure or unexpected release.
- Depending on the offshore unit location measures shall be taken to avoid damage of mooring lines by fish bites (e.g. nylon sleeve protection).
- Before and after deployment of the mooring a "Notice to Mariners" shall be issued.
- The battery life of autonomous buoys shall be clearly defined for the specific measurement and recording regime to which the buoy is configured, and service visits scheduled accordingly.
- If real-time wave information is necessary, the communication system between the wave buoy and offshore unit shall be defined.

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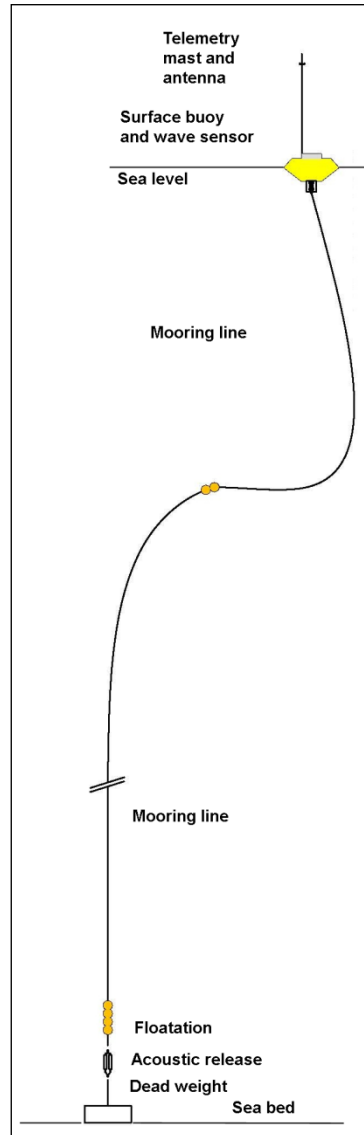


Figure 10 - Typical wave buoy design

6.9.5 Current profiler used for wave measurements

Except if specified in particular specification, upward looking current profiler solution shall not be considered for wave measurements. Practical experiences have shown the limited reliability of such solution.

If considered, a check shall be made regarding the compatibility between the high frequency cut-off of the Current Profiler wave acquisition, the depth of the Current Profiler and the wave frequency range requested. It must be noted that the extent of the wave data provided by the current profiler is considerably less than provided by the wave buoy.

The sensor sampling rate shall permit output averaging time of 20 minutes.

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6.10 Water Level

Principal techniques for the measurement of water level from fixed platforms are:

- Measurement of sea level pressure - pressure sensor
- Measurement of air gap - downward looking radar or laser sensor.

The key points to a successful water level measurement exercise are continuity, accuracy of time-keeping (time synchronization with GNSS) and accuracy of level measurement.

The sensor sampling rate shall permit water level output averaging time of 10 minutes.

6.11 Currents

The following current parameters may be measured:

- Current speed and direction at specified depth
- Current profile (speed and direction) through the water column.

If an independent mooring line is used, a "Notice to Mariners" shall be issued before and after deployment of the mooring.

The sensor sampling rate shall permit current speed and current direction output averaging time of 10 minutes.

6.11.1 Current speed and direction at a specified depth

Several instruments are designed to measure current speed and direction at fixed points. Unless specified otherwise, only instruments without any moving parts are acceptable, e.g. electromagnetic or acoustic current meters.

Unless specified otherwise, the requested current data are:

- 10 min averaged current speed
- Associated current direction.

Locations of the sensors shall be chosen to ensure measurement in free flow conditions.

6.11.2 Current profiler

Current profilers measure current speed and direction through whole or part of the water column. However:

- Current Profilers cannot measure currents near the sensor
- Upward looking Current Profilers cannot measure currents close to the surface
- Downward looking Current Profilers cannot measure currents close to the sea bed.

In addition, the range of measurement depends on water quality and acoustic noise from surrounding facilities. Therefore performance of the Current Profiler shall be clearly stated.

Location of the Current Profiler shall be chosen with care and agreed with Company.

The number of bins, and the location of each bin in terms of the upper and lower boundaries of the depth range, shall be defined and agreed prior to deployment.

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The battery life of autonomous Current Profilers shall be clearly defined for the specific measurement and recording regime to which the unit is configured, and service visits scheduled accordingly. Wherever, possible it is more efficient to run the current profiler from main power supplied by offshore unit. However design of the power transfer line should be carefully done to avoid early failure.

6.11.3 Deployment

A suitable method fulfilling the following requirements shall be developed:

- Easy deployment and retrieval of moorings using standard offshore vessels available at the site
- Recording of the mooring location
- Marking of positions with surface buoys, where appropriate
- Minimize wave effects on surface or subsurface buoys and on current meters
- Tracking of equipment in the event of mooring failure or unexpected early release.

Acoustic releases may be proposed if acceptable by local regulations, which may prescribe the removal of all objects from the sea floor.

Rigid frames may also be used for measurements close to the bottom or for the installation of Current Profilers.

The location of a Current Profiler shall be chosen

- To avoid acoustic beam pattern obstruction by any hard object (risers or mooring lines for instance)
- To ensure that currents are not influenced by surrounding structures.

6.12 Other oceanographic parameters

Although sea pressure, temperature, salinity, chlorophyll are presented as optional parameters, they are very useful for the scientific community to better understand the oceans. They are also potentially useful for the offshore platform operation (water intake, corrosion, environmental impact assessment, flow assurance, etc.).

[NORSOK Standard N-002](#) will generally apply to describe the functional requirements of the instruments for measuring these parameters. However, an improved accuracy is required for a better valorization within the scientific community:

- Sea pressure: 1 dbar
- Sea temperature: 1°C
- Conductivity: 1 mS/cm
- Salinity: 1 mPSU
- Chlorophyll-a: 10% within a range of 0 to 50 FFU (with a fluorescence sensor).

SI unit is hPa, 1 mbar (millibar) $\equiv$ 1 hPa (hectopascal).

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7. Manufacturing & Installation

Design of the I3MS and its deployment procedure shall be submitted to Company's specialists for review and approval.

7.1 Sensor Calibration

Full calibration of the sensors shall be performed.

A calibration certificate shall be issued stating as a minimum the measured range, accuracy and standard errors of each sensor.

All calibration shall be set to sensible default values on delivery. Calibration procedures and re-calibration schedules shall be included in the technical documentation.

7.2 Factory Acceptance Tests (FAT)

FAT procedure shall be submitted for review and approval prior to the testing.

The objective of FAT shall be as follows:

- All deliverables items, i.e. hardware, software, documentation, are compliant with the requirements. In particular, Contractor shall guarantee and test if necessary that all hardware is fit for a long-term exposure to a marine environment.
- The correct functioning of the equipment is in accordance with the associated specifications including all interfaces to other control systems.
- The system operates at, or better than, design specification under simulated load conditions over an agreed test period.
- The operator interface is accurate, safe and operable with respect to the presentation of data, alarms and implementation of the required control functions.
- No unwanted control actions can occur.
- The system can tolerate failure of individual components and be restored to full function following appropriate corrective actions being taken.

Any faults discovered during the tests that affect a significant portion of the system shall be rectified before proceeding further in the FAT. Changes to any software or programming will require a complete re-test of the software to demonstrate that no latent bugs have been introduced.

On completion of the FAT, a test report shall be submitted compiling all the test results, corrective actions and or modification made to the system during the tests.

7.3 Integrated FAT (IFAT)

Prior to shipping, an Integrated FAT shall be performed. IFAT procedure shall be submitted for review and approval prior to the testing.

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The objective of IFAT shall be to test:

- The system operation with all components connected (central system, sensors, ...)
- The system operation when interfaced to external “client” or “servers” systems (ICSS, berthing aid system, etc.).

When possible, the external systems shall be temporarily shipped, wired and started-up at the IFAT platform. Shouldn't it be possible, external systems shall be simulated, using frame generators, display computers, etc.

Any faults discovered during the tests that affect a significant portion of the system shall be rectified before proceeding further in the IFAT. Changes to any software or programming will require a complete re-test of the software to demonstrate that no latent bugs have been introduced.

On completion of the IFAT, a test report shall be submitted compiling all the test results, corrective actions and or modification made to the system during the tests.

7.4 Site Acceptance Test (SAT)

The objective of the Site Acceptance Test is to verify that the installed equipment is performing according to the specifications of this document. The SAT procedure will be derived from the FAT procedure and will include items that could not be tested during the FAT.

The tests shall include standard and functional tests and an endurance test on the equipment.

SAT procedures shall include the functional tests to be conducted in case of system upgrade in order to reach, at minimum, the previous level of functionalities and performances.

SAT procedures shall be submitted for approval prior to the testing being carried out.

7.5 Tagging

All instruments shall be tagged as defined in [GS EP INS 101](#).

7.6 Shipment and Storage

The monitoring system shall be delivered in a packaging suitable for transportation and long term storage.

Packaging shall be such that it provides a mechanical safeguard against damage during handling, transit and transport.

All specific handling recommendations shall be clearly indicated on the packaging in an easily readable location.

In addition, a detailed procedure for handling, storing and preserving the monitoring equipment shall be provided.

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7.7 Technical Documentation

As a minimum, the following list of technical documents shall be provided for review and approval:

- HSE and Quality plan
- Design Basis documents
- Monitoring system technical specifications for both hardware and software systems
- General Arrangement and Details assembly drawings
- Interface List
- Equipment List
- Bills of materials, instrument data sheet, cable list, instrument list
- Detail on data communication, protocol and transport media
- Manufacturing procedures, including installation, painting and welding procedures
- Electrical wiring diagram and block diagram
- Testing procedures including Sensor Calibration, FAT, SAT procedures and associated reports
- Shipping and storage procedure, handling recommendation
- Deployment and Installation procedure
- Pre-commissioning and commissioning procedure
- Operation and Maintenance manuals
- Manufacturer data book
- Spare parts lists.

As part of technical documentation, list of metadata provided in Appendix 4 shall be provided.

7.8 System upgrade

During the lifetime period the I3MS system may be subject to upgrade due to obsolescence or improvement.

In such case, an analysis of the consequences shall be performed and SAT section applicable to test the involved equipment shall be clearly established prior the operation.

8. Operation

The I3MS is required to do much more than simply capture signals output by a sensor, and display them. It may, for example, be required to:

- Apply additional calibration algorithms to correct for any systematic error in sensor performance.

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- Apply datum correction algorithms, for example to convert wind speed from speed at the height of the anemometer to speed at 10 m above sea level using standard wind profile algorithms.
- Convert data from one unit into another, e.g. from m/s into knots for helicopter operations.
- Derive averages over different periods, for example 3 second, 2 minutes, 10 minutes and 1 hour.
- Observations shall be made at standard synoptic hours, expressed in terms of UTC.
- Record both raw and processed data.
- Compute basic statistics (mean, max, min, RMS), filtering.

The following conceptual design generally applies with respect to each parameter:

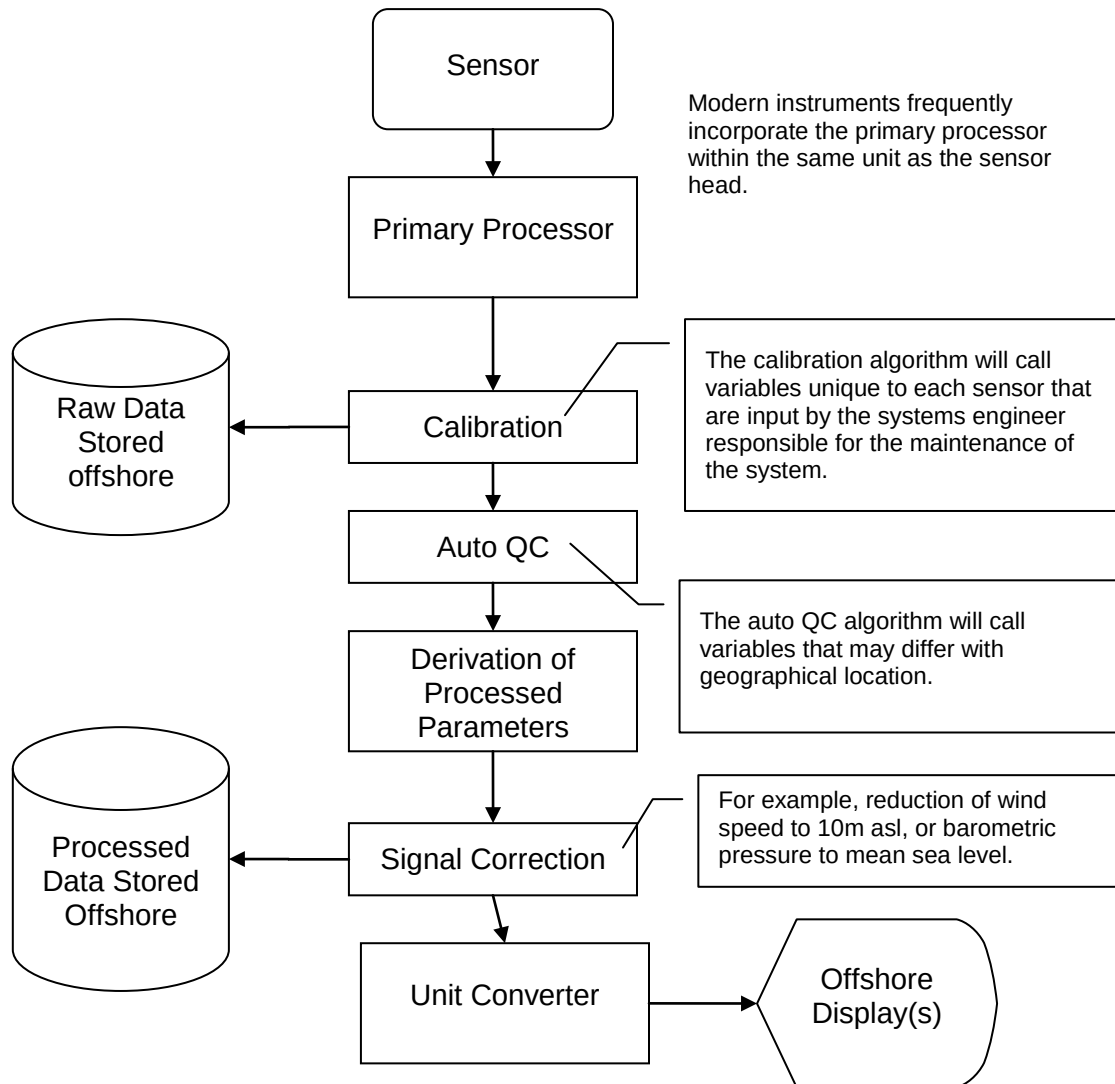


Figure 11 - Conceptual Design of Data Acquisition and Display System

From data measured to displayed data, various algorithms will be applied either for:

- Calibration purposes
- Mean value calculations
- Conversion of units
- Corrections to take into account height variation.

All the algorithms and formulae used shall be clearly stated in technical documentation.

All raw data should be stored for post process analysis and archive.

If information external from I3MS should be used in these algorithms, they should be stored with the processed data. For instance, draft of a FPSO should be stored with 10 meters wind speed.

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However, the system should be fail-safe so that if the information is not available the data is still reported (and flagged accordingly) based on best guess (mean value for instance) of the relevant information.

Design of I3MS shall ensure that data acquisition will not be stopped in abnormal cases (extreme events, offshore unit abandonment, etc).

8.1 Auto QC

It is requested that a degree of automatic quality control be applied by the system prior to display of values. As each new data value is passed on for processing it may be checked as follows:

- Range (values must lie between specified minima and maxima)
- Variability (check for repeated identical values)
- Rate of change (within physical limits for the parameter in question)
- Spread (values must lie within 'n' standard deviations of sample mean).

The values at which various thresholds should be set may vary with region and the actual threshold settings must be tuned to the location in question.

8.2 Signal Correction

8.2.1 Wind

Prior to its display for use in connection with helicopter operations the wind speed signal shall be corrected to the standard reference height of 10m above sea level. Reference height shall be clearly stated on wind display. Exceptionally, if the wind is specifically the 'Helideck' wind speed and direction reported by an anemometer adjacent to the Helideck, then it should be displayed without height correction.

Wind profile given in [ISO 19901-1](#) or in [WMO no. 8](#) is suggested for height correction.

'Sea level' should be defined as 'Mean Sea Level'. Note that the reference datum of the offshore unit itself, to be defined in the particular specification, will probably be the Lowest Astronomical Tide (LAT) and it may therefore be necessary to account for the offset between LAT and Mean Sea Level when calculating the reference height of the anemometer.

Draft variation of the unit, if any, shall be taken into account when calculating reference height. To calculate the true wind direction, the I3MS shall receive at minimum gyrocompass heading information. If necessary, attitude data will also be received.

8.2.2 Pressure

In accordance with aviation requirements the barometric pressure must be converted to mean sea level pressure (QNH) and helideck reference level (QFE). There are several approved formulae for this task, for example:

$$P = 1013.25 [1 - \{1 - (E/44307.69321)\}^5]^{5.253283}$$

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Where:

- E Elevation of pressure head in meters above sea level.
- P The additional pressure that will be measured if the sensor were to be re-positioned to mean sea level.

Where other formulae are offered they may be verified against the above. Differences should be within ± 1 hPa.

8.2.3 Dew Point and Relative Humidity

The formulae defined in [WMO no. 8](#) is recommended for dew point determination.

8.3 Storing and Archiving

8.3.1 General Requirements

All data shall be recorded with a common time base and synchronization of all the sensors shall be ensured. The data shall be recorded at fixed time, meaning beginning of every hour (12h00) or hour plus 10 min (12h10). Recording at "random" time such as, e.g., 12h17 shall be avoided.

As GNSS is providing UTC time, it is suitable that the synchronization will be performed automatically using this equipment. For equipment not linked to I3MS, the synchronization shall be checked / performed during the maintenance operations and recorded.

The system shall offer sufficient capacity for 1 year operation of the monitoring system. Automatic safeguarding of data and rebooting in case of power failure or software crash shall be ensured.

All input/output shall be, at minimum, in English language.

Every 6 months (or more frequently if specified by) raw and processed data shall be archived on digital media. As a minimum, two copies of the data shall be sent to the metocean representative in Company headquarter (DEV/TEC/GEO for TOTAL).

Data should be stored in self-describing file. The file type shall be ASCII. The files shall be readable with PC based computers, running Microsoft Windows®. A detailed file content description shall be given.

Where data compression is used, for example for the recording of large quantities of raw data, then software for the de-compression of the data must be supplied to Company with the I3MS so that Company can access the data as engineering values without the assistance of the supplier of the I3MS or any other third party.

Except when defined otherwise in this specification, the data shall be recorded with a time sampling equal or lower to temporal resolution defined in [WMO no. 8](#), Part I, section 1, Annex C.

Recorded parameters shall be derived from the time period preceding the allocated time stamp. Where the averaging period is less than the time interval between samples, the last averaged value shall be recorded unless otherwise specified.

AUTO METAR and SHIP reports shall be recorded.

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8.3.2 Wind

Every 10 minutes, the following raw and processed data shall be recorded:

- Date and time
- Wind speed and direction with a sampling rate equal to 1 Hz during the 10 minute period preceding the record
- Last averaged and highest 3 second gust wind speed and direction during the 10 minute period preceding the record
- Last averaged and highest 1 minute mean wind speed and direction during the 10 minute period preceding the record
- 10 minute mean wind speed and direction
- 1 hour mean wind speed and direction during the one hour preceding the time stamp
- Draft and heading in case of floating unit.

The highest 3 second gust in 10 minutes means is defined as the higher of a 3 second rolling mean updated at 1 second intervals throughout a 10 minute period.

8.3.3 Wave

Sea-state parameters

Raw wave data should be sampled continuously at not less than 2 Hz. Individual wave parameters will be extracted from the raw data covering the 1 hour period prior to the allocated sample time.

Sea-state samples may be derived from appropriate subsets of the raw wave data for example 4096 points spanning 34 minutes and 8 seconds. The sea-state data should be derived from raw wave data gathered over a period ending at the allocated sample time.

If sensor permits:

- Global wave parameters with a 20 min sampling rate
- Local wave parameters with a 2 Hz sampling rate.

If such rate is not available maximum record rate shall be used for recording these items.

Every hour, the following parameters shall be recorded:

- Date and time
- Significant wave height
- Peak wave period
- Peak wave direction
- Significant height for swell partition (if fitted)
- Peak wave period for swell partition (if fitted)
- Peak wave direction for swell partition (if fitted)

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- Significant height for wind sea partition (if fitted)
- Peak wave period for wind sea partition (if fitted)
- Peak wave direction for wind sea partition (if fitted)
- 2-dimensional frequency spectrum
- 1-dimensional spectrum.

Individual wave parameters

Every hour, the following raw and processed parameters shall be recorded:

- Date and time
- Wave elevation time series
- Significant wave height
- Peak period
- Up-crossing period
- Maximum wave height
- Period associated to maximum wave height
- Maximum crest height
- Maximum wave trough.

These parameters shall be derived from the one hour period preceding the allocated time stamp.

8.3.4 Current

If sensor permits:

- Current parameters with a 1 min sampling rate.

If such rate is not available maximum record rate shall be used for recording these items.

Every hour, the following parameters shall be recorded:

- Date and time
- 10 minute Mean current speed and direction at specified water depth.

8.3.5 Water level

Every 10 minutes, the 10 minutes mean water level shall be recorded.

8.3.6 Positioning system

If helicopter operations are considered, recording of the data shall be done according to sampling requested by [CAP 437](#) and [Bristow Group, Bond and CHC](#).

If structural monitoring is performed, position data shall be recorded with a frequency of 1 Hz.

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If pipeline and riser monitoring is performed, position data shall be recorded with a frequency of 1 Hz.

Draft and positions (including heading, trim and heel) of floating units shall also be recorded every 10 minutes if structural or pipeline and risers monitoring are considered.

8.4 Analysis and Reporting

AUTO METAR and SHIP messages shall be created at synoptic hours as specified in [WMO no. 49](#) and [WMO no. 306](#).

A Daily report shall be established based on AUTO METAR and SHIP reports.

Every year a Metocean report should be issued during the maintenance operation. This report should be composed of two parts: service and analysis.

Service part shall include, but not necessarily be limited to the following information:

- Project name and location
- Period covered by the report
- Description of instruments and measurements
- A summary of the instrument calibration checks, and any calibration corrections applied to the data
- Position of instruments
- Presentation of the recorded data
- Percentage of data return, for each parameter
- Comments on quality of data
- Presentation of the processing and analyses, for each parameter
- All necessary information on measurements.

Analysis shall include quality control of the data. This quality control shall permit to segregate valid and erroneous measurement. Analysis part shall be composed of processed data as per [GS EP GEO 504](#). Derivation of extremes values shall be made only if specifically requested.

8.5 Sensor Drift

During life of the I3MS, the potential drift of sensors shall be checked.

These checks may be performed either during the preparation of the Metocean report or during Maintenance visits by comparison with other measurements, as available.

Where sensor drift is observed, corrective action shall be taken. Contractor shall advise what is the level of acceptable sensor drift (i.e. not requiring recalibration or change of sensor).

9. Displays

This section provides generic information regarding displays. Displays content shall be submitted for approval.

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9.1 General Requirements

- The equipment shall provide a timely, accurate and uncorrupted display of meteorological information.
- The display device shall be designed in such a way as to draw the attention of the operator to significant changes in the displayed meteorological information.
- Where multiple wind sensors are fitted, the display shall clearly indicate the sensor or location from which the meteorological information is derived.
- Numeric and graphical displays used to display other forms of meteorological information shall provide a clear indication of function and assignment.
- A suitable method for indicator testing and controlling display luminance shall be provided.
- Fully integrated multi-function displays used in connection with safety related equipment shall show station time to within plus or minus 5 seconds.
- The display equipment shall be installed in a position such that it remains readable in all ambient light levels.
- Detail of all configuration and calibration settings, with a password protected facility to change them.

9.2 Alarm Conditions and Warning Flags

In accordance with the requirement that the display should be designed in such a way as to draw attention to significant changes, alarms should be built into the system. These alarms are to trigger audio alert and color warning flags on the display screen when parameter thresholds and/or rates of change are exceeded, thus indicating adverse weather. Alarms may trigger at various levels, for example: alert (yellow), warning (orange) and danger (red).

Note that the alarm thresholds for helicopter and marine operations may differ in which case separate display screens that might look identical when conditions are benign, but will differ as alarms are raised at different thresholds. Therefore alternative displays may be required for various applications.

The actual values at which alarms will trigger will be installation specific and therefore lie outside the scope of this document and shall be agreed with Company.

9.3 Typical Display Screens

I3MS that operate with the full range of sensors produce too much information to display on a single screen. It is therefore to be anticipated that a full system will include several screens, for example:

- Helicopter operations (alarm thresholds set for helicopter operations)
- Marine operations (alarm thresholds set for marine/crane operations)
- Structural monitoring (alarm thresholds set for general non-specific alerts)
- Pipeline monitoring (alarm thresholds set for general non-specific alerts)
- HSE (alarm thresholds set for general non-specific alerts)

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- Weather observations (alarm thresholds set for general non-specific alerts)
- Sea operations (alarm thresholds set for general non-specific alerts)
- System status
- Plotting facility to view past data
- Calibration facilities to adjust sensor calibration and offsets.

Easy user interface shall allow entering the visual estimations made by qualified personal (visibility, etc).

An advertising must be displayed in order to give the following feedback contact: DEV/TEC/GEO.

9.3.1 Display Screens Content

Considerations are:

- What must be displayed for the specific screen?
- How big must the numbers be?
- What else can be fitted on the screen?

In some cases users may specify a 'large digits' display option.

The content of each display screen, presented below, is a recommended basis for illustration only. Actual content shall be updated during the design phase to take into account:

- Specificities of the offshore unit (need for a berthing aid for instance)
- Display of optional acquisition such as current measurement if any
- Other...

The recommended content for the principal display screens is as follows.

9.3.2 Helicopter operations

This display shall comply with [GS EP LSO 115](#), [CAP 437](#), [Bristow Group](#), [Bond](#) and [CHC standards](#).

- Current date and time (Zulu/Local clearly stated)
- Instantaneous wind speed (knots) and direction (3 second values updating at 3 second intervals)
- Averaged of wind speed (knots) and direction (last 2 minutes) updating at 1 minute intervals
- Averaged wind speed (knots) and direction (last 10 minutes) updating at 1 minute intervals
- Maximum 3-second gust speed (knots) and direction over the last 2 minutes
- Maximum 3-second gust speed (knots) and direction over the last 10 minutes

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- Maximum average heave rate (the average heave rate of the largest wave (peak value) in metres per second within a 20-minute time frame)
- Average heave rate (average speed of the helideck between the top and the bottom of a wave movement curve)
- Heave period (in seconds)
- Roll (maximum in degrees from mean position over last 20 minutes)
- Pitch (maximum in degrees from mean position over last 20 minutes and trend at 3 hours interval)
- Heading in degrees True (1 second values updating at 1 second intervals)
- Position in WG84 or as specified by particular specification (local projection)
- Barometric Pressure in hPa at Helideck level (average over the last minute)
- Barometric Pressure in hPa at Helideck level (average over the last 2 minutes)
- Barometric Pressure in hPa at Sea level (average over the last minute)
- Barometric Pressure in hPa at Sea level (average over the last 2 minutes)
- Air temperature in degrees Celsius (average over the last 1 minute)
- Air temperature in degrees Celsius (average over the last 2 minutes)
- Dew point temperature in degrees Celsius (average over 1 minute)
- Relative humidity in % (average over the last 2 minutes)
- Altitude of lowest cloud base in feet
- Cloud coverage in oktas and in stated as few/scattered/broken/overcast (FEW/SCT/BKN/OVC) in feet above the surface
- Visibility in meters (average over the last 10 minutes)
- Rain amount (over the current 24 h)
- Rain intensity (over the last 1 minute)
- Present weather (if available)
- Significant wave height in meters (if available)
- Maximum wave height in meters (if available).

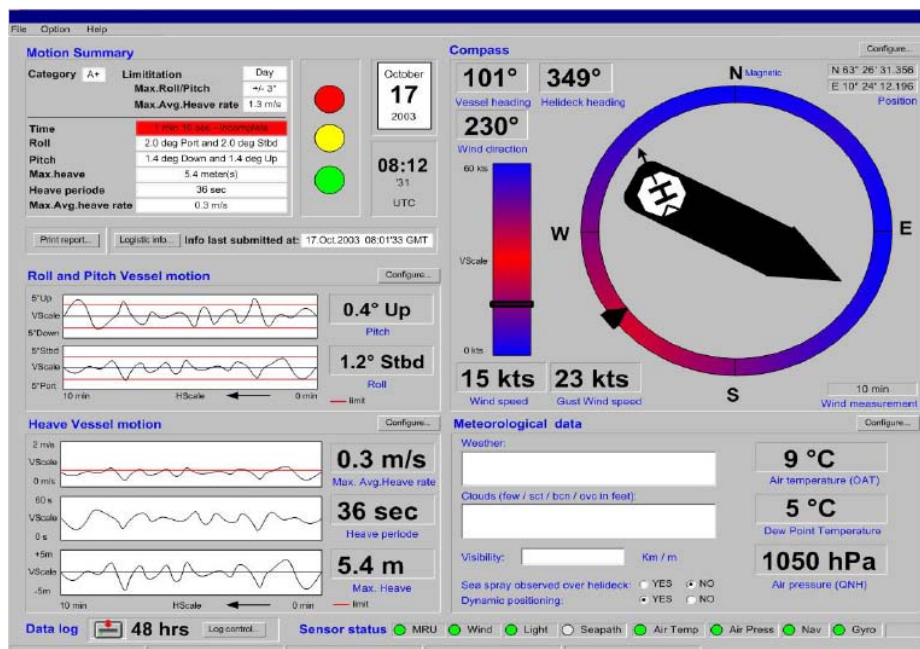


Figure 12 - Typical plot for helicopter operation screen

9.3.3 Marine Operation

- Current Date and Time (Zulu/Local clearly stated)
- Instantaneous wind speed (knots) and direction (1 second values updating at 1 second intervals)
- Averaged wind speed (knots) and direction (last 2 minutes) updating at 1 minute intervals
- Averaged wind speed (knots) and direction (last 10 minutes) updating at 1 minute intervals
- Maximum 3-second gust speed (knots) over the last 2 minutes
- Maximum 3-second gust speed (knots) over the last 10 minutes
- Significant wave height in meters
- Mean wave period in seconds
- Maximum wave height in meters
- Tidal level in meters relative to specified datum
- Tidal trend, graphical last 2 minutes
- Currents at different depths to be specified in particular specification (averages over the last 10 minutes).

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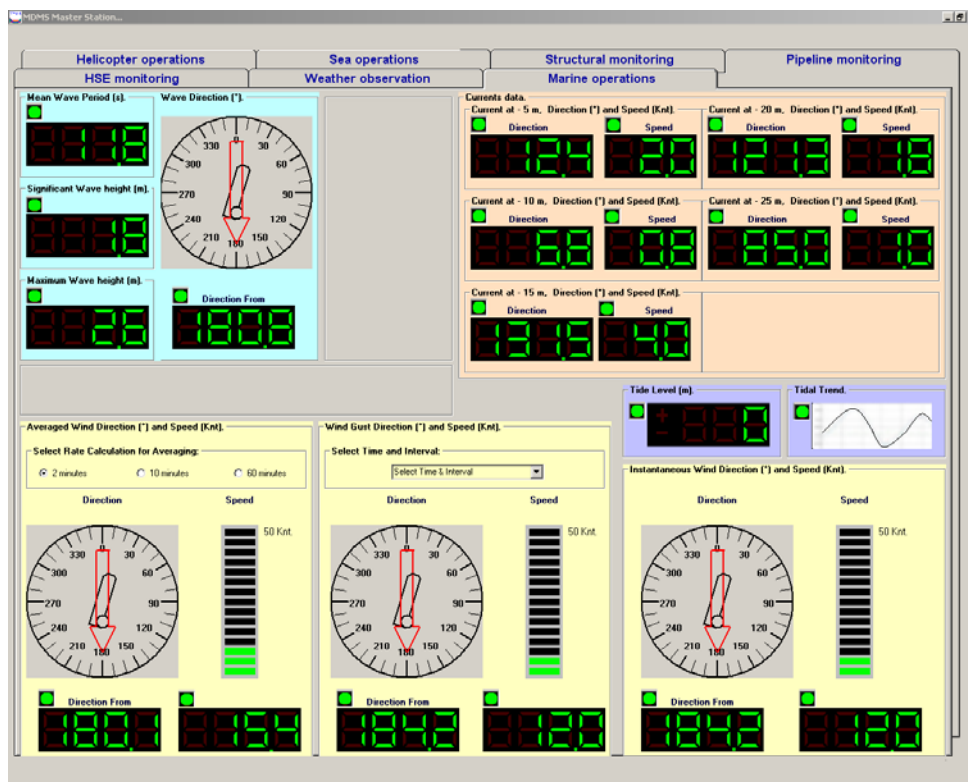


Figure 13 - Typical plot for marine operation screen

9.3.4 Structural monitoring

- Current Date and Time (Zulu/Local clearly stated)
- Instantaneous wind speed (knots) and direction (1 second values updating at 1 second intervals) or better if available
- Averaged wind speed (knots) and direction (last 10 minutes) updating at 1 minute intervals
- Maximum 3-second gust speed (knots) over the last 10 minutes
- Currents at different depths, to be specified in particular specification (averages over the last 30 minutes)
- Heave (maximum trough to crest excursion over the last 20 minutes in meters)
- Heave period (in seconds)
- Roll (maximum in degrees from mean position over last 20 minutes)
- Pitch (maximum in degrees from mean position over last 20 minutes)
- Heading in degrees True (1 second values updating at 1 second intervals)
- Position in WG84 or as specified by particular specification (local projection recommended)

- Significant wave height in meters
- Mean wave period in seconds
- Maximum wave height in meters
- Drafts (6 values)
- Plot of wave spectral energy in m^2/Hz against frequency and direction.

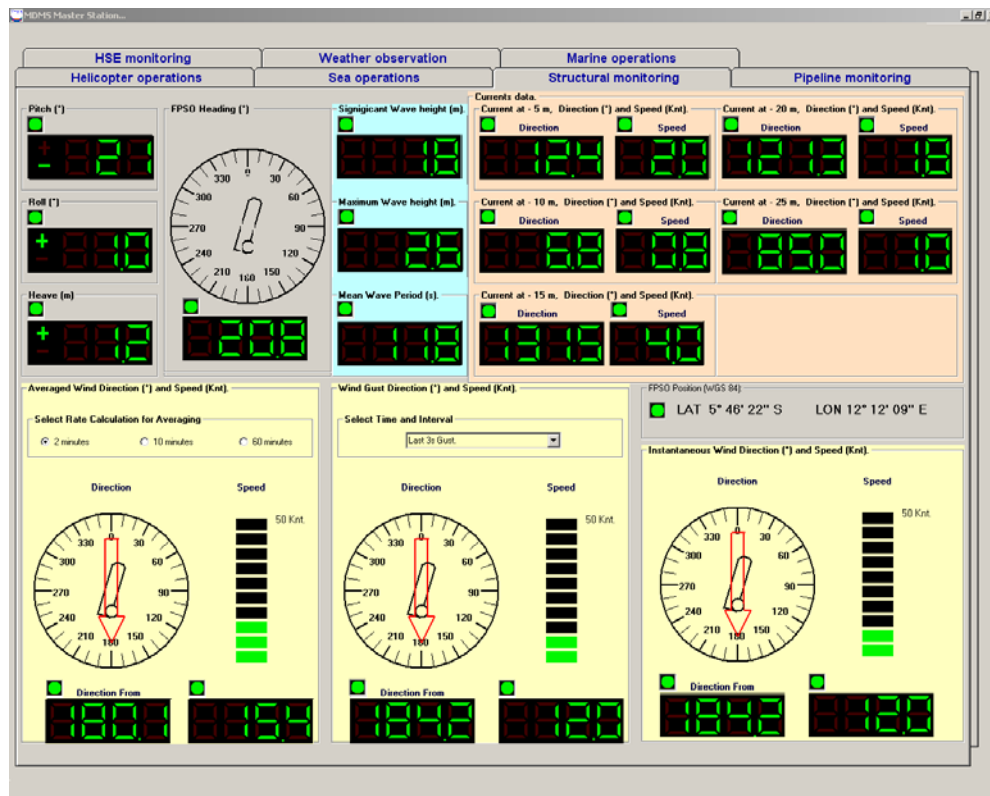


Figure 14 - Typical plot for Structural monitoring screen

9.3.5 Pipeline monitoring

- Current Date and Time (Zulu/Local clearly stated)
- Heave (meters)
- Heave period (in seconds)
- Roll (degrees)
- Pitch (degrees)
- Surge acceleration (g)
- Sway acceleration (g)
- Heave acceleration (g)
- Roll rate (deg/s)

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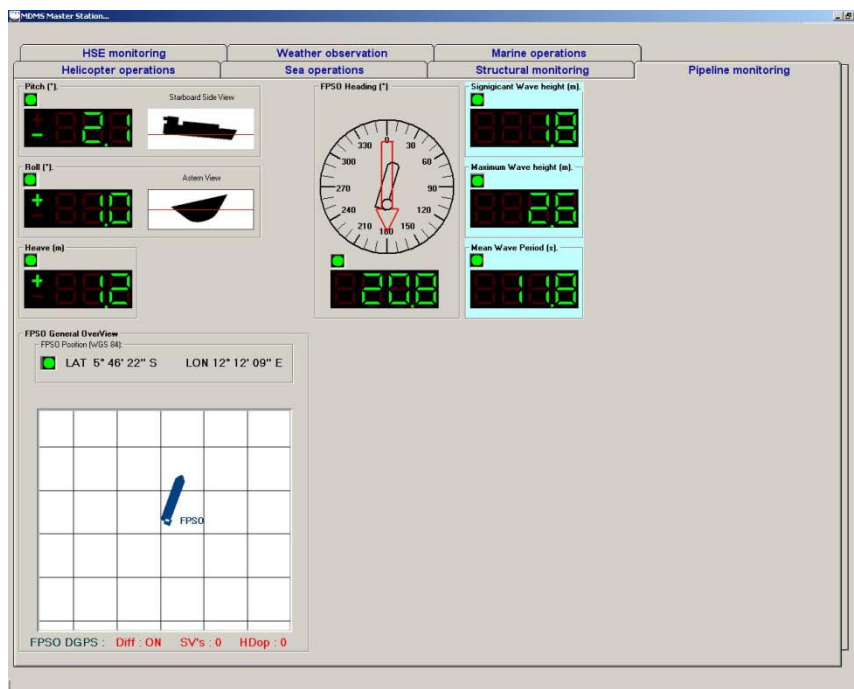
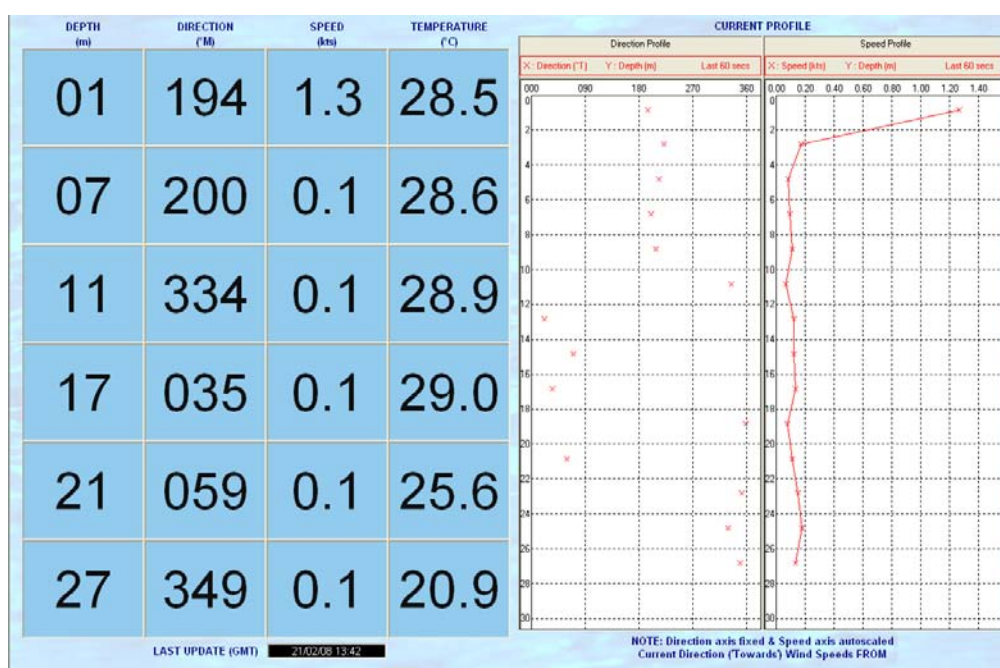
- Pitch rate (deg/s)
- Yaw rate (deg/s)
- Heading in degrees True (1 second values updating at 1 second intervals)
- Position in WG84 or as specified by particular specification (local projection)
- Significant wave height in meters
- Peak period in seconds
- Maximum wave height in meters
- Mean wave period in seconds
- For several depths (i) along riser:
 - Depth (m), current speed (m/s) and direction(deg).

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Figure 15 - Typical plot for Pipeline monitoring screen

Figure 16 - Typical plot for current profile
9.3.6 HSE

- Current Date and Time (Zulu/Local clearly stated)

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- Averaged wind speed (knots) and direction (last 10 minutes) updating at 1 minute intervals
- Maximum 3-second gust speed (knots) over the last 10 minutes
- Currents at different depths, to be specified in particular specification (averages over the last 10 minutes)
- Air temperature in degrees Celsius (average over the last minute)
- Rain amount (over the current 24h)
- Rain intensity (over the last minute)
- Present weather (if available)
- Cloud coverage in oktas
- Tidal level in meters relative to specified datum
- Tidal trend, graphical last 2 minutes
- Currents at different depths, to be specified in particular specification (averages over the last 10 minutes).

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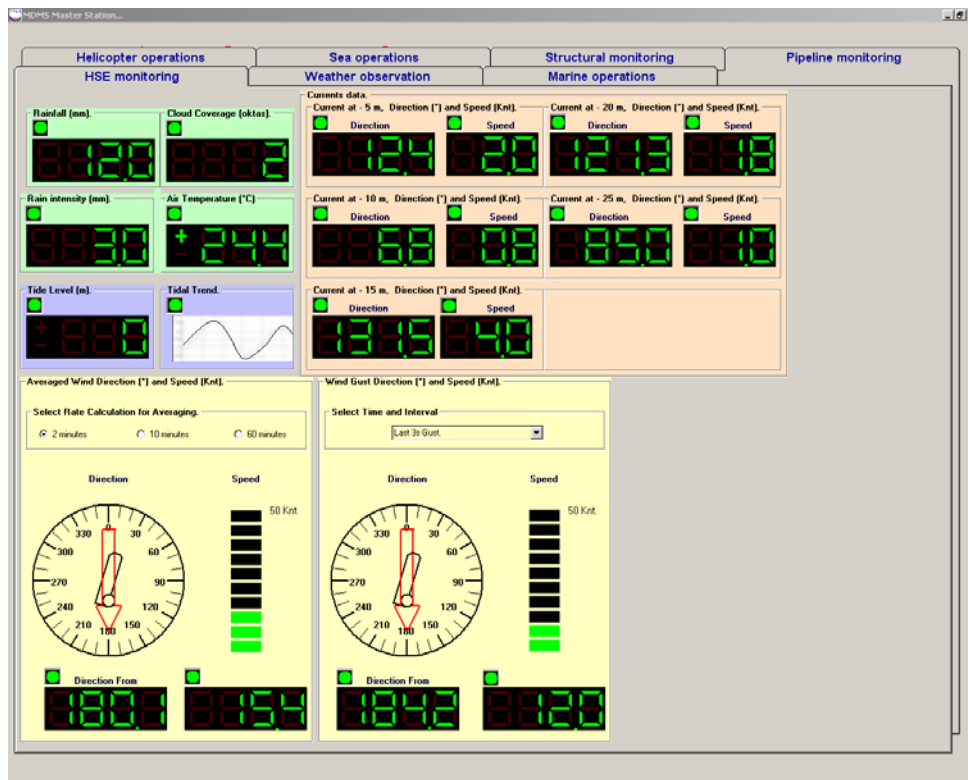


Figure 17 - Typical plot for HSE monitoring screen

9.3.7 Weather observation

- Current date and time (Zulu/Local clearly stated)
- Instantaneous wind speed (knots) and direction (1 second values updating at 1 second intervals) for both sensors if second sensor available
- Averaged wind speed (knots) and direction (last 2 minutes) updating at 1 minute intervals for both sensors if second sensor available
- Averaged wind speed (knots) and direction (last 10 minutes) updating at 1 minute intervals for both sensors if second sensor available
- Maximum 3-second gust speed (knots) over the last 2 minutes for both sensors if second sensor available
- Maximum 3-second gust speed (knots) over the last 10 minutes for both sensors if second sensor available
- Wind speed and direction data for helideck sensor if fitted
- Wind gust data for helideck sensor if fitted
- Barometric pressure in mb at sea level (average over the last minute)
- Barometric pressure in mb at Helideck level (average over the last minute)

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- Barometric pressure at sea level from second sensor if fitted (average over the last minute)
- Barometric pressure at helideck level from second sensor if fitted (average over the last minute)
- Air temperature in degrees Celsius (average over the last minute)
- Wet air temperature in degrees Celsius if fitted (average over the last minute)
- Relative humidity in % (average over the last minute)
- Dew point in degrees Celsius (average over the last minute)
- Wind chill in degrees Celsius (average over the last minute)
- Altitude of lowest cloud base in feet
- Cloud coverage in oktas
- Visibility in metres (average over the last minute)
- Visibility in metres (average over the last 10 minutes)
- Rain amount (over the current 24 h)
- Rain intensity (over the last minute)
- Present weather (if available).

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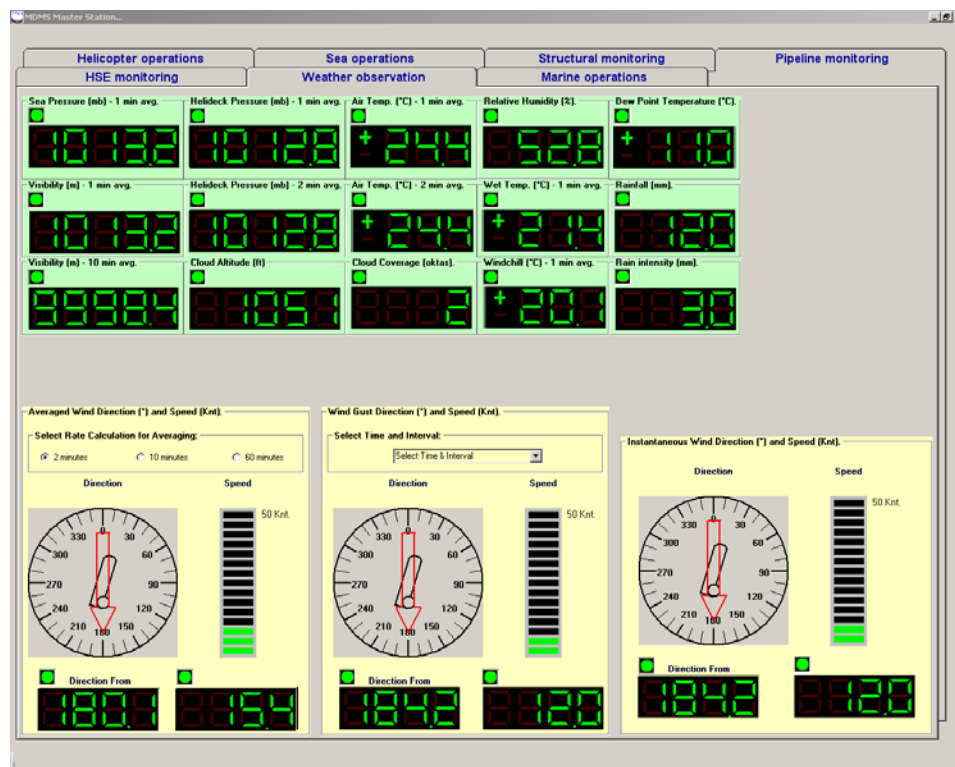


Figure 18 - Typical plot for weather observation screen

9.3.8 Sea observation

- Current date and time (Zulu/Local clearly stated)
- Significant wave height in meters
- Maximum wave height in meters
- Maximum crest elevation in meters
- Mean wave period in seconds
- Wave direction
- Plot of spectral energy in m^2/Hz against frequency and direction
- Spectral peak period in seconds
- Currents at different depths, to be specified in particular specification (averages over the last 10 minutes)
- Significant wave height - wind sea partition - in meters (if fitted)
- Spectral peak period– wind sea partition - in seconds (if fitted)
- Wave direction - wind sea partition - in seconds (if fitted)
- Significant wave height - swell partition - in meters (if fitted)
- Spectral peak period - swell partition - in seconds (if fitted)

- Wave direction - swell partition - in seconds (if fitted)
- Tidal level in metres relative to specified datum (if fitted)
- Tidal trend, last 2 minutes (if fitted).

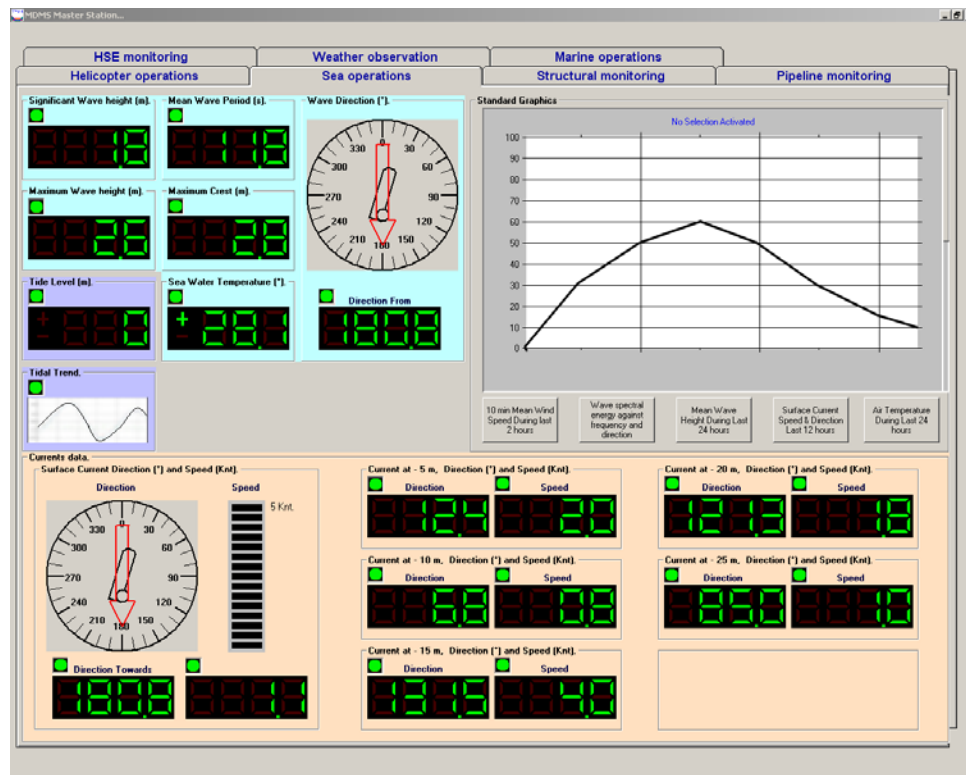


Figure 19 - Typical plot for sea observations screen

9.4 System Status

Displays of system status should distinguish between problems caused by:

- Total sensor failure that needs attention
- A temporary data gap that requires no action.

The system status display should indicate the age of the data. This may be:

- Current - i.e. fully up to date
- Recent, but not current - i.e. an update should have been received, but has not. The data are therefore not fully up to date, but the displayed value is sufficiently recent to be indicative of present conditions (say values up to 30 minutes old)
- Ageing - i.e. an update has not been received for some time (say up to 3 hours)
- Off-line - no data received within the last 3 hours.

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The system status display should also indicate the validity of the data, as detected by the auto-QC routines. The system status routines should intervene to prevent:

- The display of null values
- The display of values that have failed auto-QC.

The system status display should provide information on wave buoy (ref. 6.10.4) or mooring line position (ref. 6.12.3). An alarm shall be activated if the buoy is drifting outside a defined perimeter. Position of the buoy or mooring line should be recorded.

PARAMETER	SENSOR STATUS	PARAMETER	SENSOR STATUS
WIND SPEED SENSOR	OK	WIND DIRECTION SENSOR	OK
BAROMETRIC PRESSURE	OK	GPS	OK
AIR TEMPERATURE	OK	RELATIVE HUMIDITY	OK
MOTION SENSOR	OK	GYRO	OK

System Started	08/06/2011 15:03 UTC	Disk Space C: (Mb)	29676	Disk Space D: (Mb)	0	Last Update	08/06/2011 16:43 UTC
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Figure 20 - Typical display for sensor status

9.5 Maintenance page

The maintenance manual shall be available on the computer hosting the I3MS.

All relevant information regarding the whole I3MS system (software shut down, disk full, software reload, sensor failure and replacement, maintenance operation and generally speaking all events including any part of the system shall be logged in a dedicated table by an authorized user. At minimum the table shall inform about

- Date and time of the event
- Name of user
- Title of user
- Modification cause

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- Modification description
- Documents reference if existing.

The maintenance table shall be easily shared typically by using exporting or printing facilities.

Maintenance page shall also include information on future maintenance activities to be performed. Especially, at start up of the I3MS system, developer of I3MS should fill the maintenance page with a schedule of planned routine service and maintenance to be done on all I3MS equipment. Reminder of routine service should be automatically issued by the system at due time.

9.6 Plotting Facility

Suitable software will be proposed to configure mimics and display real-time data and trends.

The plotting facility should, as a minimum, allow the user to select a parameter and period (between 1 hour and 30 days prior to present) over which to display the data.

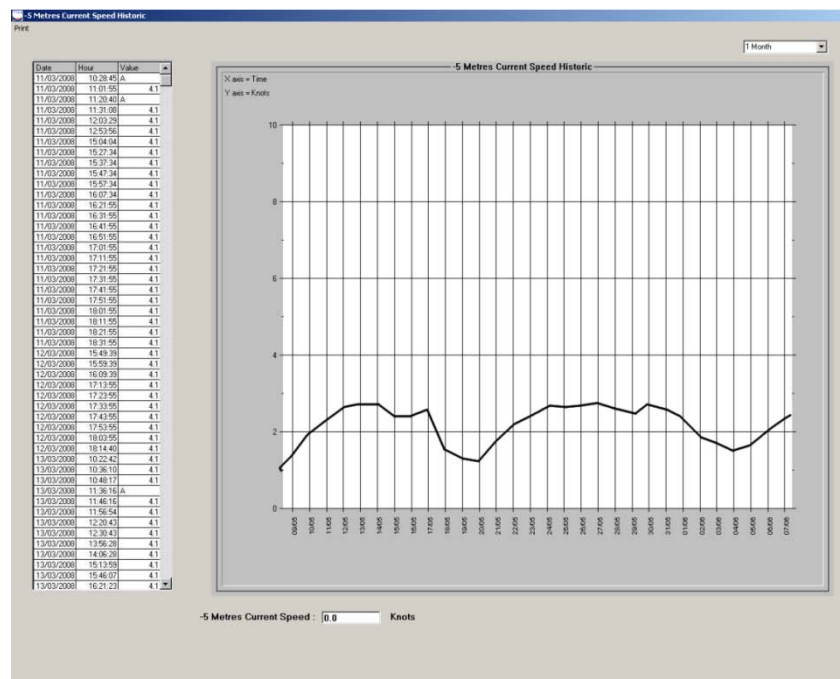


Figure 21 - Typical plot for plotting facilities.

9.7 Calibration Facility

The calibration facility should allow the systems engineer to apply a simple linear calibration of the form “ $y = mx + c$ ” to each parameter, if needed.

The calibration facility is also the point at which offsets are entered, for example:

- Barometric pressure sensor height above mean sea level
- Helideck height above mean sea level
- Anemometer height above mean sea level

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- Wave sensor height above LAT
- Offset of the GNSS receiver with respect to the Position reference point

10. Maintenance

10.1 During project phase

During the course of a project Maintenance and Inspection Engineering is performed, consisting of several simultaneous activities:

- Maintainability and Inspectability studies **GS EP EXP 201**
- Documentation management **GS EP EXP 203**
- Spare-parts selection **GS EP EXP 205**

To ensure proper operation and maintenance of the I3MS, Contractor in charge of design and procurement of I3MS shall provide all information necessary for performance of Maintenance and Inspection Engineering study. Information to be provided is described in **GS EP EXP 201**, **GS EP EXP 203**, **GS EP EXP 205** and **GS EP EXP 207**.

10.1.1 Spare Parts Lists

A list of spare parts necessary for start-up and also for the first two years of operations shall be provided.

The availability of sufficient spares and necessary consumables shall be ensured to support onshore testing, offshore commissioning and life of the I3MS.

10.1.2 Training

During project phase, a training session should be prepared on how to operate and maintain the I3MS system. Training session should be provided to future marine operators and maintenance operators. Ideally, this training session should be done during commissioning of the unit.

During field operations, this training should be provided to new operators in connection with the system.

10.2 During operation

In order to maintain I3MS a suitable Contractor will be required to perform:

- Routine service and maintenance
- Ad hoc visits in response to system failures.

The selected Contractor will require:

- Detailed knowledge of the sensors fitted to the system
- Detailed knowledge of the processing and display software
- The necessary offshore working permits.

If a significant modification is planned to be performed then the relevant functional tests, included in the SAT, shall be performed in order to verify that the I3MS functionalities are not

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corrupted. This should typically apply for any upgrade or equipment replacement by new devices.

In case of software evolution the possibility to downgrade to the previous version shall be available.

10.2.1 Prior to an Offshore Service and Maintenance Visit

It is recommended that the selected Contractor prepares a pre-visit schedule detailing:

- The nominal scope of work
- The prioritization of each task
- The anticipated total duration of each offshore visit
- The requirement for bed space, if any, on the offshore installation
- Any assistance required from platform personnel.

The Contractor should then liaise closely with the appropriate offshore dispatch personnel with respect to sea or air freight of equipment, for example: sensor spares, consumables, tools and harnesses.

Prior to visit the Contractor shall agree with Company the list of individuals to be notified before the system is switched off for maintenance or repair.

2 days prior to mobilization

Final confirmation that the offshore service visit is to proceed should be given not less than 2 days prior to mobilization. At this time permits to work should be issued.

1 day prior to mobilization

The Contractor should confirm arrival of all equipment shipped in advance of the planned offshore visit. If the equipment is not on the platform at this time the appointed representatives in each organization will need to establish whether or not the visit is still possible.

Day of Mobilization

The Contractor shall mobilize all the necessary Personnel and Equipment to the Company check-in at the relevant airport ready to go offshore on the mobilization date.

During an Offshore Service and Maintenance Visit

Arrival on site

The Contractor shall undertake, and document, a pre-site briefing with nominated site engineers.

Performance of the work

Contractor shall notify key personnel prior to switching off the I3MS, as agreed prior to visit.

The Contractor personnel shall check all parts of the Metocean system on the installation including sensors, cabling, junction boxes, interfaces, computer equipment and software to ensure that they are all performing within and are all in accordance with the current

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specification. The Contractor shall maintain an accurate record of all system drawings, sensors, hardware and software in the system and document any modifications made.

Where it is possible to check platform instrumentation against portable precision instruments, spot checks of the accuracy of the platform instrumentation shall be made.

Contractor shall document any replacement of sensor exceeding acceptable drift (section 8.5). It includes calibration certificates (section 7.1).

The Contractor shall ensure that the hard disc drives (and any other offshore storage medium) for each offshore processor retain sufficient capacity to record all required data until the next scheduled maintenance visit.

All the stored data shall be downloaded during each offshore visit. A minimum of two copies of downloaded data shall be made prior to removal of any data from the I3MS memory. A backup copy should be left with the I3MS and the principal copy transported to Company offices. Under no circumstances should both copies of the data be transported in the same bag. The backup copy should be retained until the data are fully installed on Company computers and thus subject to Company normal backup procedures; only then may it be discarded.

The Contractor shall ensure that the metocean data acquisition system is operating correctly prior to completion of the work and departure from the offshore unit.

Maintenance page (section 9.5) of the server shall be updated with work performed and equipment concerned.

10.2.2 After an Offshore Visit

The Contractor should notify Company whether or not the metocean data acquisition system was operating correctly on departure from the platform. This notice shall be issued at the earliest opportunity, but in any case:

- If the system was fully operational, at the beginning of the next working day
- If the system was not fully operational, then notification should be issued not later than 4 hours following completion of the maintenance visit.

The Contractor should then prepare and submit a draft site visit report. Any action listed thereon should be clearly marked whether it is for the attention of the Contractor or the Company. A site visit report would naturally be tailored to the activity in question, but would typically be structured as follows:

- Distribution list and primary contacts
- Action summary
- The date and time of the service visit
- Daily log of work carried out
- Note of any deviation from set-up since previous visit
- Details of all sensors as follows:
 - Sensor type
 - Manufacturer

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- Model
- Sensor location
- Installation date
- Height above sea level
- Exposure
- Serial number
- Information relating to the condition of all aspects of the sensor, mounting and cabling at the time of the visit
- Numerical information pertaining to calibration checks, etc.
- Any other notes
- The details of the main system processor and software configuration, including at least the following
 - Manufacturer
 - Type
 - I.P. Address
 - Location
 - Installation date
 - Software version
 - Operating system
 - Time and date last re-started
 - Hard disk space
 - Any changes to onshore export strings since last visit.
- The details of services provided with respect to other relevant equipment, for example interface units
- Catalogue of all archived data (processed and raw data) copied from offshore PC to CD-ROM
- Changes made to the system, including details of any calibration offsets
- Detail of test equipment used
- Full details of tests and calibrations conducted, clearly specifying test or failure
- A summary of the status of the system on completion of the work and statement of any work carried out
- Recommendations for future work/actions
- Briefing and de-briefing reports

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- Final work scope submitted to platform prior to visit, in appendix
- Statement of any problems encountered, unresolved issues or matters that materially affect data quality or continuity.

The Company shall review and comment the draft report. On acceptance the Contractor shall submit:

- Final copy of the site visit report
- Copy, on CD-ROM or other agreed computer media, of all data downloaded from the offshore system.

11. Interfaces with Other Systems

The I3MS shall interface with other control systems. Interfaces and data sharing shall be handled early in I3MS conception. A review of data to be shared with other systems shall be undertaken.

As a minimum, systems that may request data from I3MS are:

- Integrated Control and Safety System
- Hull and mooring monitoring system (structural monitoring system)
- Dynamic Risers monitoring system
- Berthing aid system
- Telecom system.

As a minimum, I3MS will request following data from external systems:

- Date and time common to other systems
- Water depth if downward looking radar is installed.

In case of a floating unit, the following additional information shall be transmitted:

- Draft (6 drafts values typically).

I3MS shall keep running even in case of interface problem.

Appendix 3 presents the basic requirements to keep the system generic so that it can readily interface with other systems onboard or onshore and provide data in suitable format to meet any regulatory or typical end user requirements.

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Appendix 1

Appendix 1 Units

I3MS is required to display data using both SI units and Operations units. All recorded data shall be in SI units.

Parameter	Datum	Application	
		Scientific Recorded data	Operations
		Units	Units
Wind speed	True North	m/s	knots
Wind direction		Degrees	Degrees
Gust Speed		m/s	knots
Visibility		meters	meters
Cloud Amount		Oktas	Oktas
Cloud Height	Sensor Elevation	meters	feet
Air Temperature		Degrees Celsius	Degrees Celsius
Wind Chill		Degrees Celsius	Degrees Celsius
Due Point Temperature		Degrees Celsius	Degrees Celsius
Relative Humidity		%	%
Pressure as QNH	Mean Sea Level	hPa	mb
Pressure as QFE	Helideck Level	hPa	mb
Rainfall		mm	mm
Significant Wave Height	Sample mean	meters	meters
Maximum Wave Height	Sample mean	meters	meters
Mean Wave Period	Sample mean	seconds	seconds
Water Level	LAT	meters	meters
Current Speed	True North	m/s	m/s
Current Direction		Degrees	Degrees
Sea Temperature		Degrees Celsius	Degrees Celsius
Salinity		PSU	PSU



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Appendix 1

The international nautical mile is defined as exactly 1,852 meters. The conversion factors based on International nautical miles are:

- 1 international nautical mile per hour = 0.514444 meters per second
- 1 meter per second = 1.943844 international nautical miles per hour.

Note: For some specific locations (Gulf of Mexico for instance) I3MS may display wave height in feet and temperature in Fahrenheit.

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Appendix 2

Appendix 2 Resolution and Accuracy

These values are given as a reminder; comparison with relevant codes should be performed.

Variable	Range	Resolution	Accuracy	Output averaging time	Temporal Resolution
Atmospheric pressure	900 to 1080 hPa	0.1 hPa	±0.1 hPa	1 min	1 hr
Air temperature	-60 to +60°C	0.1°C	±0.1°C	1 min	1 hr
Dew point temperature	<-60 to +35°C	0.1°C	±0.5°C	1 min	1 hr
Relative humidity	0 to 100%	1%	±3%	1 min	1 hr
Wind speed	0 to 75 m/s	0.5 m/s	±0.5 m/s for ≤ 5 m/s ±10% for > 5 m/s	2 and/ or 10 min	
Wind direction	0 to 360°	1°	±5°	2 and/or 10 min	
Gust	5 to 75 m/s	0.5 m/s	±10%	3 s	
Spectral frequency	0.001 to 1 Hz	0.01	2%		
Visibility (MOR)	0 to 15 km	50 m	±50 m for ≤550 m ±10% for ≥ 600 m ≤1500 m ±20% for >1500 m	1 m	10 m
Cloud height	0 to 7500 m	10 m	10 m		
Cloud amount	0 to 8 Oktas	1 Oktas	1 Oktas		
Precipitation amount	0-> 500 mm	0.1 mm	±0.1 mm for ≤ 5 mm ±2% for > 5 mm		1 day
Precipitation intensity	0 to 2000 mm/h	0.1 mm/h	±0.1 mm/h for ≤ 2 mm/h ±5% for > 2 mm/h	1 min	10 min
Depth of snow	0 - 10 m	1 cm	±1 cm for ≤ 20 cm ±5% for > 20 cm		1 day
Significant wave height	0 - 20 m	0.1 m	±0.2 m for ≤ 5 m ±4% for > 5 m	20 min	1 hour
Maximum wave height	0 - 35 m		±0.2 m for ≤ 5 m ±4% for > 5 m	20 min	1 hour
Wave period	2 to 30 s	0.1 s	2%	20 min	1 hour
Wave direction	0 to 360°	10°	±5°	20 min	1 hour
Spectral frequency	0.02 to 0.5 Hz	0.01	2%	20 min	1 hour
Sea surface elevation	-15 to +20 m	0.1 m	±0.2 m for ≤ 5 m ±4% for > 5 m		1 hour
Current speed	0 to 5 m/s	0.1 m/s	2%	10 min	1 hr
Current direction	0 to 360°	1°	±5°	10 min	1 hr

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Variable	Range	Resolution	Accuracy	Output averaging time	Temporal Resolution
Water level	±3 m	1 cm		10 min	10 min
Sea Temperature	-2 to 40°C	0.1°C	0.1°C	1 min	1 day
Conductivity	0 to 70 mS/cm	0.01 mS/cm	0.5%	10 min	1 day
Salinity	0 to 40 psu	0.01 psu	0.01 psu	10 min	1 day
Thickness of ice accretion		1 cm	+1 cm for ≤ 10 cm +10% for > 10 cm		1 day
Visibility (RVR)	10 to 1500 m	1 m	10 for < 400 m 25 m for 400 to 800 m 10% for more than 800 m	1 min	10 min

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Appendix 3 Metocean Data Output Formats and IT Considerations

INTRODUCTION

This Appendix 3 aims to cover ALL the major Data Interfaces which should be available in a Metocean Data Acquisition System (I3MS). This includes important IT considerations and connections to third parties. The document references which protocols should be supported as standard, together with technical information on how to implement these protocols. Data interfacing with standards noted may have an impact on IT and consequently information would also be provided on certain IT aspects which are relevant.

DATA PROTOCOLS

The I3MS will often be required to receive data from other systems onboard (e.g. Gyro, DGPS, draft sensors) and send data to other systems (e.g. ICSS, berthing aid, riser monitoring) and provide data to other users (heliports, web sites, onshore operations support offices, weather forecasters) in a variety of formats, without the need for any software changes. Output options should be configurable by the user but should be locked with a password.

Typically connections that must be supported are multiple serial input/outputs and an additional TCP/IP network connection.

ASCII (American Standard Code for Information Interchange)

The I3MS system must be able to send standard ASCII files (comma separated) either as files or via a serial port. Files can be sent as Exports over a network (Ethernet using TCP/IP Transmission Control Protocol/Internet Protocol). Files/data can also be sent as serial data using RS232/422/485 protocols. The system must be able to be configured on site to send the exact format as required.

NMEA (National Marine Electronics Association)

The I3MS system should be compliant with standard NMEA outputs via serial ports. The system should be able to handle multiple messages on one serial port. The I3MS system should also be able to generate compliant NMEA messages with configurable header strings. The I3MS system must be compliant with the NMEA 0183 standard. It should be noted that NMEA is moving to a new standard (NMEA 2000) and where possible systems should also be compliant with this standard

OPC (Object Linked Environment (OLE) for Process Control)

An increasingly common method of data exchange with other offshore systems is OPC. The I3MS system as supplied shall have the capability of acting as a standard OPC Server/Client compliant with OPC Versions 1, 2 and 3 minimum specification should be that data values update at least at one minute intervals. As a minimum the system should support at least 200 data tags. Bad data should be uniquely identified with a selectable error code.

MODBUS

The I3MS system should support both Modbus over serial and Modbus over TCP/IP. In addition either master or slave configurations should be supported. The I3MS system should support a minimum of 200 data tags. Update frequencies can vary but generally one minute is acceptable.

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GENERAL DATA OUTPUT FORMATS TO THIRD PARTIES

There is often a requirement for the I3MS to provide weather information in a user-friendly format to other end-users, so the I3MS must be user-configurable to export data strings or data files to other location via a serial or network link.

Connection and Data Transfer via the Internet

The I3MS system should have the capability to send data via the Internet to a secure site for displaying as web pages. The system should have the capability of sending data securely using at least 128 bit encryption. A Standard network port should be used. The system should use a standard method of transmitting the data (e.g. XML Extensible Markup Language) and whatever method is chosen at the very least it should provide acknowledgement that the data has been transmitted correctly.

METAR's

METAR's are defined as routine aviation weather reports (the abbreviation to METAR is subject to controversy over its origins) and is coded according to the specifications contained in the WMO (World Meteorological Office) Handbook [WMO no. 306](#), section FM15. Normally METARS are coded by trained observers but it is permitted to transmit METARS from automatic meteorological systems (providing that they have the code 'AUTO' inserted in them). Generally there are two types of METARS - those which are used in North America and those which are used in the rest of the world. The basic differences are to do with the types of units used: Imperial for North America, and SI (Système International d'Unités, or International System of Units) for the Rest of the World. METARS are normally issued by Meteorological Departments at airports, or issued for airports by the national meteorological institutes. They relate to Offshore Helidecks.

SHIP

As the SYNOP messages is used for reporting synoptic surface observations from a fixed land station, manned or automatic. The SHIP code is used for the same kind of observations from a sea station, manned or automatic. The code are detailed in [WMO no. 306 ASCII Data to Weather Forecasting Agencies](#)

These are usually proprietary formats using ASCII data in comma or tab separated files with header information and units. This must be configurable to be sent in real-time or at specified times several times per day. Metadata should be sent with the data so it can be used by weather forecasters.

GTS Global Telecommunication System

The GTS (Global Telecommunications System) is controlled by the national meteorological services in each country. It has been set up to disseminate meteorological data around the world. Access to the GTS is only via national meteorological departments. Data may be inserted into the GTS but this will be determined by the national meteorological service of the country involved.

Outputs to DCS (Distributed Control Systems) and ICSS (Integrated Control Systems)

Modern production installations are commonly equipped with an ICSS (Integrated Control and Safety System) or DCS (Distributed Control System) to manage and display data acquired by a wide range of installed sensors. The I3MS system should be capable of sending data to these systems. This could be by utilizing some of the protocols already noted (e.g. Modbus or OPC) or

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it could be a proprietary communication system. The I3MS system design should be capable of having additional output routines added to suit the requirements.

Outputs to Proprietary Systems

The I3MS system should be capable of sending data using one of the mentioned protocols to proprietary network systems such as OPNET, SOILNET and others. These systems commonly use Port 80 in Windows (Standard HTTP Port) to send data in a wide variety of formats.

Outputs to Analogue Devices

The I3MS system must be capable of sending data to analogue devices using systems such as 4 to 20 mA current loop system, or 0 to 5 VDC systems.

TYPES OF DATA OUTPUT AND PROTOCOLS

Most I3MS systems reside on the offshore installation's internal network. Most often they reside on the Process Control Network. Process networks usually have NO connections to the Internet. If there is a process network then usually there will be another network (usually called the Business Network). Normally it is possible to send data from the process network to the office network but NOT from the office network to the process network (except in response to a call from the process network such as an ACK/NAK).

Ethernet TCP/IP

TCP/IP is used to transfer files across the network. Most files are ASCII encoded and usually small or very small in size - typical file sizes range from 1 to 5 KB. When transferring files it is essential that confirmation is received by the system that the file has been transferred. Equally the software needs to be able to resend failed files up to a programmable limit. This is required to cope with temporary network outages.

FTP (File Transfer Protocol)

FTP is an Industry standard method of transferring files. ALL Operating Systems support FTP, most commonly Windows XP Professional has a native copy of FTP. However it is common to use a commercially available FTP program which has other facilities including using a simple scheduler. It is possible to copy files over the Internet if access is allowed.

Satellite Transmission

There are a number of different satellite transmission systems including Iridium, Orbcomm, Argos and Inmarsat.

In general the geo stationary systems (e.g. Inmarsat) can send large amounts of data (at a cost) but need a high powered transmitter. The LEO (Low Earth Orbit) systems such as Iridium can handle lower amounts of data but are much cheaper to run.

The I3MS shall be capable of exporting data suitable for export via one of the aforementioned links. The parameter list and export rate should be user-configurable to reduce the parameter list and transmission costs if required. These settings should be password protected, but easily changed or enabled if a link is available. Failure of the link or backing up of exports must not compromise the core operation of the I3MS.

Radio Modems

These can transmit serial data over short distances (maximum effective range is about 15 km). They can be used in hazardous areas. It should be noted that various licensing restrictions apply to radio modems and the system should comply with all relevant licensing information.

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The I3MS should include a configurable function to export data via a radio link in ASCII or binary format. The system should allow configuration of pause and re-transmissions to cope with potential interference, poor conditions or temporary line of sight blockages such as vessel passing by.

Acoustic Modems

These modems can transmit data over short distances underwater and may be a viable alternative to sub-sea cabling. Powers saving features are key requirement in underwater telemetry systems, so the I3MS should include configurable functions to export data via acoustic modems such as data compression, selectable parameters, limited re-tries, delays and battery warnings to avoid premature battery failures in noisy environments.

WIFI

WIFI can be used for very short data transmissions (up to 300 meters). Hazardous area versions of WIFI should be utilized where necessary. WIFI access should be considered to provide data access or configuration of systems with awkward access such as those in explosion proof enclosures.

REGIONAL REQUIREMENTS

The I3MS system should comply with all the requirements relevant to the region in which it is operating. Typically, these may be covered by a widely adopted standard such as [CAP 437](#) but some countries have additional mandatory requirements such as Norway and Canada. The following are examples of compliance with regional requirements. However, the I3MS must comply with the latest regulations in the country of intended operation. For mobile drilling units, the international standards and the examples given below should be included.

Current Profile Data Output to US Government BOEMRE

I3MS system installed on rigs and production units within the Gulf Of Mexico and operating in water depths of more than 1000 feet are required to comply with the NTL 2009-G02 (as amended). This instruction is to measure a current profile and distribute the data to the BOEMRE web site using FTP. The format of the data is to be Teledyne RDI's binary format data and the data is to be sent at regular intervals as specified in the NTL notice. The I3MS system must comply with this requirement if required to do so.

Canadian MANMAR Output

This output was specifically designed by Environment Canada and based on the WMO code books. The MANMAR is a specifically coded weather report used by the Canadian Meteorological Office. Rigs and vessels operating in Canadian waters may be required to transmit weather observations in MANMAR format to the Canadian Meteorological Service. Other information on helicopter operations and metocean data is included in CNSOPB publications (September 2008).

DF22 Data Output to Norwegian Meteorological Office

This is a specialized format of ASCII data complying with the Norwegian Meteorological Office's (DNMI) special format known as 'DF22'. It is often a license requirement when operating in Norwegian waters that data from the rig/platform is transmitted at regular intervals to the Norwegian Meteorological Office. The Meteorological Office will require the data to be in DF 22 format.

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CAP 437 Helideck Monitoring Specification

The CAP 437 helideck monitoring specification is issued by the UK Civil Aviation Authority and specifies certain measured parameters, measurement accuracies, data formats and presentations applying to all offshore helidecks. (This was last updated in February 2009). The I3MS system must comply with these regulations. This standard (CAP 437) is often used as the default standard in areas of the world outside of the UK.

Norwegian Helideck Monitoring Specification

I3MS systems which operate in Norwegian waters must have a system which complies with NORSOK standards and the following publication specific to offshore helicopter regulations:

“Standard Measuring Equipment for Helideck Monitoring System (HMS) and Weather Data (Version 7) issued by [Bristow Group, CHC and Bond Helicopter](#).”

This standard provides guidance on what parameters should be measured, how data should be displayed, specifies the accuracy of some of the sensors being used and frequency of calibration checks.

In addition all I3MS systems in Norwegian waters must meet the regulations as stated under the Norwegian Civil Aviation Authorities (NCAA) BSL D 5-1 and BSL G 7-1.

Offshore Norway and increasingly offshore the UK it is common practice that the Helideck Certification Agency (HCA) will audit vessels with helidecks to this reference as part of overall Helideck safety, so the I3MS shall be fully compliant at the time of delivery.

OPERATING SYSTEMS AND WINDOWS BROWSERS

The I3MS system must be capable of running on all current Windows Operating systems.

Supported Operating Systems

Windows XP Professional with Service Pack 3

Windows 2003 Server with Service Pack 2

Windows Vista (minimum is Vista Business with Service Pack 2)

Windows 7 (Business Edition)

Windows 2008

Internet Browsers

Should be compatible with Internet Explorer Versions 6, 7 and 8 without use of specific script of plugins that may be restricted by IT security.

Other Browsers e.g. Firefox any limitations should be stated.

IT CONSIDERATIONS

The I3MS system must be capable of complying with local IT policy restrictions and these generally cover such features as usernames and passwords, domain membership, backup frequency, and general security policy.

System Running as a Service

The I3MS system should be capable of running as a standard windows service thereby enabling the system to run without a user logging on.

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Appendix 3**Auto Logon**

In the event of a reboot (e.g. due to a power failure) the I3MS system should be capable of auto logging on. It should be noted that some IT policies do not allow auto logging on.

Auto Starting

In the event of a power failure the I3MS system must be capable of automatically starting without user intervention.

Remote Access

If IT policies allow the I3MS system should be capable of remote access. This could be via Windows built in software (e.g. Remote Desktop) or use of a proprietary software program (e.g. PC Anywhere).

WARNINGS AND ALARMS**Alarms**

The I3MS system should be capable of providing alarms in a variety of formats including audible and visual alarms. These alarms should be easily configurable to use a wide variety of parameters as their trigger points. The threshold values should be user-configurable and password protected if required.

Relays

The I3MS system should be capable of utilizing a wide variety of relays to supply information to other systems including normally open/normally closed zero volt systems. The threshold values should be user-configurable and password protected if required.

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Appendix 4 List of Metadata

Owner Details

Contact details of the originator which collected the data

Project Name (if applicable)

Data Type (e.g. current, wave, sea level, met)

Mooring/Instrument Details

Instrument category (e.g. current meter, wave recorder)

Instrument model and Manufacturer

Instrument Serial number

Latitude of mooring (degrees)

Longitude of mooring (degrees)

Site Area and Name of Site

Method of position fix (e.g. GPS)

Water column Depth (m)

Sea Floor Depth Qualifier (e.g. echo sounder, GEBCO)

Instrument depth or height

Operation history:

- Principle of measurement?
- Any instrument modifications?
- Date and Time of Deployment and Recovery of the instrument
- Date and Time of start and end of usable data
- Additional notes on deployment
- Additional notes on performance (e.g. high frequency cut-off)

Name of the vessel used if applicable

Cruise information if applicable

Cruise departure date and harbour if applicable

Cruise arrival date and harbour if applicable

Timing Details

Time zone (GMT, UTC)

Type of sampling (e.g. instantaneous, averaged)

Precise time interval between successive data cycles in series (seconds) (optional)



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Appendix 4

Parameter Details

Parameter definition (description including convention like direction to/from, formulae if possible)

Parameter units

Data Processing Details

Description of calibrations

Description of any data processing done by the originator

List and description of the data folder provided

Originator's Data Format (optional)